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An Institutional Level Case Study of Teaching and Learning Approaches and Underlying Motivations in Indian Context

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Abstract: The paper deals with the impact of motivation of faculty and students, on effectiveness of teaching and learning processes respectively. The motivation for choosing engineering as career by the students, and for joining teaching and pursuing it as career by faculty; was probed by a survey of both these stakeholders in the institution. It was found that only half of the students were self- motivated to pursue engineering education. Considerable level of correlation emerged between reasons for pursuit of higher studies and aspirations of type of jobs the students prefer after their studies. Nearly a quarter of the student population in the survey wanted to be entrepreneurs after five years of work experience and beyond. The motivation of faculty to learn and deliver effectively was correlated to their aspirations to pursue research. On the flip side, a quarter of the faculty who didn't get any suitable job before joining teaching, exhibited low motivation to learn and teach, and also considered the authority they wield on students and respect they get from parents as motivating factors to continue in the job.

The survey also revealed their wide differences in perceptions of the effectiveness of the pedagogy. The understanding of these factors and creating enabling environment in institutions would enhance quality of engineering education in the Indian context.

Keywords: Learning effectiveness, motivational factors, quality of engineering education, entrepreneurship, and effectiveness of Pedagogical methods.

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1. Introduction

The quality of engineering education depends on motivation of students to learn and acquire knowledge, skills and ethical attitudes. Knowledge is database of a professional engineer; skills are the tools to manipulate the knowledge in order to meet a goal dictated or strongly influenced by the attitudes1. In a scenario, where India produces maximum number of engineers in the world and only one fifth of them are employable; it is a national concern that their quality should improve. The paper is an attempt to study motivations of the students to learn effectively and of the faculty to impart knowledge through an effective pedagogy, in an engineering institution; through a survey methodology.

Number of research questions was formulated to

effectively cover the purpose of the paper.

Educational research and theory suggest that cultural and historical contexts shape what and how a person may learn[2] The students arrive at college and perceive the world through various lenses that were formed throughout their growth and development[3] This leads to research question: (1) Are the students self-motivated to choose engineering studies?

Prior experiences and learning guide the students' present learning[4] The achievement of their goals after graduation depends on their learning abilities. This leads to a research question: (2) How do students see the engineering studies helping them to achieve their goals in life?

India produces maximum number of engineers in the world. But, the key issue in engineering education should be the quality of graduates, not just the quantity, since the quality factors have biggest impact on innovation and entrepreneurship5. This leads to a research question: (3) Do the students prefer to be entrepreneurs after graduation, if so when would they like to be one?

Until 30 years ago, the primary value of engineering practice was functionality and profit. A good process achieved it. Both the curriculum and faculty enforced these values. Pedagogy has been the same last 30 years though the technology has entered the classroom. In the past, the technological characteristics of engineers were:

(1) their knowledge (facts and concepts),

(2) the skills they use in managing and applying knowledge such as computation, experimentation, analysis, synthesis/design, evaluation, communication, leadership and teamwork, and

(3) their attitudes that dictate their goals such as personal values, concerns, preferences and biases. Knowledge is database of a professional engineer; skills are the tools to manipulate the knowledge in order to meet a goal dictated or strongly influenced by the attitudes. At present the skills required are:

(1) life time learning skills;

(2) problem solving, critical thinking and creative thinking skills;

(3) interpersonal and teamwork skills;

(4) communication skills;

(5) self-assessment skills;

(6) integrative and global thinking skills, and

(7) change management skills1. These are reflected in Accreditation board of Engineering and Technology (ABET) criteria 2000. Nevertheless, little evidence of anything that has appeared in the articles and conferences on engineering education in past half century can be found in classrooms or textbooks1. Students have different levels of motivation, different attitudes about teaching and learning, and different responses to specific classroom environment and instructional practices. Instructor needs to understand these thoroughly to succeed. Three categories of diversity that influence teaching and learning are,

(1) difference in students' learning styles (characteristic way of taking in and processing the information),

(2) approaches to learning (surface, deep and strategic), and

(3) intellectual development levels (attitudes about the nature of knowledge and how it should be acquired and evaluated)6. This has implication for pedagogical methods to be developed for these categories of students. Therefore, Faculty Development Programs (FDPs) should be based on pedagogical strategies, learning theories or human development issues. Instead of Deductive or Conventional "Talk-and- Chalk" method, Inductive methods of pedagogy (inquiry, project-based and problem-based learning) are recommended7. The factors that motivate adult learning (Wlodkowski,1999) are: (1) Expertise of presenter, (2) Relevance of content, (3) Choice in application,

(4) Praxis (action plus reflection) and

(5) Group work7. Transformational change in higher education requires continuous interplay between educational research and educational practice. This requires focus on faculty to motivate them to create and sustain innovations within engineering education system (Research-Practice Cycle)[8]Teaching more about "real-world" engineering design and operation including quality management; coverage of more material in

frontier areas of engineering; offering more and better instruction both in oral and written communication skills and team work skills; providing training in critical and creative thinking skills and problem solving methods; instilling ethics with connection between technology and society, and reducing number of hours in engineering curriculum so that the average student can complete the course in four years; are the present requirements in engineering education[9] This can be met only by innovative pedagogy but not by traditional single subject lecturing approach. The instructional methods meeting this criteria are: (1) Formulate and publish clear instructional objectives based on Bloom's Taxonomy of Educational objectives (knowledge, comprehension, application, analysis, synthesis and evaluation)[10]; (2) Establish relevance of course material and teach inductively, because the students tend to study hardest and learn best what they are interested in and believe they have a need to know11; (3) Balance concrete and abstract information in each course; (4) Promote active learning in classroom; (5) Use cooperative learning where students work in teams on a learning task structured to have positive independence (group goals), individual accountability, and face-to-face promotive interaction;

(6) Give challenging but fair tests; and (7) Convey a sense of concern about students' learning12. Learning environment is impacted by three factors of college framework: (1) Curriculum emphases (what is taught); (2) Instructional approaches (how it is taught); and (3) Co-curricular experiences of students (what activities students participate in)13. Therefore, all important research question about effectiveness of the pedagogy (on rating scale of 5) was addressed to both students and faculty: (4) What is the students' rating of different pedagogy for effective learning? and What is the faculty's rating of different pedagogy for effective learning by students? Two separate research questions in respect of the faculty were: (5) Did they choose the job of faculty out of their passion or compulsion? and (6) What are their motivations to be faculty?

The above six research questions can be combined into two research issues/questions: (1) Are faculty and students, motivated to teach/transfer knowledge and be taught/acquire it respectively, in engineering institutions? Or Is it right to assume that they are motivated? and (2) Are there marked differences in perceptions of faculty and students about the effectiveness of the pedagogy in vogue?These questions were not probed earlier in the Indian context, which differ largely from global context. The study/paper is an effort in this direction.

2. Method

Participants: A random sample of 130 students from all four years of engineering course and a random sample of 39 faculty from all departments were taken for responses in a survey by administering questionnaires to them.

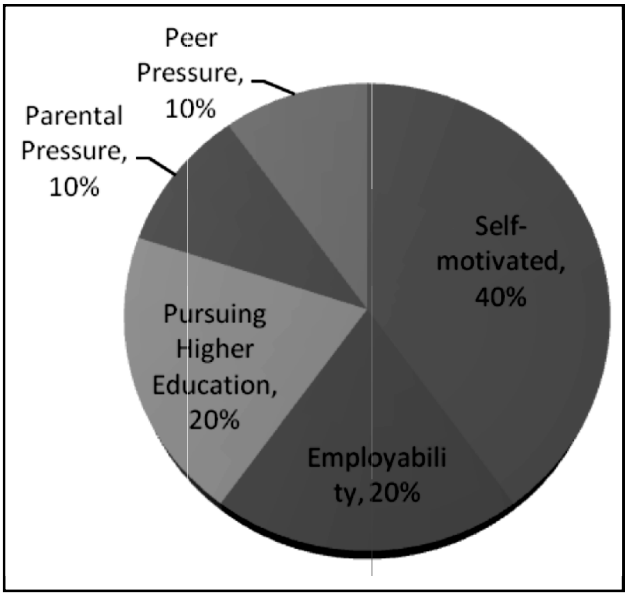
Procedure: The purpose of the survey was explained to them in their classrooms and written responses on objective type of questions as brought out earlier, were taken on a rated scale of five (5- being the highest rating and 1-being the lowest). Some questions had responses on rank ordering on a scale of five (1-being highest ranking and 5- the lowest). Rated responses were collated using Excel sheets and rank ordered responses using Statistical Package for Social Sciences (SPSS v18).

3. Results

A. Analysis Of Responses From Students: The results of various statistical tests conducted on the responses of 130 students are given below.

1) Why did they choose the engineering education?

The rank ordered responses from '1' (strongest

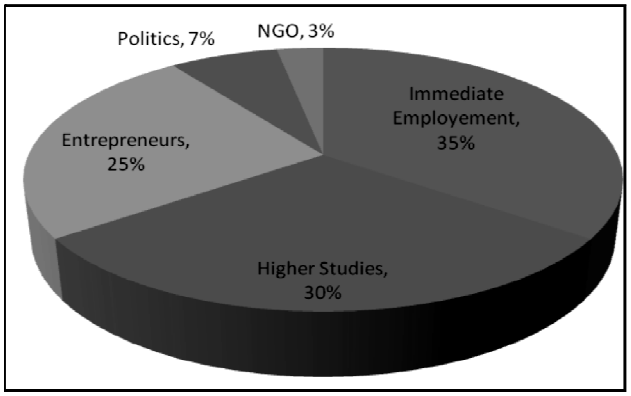


reason) to '5' (weakest reason) were analyzed using SPSS (Descriptive Statistics- Frequency), which revealed following percentage of them chose admission for reasons given against each:

- 40% were self- motivated;
- 20% each for employability prospects and pursuing higher studies; and
- 10% each due to Parental-pressure and Peer-pressure.

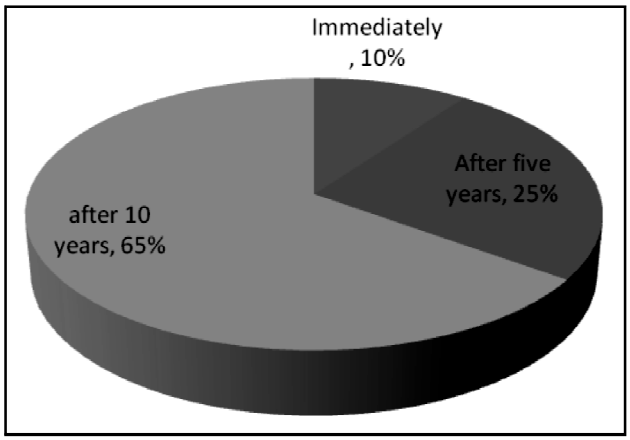
2) What do they want to do after graduation (rank ordered responses)? Similar analysis as above revealed following percentage chose options mentioned against each:

- 35% wanted to seek immediate employment;
- 30% wanted to pursue higher studies (MS/M.Tech/MBA);
- 25% wanted to be entrepreneurs;
- 7% wanted to join politics; and
- 3% wanted to join a Non- Governmental Organization(NGO) to focus on societal problems.



3) When do they want to settle as entrepreneurs? Their responses in number of years after their graduation are as follows:

- 10% immediately;
- 25% after five years; and
- 65% after 10 years.



4) Which kind of job do they like to seek (on rated scale)? Their responses were collated on Excel sheet and their analysis revealed that 60% preferred Government/Public Sector Units(PSU) and 40% private sector.

5) What kind of higher education do they like to pursue (on rated scale)? Similar analysis of their responses revealed that 60% wanted to pursue MS program, with 25% MBA and 15% M.Tech.

6) How do they rank different pedagogy for better learning effectiveness? Similar analysis revealed following descending order of preference:

- Activity based learning;
- Project based learning;
- Conventional "Chalk-and-talk"/Lecture method;
- Mix of all the three above; and
- Assignment method.

7) Pearson's Correlation Test using Excel (with Significant Level (?) =0.01): Between ratings of two variables; (1) 'type of employment' (Private, Government/PSU), and (2) 'type of higher studies' (MS, MBA and M.Tech), revealed Pearson's correlation coefficients as given in the table 1:

Table 1: Correlation Coefficients Between 'Type of Employment' and 'Type of Higher Studies'

Type of Employment/Higher Studies	MS	MBA	M.Tech.
Private Sector	**0.26**	**0.23**	0.04
Govt/PSU	0.11	0.12	**0.21**

The students who preferred to join private sector had shown considerable choice to do MS and MBA, while the students who preferred to join public sector had shown considerable choice to M.Tech.

8) Spearman's Correlation Tests: Between 'Reasons for choosing engineering education' and 'What do they intend to do after graduation' (rank ordered data), shown significant correlation, only for the following combinations, with Significant Level (?) =0.05 (for two tailed tests):

 Correlation test between, 'Chose engineering education for better prospects of a good job' and 'Like to seek immediate employment after graduation': Spearman's correlation coefficient, r= 0.228 (from SPSS); Corresponding z value from Normal Distribution table= 0.61; Standard Error, ?r = 1/?n-1 calculated with n=130 is 0.09; then the Acceptance Region or Limit is z*?r =0.055; which is less than r=0.228. Correlation coefficient 'r' falls in Reject Region and hence, the Null Hypothesis, that the correlation doesn't exist is rejected, and the Alternate Hypothesis that the correlation exists between two variables is accepted.

 Similar calculations for another set of variables; 'Joined engineering for pursuing higher studies' and 'Intends to pursue MS/MBA/M.Tech. immediately after graduation', also exhibited significant correlation.

3.2 Analysis Of Responses Of Faculty: The results of various statistical tests carried out on responses of 39 faculty are given below:

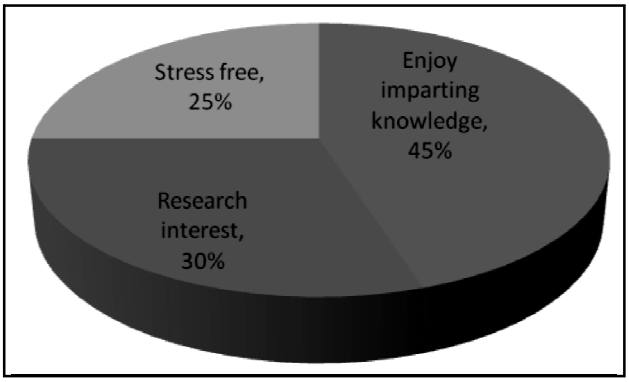
(1) Why did they join as faculty (rank ordered)?

The rank ordered responses from '1' (strongest reason) to '5' (weakest reason) were analyzed using SPSS (Descriptive Statistics- Frequency), which revealed following percentage chose to join as faculty for reasons given against each:

- 45% enjoy learning and imparting knowledge to students;
- 30% felt teaching will help in pursuing research in the field of their interest; and
- 25% didn't have a suitable job before joining as faculty and they feel it is stress-free job.

(2) What are the motivations to join as faculty (rank ordered)? Similar analysis revealed following percentage of faculty with their approach mentioned against each:

- 50% enjoy the position of authority and respect from students and their parents;
- 25% strive their best to impart knowledge and inspire students to learn their subject by encouraging students to ask questions in classroom and outside; and
- 25% would like to use resources in the institution to prepare to find better job outside.



(3) How do they rank different pedagogy for effective learning by the students? Their responses on a rated scale of five (5 being the highest and 1 the lowest) were compiled on an Excel sheet and analyzed for their rank ordering based on the average score of different pedagogy. Analysis revealed following descending order of preference:

- Conventional "Chalk-and-talk"/Lecture method;
- Mix of all the four methods;
- Assignment method;
- Activity based learning; and
- Project based learning.

(4) Spearman's Correlation Tests between the following sets of variables (rank ordered data), with Significant Level (?) =0.05 (for two tailed test) were conducted. The sets which exhibited correlation between them are discussed below.

 Correlation test between, 'Didn't find a suitable job before joining as a faculty' and 'You like being faculty because it is stress-free and has social respect':

Spearman's correlation coefficient, r= 0.401 (from SPSS); Corresponding z value from Normal Distribution table= 1.29; Standard Error, ?r = 1/?n-1 calculated with n=39 is 0.17; then the Acceptance Region or Limit is z*?r =1.29*0.17=0.219, which is less than r=0.228. Spearman's correlation coefficient falls in Reject Region and hence, the Null Hypothesis, that the correlation doesn't exist is rejected, and the Alternate Hypothesis that the correlation exists between two variables is accepted.

 Correlation test between, 'You enjoy the authority and the respect of the faculty position' and 'You like being faculty because it is stress-free and has social respect': Spearman's correlation coefficient, r= 0.352 (from SPSS); Corresponding z value from Normal Distribution table= 1.05; Standard Error, ?r =1/?n-1 calculated with n=39 is 0.17; then the Acceptance Region or Limit is z*?r =1.05*0.17=0.179, which is less than r=0.352. Spearman's correlation coefficient falls in Reject Region and hence, the Null Hypothesis, that the correlation doesn't exist is rejected, and the Alternate Hypothesis that the correlation exists between two variables is accepted.

 Similar analysis reveals correlation between 'You try to inspire the students to learn the subject by making it understandable to them' and 'You like being faculty because it offers opportunity to pursue research in your area of interest'.

4. Discussion

From the results of various statistical tests carried out on the responses of the students and faculty, the following inferences can be drawn on the research questions formulated earlier:

4.1 Motivation Level Of Students To Pursue Engineering Education: About 20% of them had pressure from either parents or peers or both, and the rest were well motivated and focused on getting a job or pursuing higher studies after graduation. These 20% of them found to have problems in meeting minimum attendance criterion to appear for examinations and minimum credits criterion for promotion to senior classes.

4.2 Goal Seeking By Students: On completion of graduation, one third of them wanted to seek immediate employment, another one third wanted to pursue higher studies, and a quarter of them wanted to be entrepreneurs after working experience ranging from five to 10 years. The current curriculum doesn't provide matching inputs to students to take up entrepreneurship after graduation, therefore it may be modified accordingly to give adequate knowledge. The value of Pearson's correlation coefficient between 'type of jobs(private/Govt.)' and 'type of higher studies(MS/MBA/M.Tech) the students wish to pursue', confims the current practice of most of the MS qualified being employed abroad than MBA and M.Tech from India. Spearman's correlation coefficients for testing the focus of students before they chose engineering education and their focus while doing the course; reveal that they are well focused on their goals.

4.3 Pedagogy: Students preferred 'Inductive methods' of instruction (inquiry, project-based, problem-based and activity-based) over 'Deductive methods' (conventional lecture/'chalk-and-talk'); while the faculty exhibited reverse choice. The demands of the modern engineering education as reflected by ABET-2000 calls for 'Inductive methods' of instruction as discussed under 'Introduction section' of the paper. The change needs to be brought in. This is in conformity with the previous studies outside India.

4.4 Faculty: The analysis (under 'Results Section') reveal the following:

 Purpose of joining as faculty: One quarter have joined as faculty because they didn't have a suitable job before.

 Striving or Inspirational Type of faculty: This category constitutes only one quarter. The rest either like the authority and respect associated with their faculty position or like to use time and resources to prepare for competitive examinations for other jobs.

 Motivation to continue as faculty: Strong correlation between 'faculty who chose teaching since they didn't have a suitable job' and 'faculty who felt their job was stress free, with authority over students and respect from their parents', is detrimental to enhancing the quality of engineering education. On the flip side, strong correlation between 'faculty who strived to inspire students to commit to learning' and 'faculty who believe that teaching offers opportunity to pursue higher goals of learning and research' is a balancing or encouraging factor. It is a matter of concern for improving the quality of engineering education that the proportion of the former was found to be more than the latter.

Limitations:

Some of the limitations in the conduct of the current study are; (1) While the students' responses were forth coming readily, the faculty's responses were guarded, and (2) the survey was conducted in only one college and the validity of the responses can be tested when the study is repeated in a random sample of colleges. Therefore, generalizations are not appropriate.

5. Conclusion:

The study brings out that the quality of engineering education in Indian context can be improved through; (1) motivation of students to focus on lifelong learning rather than examination and immediate job seeking oriented learning; (2) self- motivation rather than parental and peer pressure; (3) Inductive method of pedagogy rather than Deductive methods, as currently being practiced widely; (4) Readiness on the part of faculty to change the pedagogy to create interest in students and inspire them to commit to life-long learning; and (5) shift in focus of faculty to 'research-practice cycle', rather than treating teaching as any other livelihood option. The findings of this study are in alignment with other studies in the past, as brought out in the 'Introduction Section' of the paper in other parts of the world.

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