An Assessment of Student Motivations to Join College of Engineering: Case Study of Prince Mohammad Bin Fahd University in Saudi Arabia

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Abstract—A survey was conducted to freshmen students who took early introduction to engineering course to assess their motivation to joint engineering program. Questions asked used motivational behavior covering job expectation, social, professional and personal perception, as well as scientific capabilities. The survey result was compared with their course performance in terms of grades they acquired in that course to investigate whether there is high correlation between motivation and performance. Furthermore, student evaluation that is normally conducted at the end of the course session was examined and contrasted with the survey results as well as their grades to investigate the motivational pattern and consistency. The outcomes of this study can be used as input for engineering educators to motivate high school students or students currently being enrolled in a preparation year at a university to join engineering program. Also, findings obtained in this study can be used by instructors who teach introductory course levels to engineering students to develop teaching strategy that could increase student’s motivation and confidence in math and science. Although the scope was focused on the College of Engineering, Prince Mohammad Bin Fahd University (PMU), the study outcomes can be extrapolated to other universities within Saudi Arabia and developing countries.

Keywords—Freshmen, introduction to engineering, motivational behavior, engineering education

I. INTRODUCTION

Engineers are applying sciences to real-world practical applications for the benefits of society [1]. American Accreditation Board for Engineering and Technology defined engineering as “the profession in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefits of mankind” [2]. Apparently, engineers are the drivers for society development and the needs for engineering are typically increases with the increase of the socio-economic development level. Increasing the number of students admitted to engineering program and the number of engineering graduates is challenging task in both developing and developed countries [3-5]. To increase the number of engineering graduates, educators need to find ways to increase student persistence from entry until graduation [6]. Previous studies show that self-efficacy, expectancy, interest, attainment, utility, and identification are constructs that may motivate freshmen students to take engineering program [5,7]. Self-efficacy construct is the student judgment of his ability to perform a task in engineering. Expectancy construct is the student belief in the possibility of his career success should he chooses engineering. Interest construct is the enjoyment student experiences from engaging in engineering activities or from interest in engaging engineering activities. Attainment construct is the importance of doing well in engineering in terms of student’s core personal values. Utility construct is the usefulness of engineering in terms of reaching student short and long-term career goals. Identification construct is the extent to which the student defines the self through a role or performance in engineering program [5].

There are many motivational factors that could influence student's thinking to joint engineering program. Providing parental and high school mentorship before college might increase student motivation to admit to engineering and to make informed decision. Identified and implemented mechanism to increase confidence in math and science skills will also motivate students to joint engineering program. [3,5, 8-11]. Student may start an engineering degree with an aspiration that they may invent something new or makes difference to the world [12]. With respect to gender, Parikh et al (2009) conducted a survey among male and female students in six different disciplines of engineering [13]. It was found that motivation to study engineering for women is different from men and different among majors. Furthermore, male engineers appear to be motivated similarly across the different engineering majors except for intrinsic behavioural motivation. A study conducted by Marra and Wheeler (2000) demonstrated the positive impact of using authentic problem to increase student motivation with undergraduate engineering students [14]. In their study, they found that the authentic project increased intrinsic, as contrasted to extrinsic, motivation relative to a traditional course which did not include the authentic project. As engineering is about application of science to real problem solving skill, it is important to see strong connection between coursework and real engineering practice. Failure to see the relevance of engineering coursework could be a de-motivation to engineering students and contributed to student attrition [9].

Research investigating student motivation to join engineering programs is very limited and further study in this area is needed especially in developing countries [15,16]. The main objective of this study is to assess and analyze the key motivators of students joining engineering program with special case study taken from newly established college of engineering in Prince Mohammad Bin Fahd University in Kingdom of Saudi Arabia (KSA).
II. ENGINEERING EDUCATION IN KSA

Over the last four decades, the Kingdom of Saudi Arabia (KSA) has been going through a significant socio-economic development that is characterized by population, urbanization, and industry with fast and tremendous growth rate [17-19]. This comes with an ongoing high demand for qualified and well-trained engineers. There are a large number of international expatriate engineers currently working in KSA. The needs for engineers are tremendous at the time-being and are expected to grow in the future. In the educational sector there has been a tremendous growth in the number of universities to meet the local market needs of skilled professional. The post-secondary education system in KSA is, to a certain degree, similar to the educational system of the United States. Currently, KSA’s higher education system comprises of 24 government universities, 24 private universities and colleges, 18 primary teacher’s colleges for men, 80 primary teacher’s colleges for women, 37 colleges and institutes for health; and 12 technical colleges [20]. The majority of KSA’s universities’ and colleges are offering engineering degree programs. Public higher education institutions are tuition free for student. In 2005, KSA initiated King Abdullah Scholarship Program aimed to enhance the sustainable development of human resources in the KSA, so that they can compete in the labour market in the various fields of scientific research locally and internationally [20]. The program offers full scholarship to Saudi students at both graduate and undergraduate levels to obtain their higher education degrees from local and international and universities. In spite of various KSA’s initiatives in higher education development, student’s enrolment and persistence level in engineering programs is still below the country needs. The outcome of this paper is expected to contribute to improve motivation amongst Saudi students to joint engineering program. Although the scope of the study is specific to PMU College of Engineering (COE), it is anticipated that the results can be extrapolated to typical situation across KSA due to similar high school educational background and culture.

PMU is a private university located in the Eastern Province of KSA. As majority of university in KSA, English is a primary language instruction with intensive language training provided before students join four year degree program. PMU provides highly innovative student-centered approach to impart education, offers chance to students to explore genuine paths to learn and innovate when being groomed for their future roles as hard-core professionals. PMU COE offers Electrical, Mechanical, and Civil Engineering undergraduate programs for male students [21]. The other major colleges within PMU include college of business administration, college of computer science and engineering, and college of natural science and art. The majority of PMU students have a scholarship either from KSA government or from petrochemical industry. The total number of male students at PMU is 1634 among which 957 students enrolled into the college of engineering (COE). Out of those COE students, 323 students are at the freshmen level.

III. METHODOLOGY

The research aims to assess and analyze the key motivators of students pertaining to engineering education and profession in KSA using a case study of newly established university located at the eastern part of the country. To achieve the stated objective a questionnaire was developed and distributed to freshmen students registered under COE. The questionnaire was divided into two distinct sections: respondent’s characterization and motivation categories. Following serious of meetings and brainstorming sessions among college of engineering faculties, four motivation categories were identified that may influence students to join engineering program: Job Expectation (expectancy and utility constructs); Social Desire (identification construct); Professional and Personal Desire (interest and attainment constructs); and Scientific Capabilities (self-efficacy construct). A set of questions were developed for each categories as shown in Table 1. Each question was surveyed using five different ranks of multiple-choice appreciation: strongly agree, agree, neutral, disagree and strongly disagree. A quantitative scale was given to each rank: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree and 1 = strongly disagree. The percentage of respondents in each rank was collected and a mean out of 5 was calculated. A mean value of 5 indicates complete agreement with the question merit and a mean value of 1 indicates complete disagreement with the question merit. Initially, a pilot trial was conducted to check the question clarity in October 2013. Then, the survey was modified and adjusted accordingly to reflect population to be surveyed, freshmen students. The questionnaire was distributed to freshmen engineering enrolled in the Introduction to Engineering course in the December 2013. Introduction to Engineering is the first course offered to freshmen students at PMU after completing preparatory program and it is administered under COE. Before the distribution, the purpose of the questionnaire was explained to the students. The questionnaire was distributed for on-spot completion and collection and the main restriction on 100% return rate was the student attendance on the survey date. Collected questionnaires were compiled into a PASW SPSS Statistics 18.0 database and Excel Spread Sheet software’s for analysis and interpretation. Detail statistical results of the survey can be seen in Table 1.

IV. RESULTS

A- RESPONDENTS DEMOGRAPHIC

In total 51 engineering students participated in the survey comprising of 22 students (43%) from electrical engineering students; 22 (about 43%) from mechanical engineering students; 5 (10 %) from civil engineering students; and 2 (4%) students have not finalized their choice yet. The high percentage of students involved in mechanical and electrical engineering program is speculated due to the fact that PMU is located in the petrochemical industry hub, therefore, mechanical and electrical engineering graduated are highly demanded in the local job market relative to civil engineering.
82% of the respondents were under 22 years old while 18% of respondents were 22 years old or older. A 22 years old or older students in the freshmen level implies that the students are currently working as professional (e.g. technicians), and they have been sent by their employer (typically petrochemical company) to attain engineering degree as part time students. This fact can also be observed when respondents have been asked about the source for their financial support (tuitions and fees), in which 18% answered from employer; 37% government scholarship; 35% family support; and 10% student loan. The respondents were asked if they know the difference between civil engineering, electrical engineering and mechanical engineering disciplines; and if they definitely will stay with their current discipline. About 72% of respondents answered yes to those two questions, while the remaining answered no. Although the respondents who are at the freshmen level have already completed a full year in the preparation program, about 28% of them have not taken a firm decision about their discipline. The respondents have been asked how they have learned about engineering disciplines, and their responses are: about 30% said from family, while 26% from media, 30% from other students and friends and about 14% from various other sources including relatives, and high school teachers. Surprisingly, this response could indicate that there is relatively small influence of high school mentors on student awareness about engineering disciplines.

B- MOTIVATION CATEGORIES
The responses to each question in each category are summarized in Table 1. It can be seen that Professional and Personal Desire category had the highest mean among the other categories while the Social Desire category was the lowest. In general with respect to the degree of appreciation, the survey results shows the highest rank for the degree of appreciation “agree”, where 42.2% of students choosing agree on Professional and Personal Desire, 40.4% on Scientific Capabilities, 36.6% on Job Expectations and 24.8% on Social Motivation. On average of these top four ranks, 34.6% of the students were found falling within these four categories at the same time. Following the same analysis it is found on the average that 22.7% of students chose strongly agree and falling within the four categories at the same time too. This makes a total 57.3% of students who chose agree or strongly agree on the main four categories of motivation, leaving 42.7% of students choosing either neutral, disagree or strongly disagree. Amongst this 42.7% response, 24.5% chose neutral, 10.1% chose disagree and 8.1% chose strongly disagree. The result shows that 18.2% of the respondents (the sum of disagree and strongly disagree ranks) did not see in the main four categories any source of motivation for them. This group of respondents may join the university aiming at obtaining university degree regardless of the discipline or have some other sort of motivations that required further analysis.

C- JOB EXPECTATION CATEGORY
This category included questions that evaluate expected job for engineers on freshmen student decision to join engineering. This category scored a mean value of 3.5 as shown in Table 1. This value implies a good role of job expectation on the student decision to join engineering discipline. The highest score was given to the statement “I want to be an engineer, because engineering is a well-paid profession compared to most of the other professions”. This result stresses the high impact of expected salary of engineers in the respondent’s decision. Worth noticing that engineering profession is among the highest paid profession in KSA. It is obvious that majority of students believe in the reward of the engineering profession.

D- SOCIAL DESIRE CATEGORY
This category assessed the role of family, friends, and society in the student’s choice of joining engineering program. The analysis results show that this category plays a limited role in the respondent’s decision. The influence family and friends is minimal to the student's choice showing 2.0 and 2.4 out of 5 point, respectively. More than 80% of respondents agree with the statement of “I want to be an engineer, because engineering is one of the prestigious professions that will maintain my class level in the society”. This answer stresses the value of society perception of engineer and it can be used as one of the strongest motivations for student to be an engineer.

E- PROFESSIONAL AND PERSONAL DESIRE CATEGORY
Professional and personal desire category covers the student’s interest to be involved in solving community technical problems, building characters as a hands-on type person, developing professional engineering competencies such as team work and communication skills. This category received the highest mean score among the four categories. The respond to the statement “I want to be an engineer, because engineers contribute to society by solving community/world problem” came with more than 85% agree as being very motivated to them to attend engineering college. Nevertheless, all other questions in this category scored high too.

F- SCIENTIFIC CAPABILITIES CATEGORY
Scientific capabilities category covers the student’s interest in natural science, his attraction and success in math and physics subjects, and his analytical ability towards experimentation and analysis. This category scored second after the Professional and Social Desire category. The majority of respondents consider their scientific capabilities a key motivator for them to join engineering discipline. 70% of the respondents agree or strongly agree with the statement “I chose Engineering because I like science subjects”. It can be concluded that many students who join engineering are aware of math and physics as engineering backbone. This proves the fact that background capability is important when it comes to student’s choice.
V. DISCUSSION

To confirm student motivation particularly in the Scientific Capabilities, student performance (grade) in the science related subjects was presented. Figure 1 shows the grade distribution of the students who were enrolled in the Introduction to Engineering course and participated in the survey. It should be noted that students who withdraw from the course were excluded in the distribution. The main objectives of the Introduction to Engineering course is to prepare freshmen students with strong analytical skills in math and physics using simple actual application in engineering majors. To be enrolled in this course, students are required to complete basic math which is provided during their

<table>
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<tr>
<th>Survey Questions</th>
<th>Percent of answer</th>
<th>Mean out of 5</th>
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<tbody>
<tr>
<td>I want to be an engineer, because engineering is a well-paid profession compared to most of the other professions.</td>
<td>35.3 47.1 15.7 2.0 0.0</td>
<td>4.2</td>
</tr>
<tr>
<td>I want to be an engineer, because it will be easy for me to find a job after graduation.</td>
<td>27.5 45.1 19.6 7.8 0.0</td>
<td>3.9</td>
</tr>
<tr>
<td>I want to be an engineer, because I am employed and my employer requested me to study engineering.</td>
<td>2.0 17.6 25.5 27.5 27.5</td>
<td>2.4</td>
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Category 1 Average 3.5

Category 1: Job Expectation

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<tr>
<td>I want to be an engineer, because engineering is one of the prestigious professions that will maintain my class level in the society.</td>
<td>29.4 52.9 15.7 2.0 0.0</td>
<td>4.1</td>
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<tr>
<td>I want to be an engineer, because my family (parents) told me to do so.</td>
<td>2.0 11.8 35.3 25.5 25.5</td>
<td>2.4</td>
</tr>
<tr>
<td>I want to be an engineer, because my friends/peers told me to do so.</td>
<td>2.0 9.8 15.7 35.3 37.3</td>
<td>2.0</td>
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Category 2 Average 2.8

Category 2: Social Desire

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<td>I want to be an engineer, because engineers contribute to society by solving community/world problem.</td>
<td>47.1 37.3 13.7 0.0 2.0</td>
<td>4.3</td>
</tr>
<tr>
<td>Engineering is interesting and fun and I feel good when I deal with engineering products.</td>
<td>31.4 41.2 23.5 3.9 0.0</td>
<td>4.0</td>
</tr>
<tr>
<td>I chose Engineering because I like to build, fix, and repair stuff.</td>
<td>35.3 41.2 17.6 5.9 0.0</td>
<td>4.1</td>
</tr>
<tr>
<td>I chose Engineering because I like to develop and design new systems and components.</td>
<td>29.4 41.2 23.5 5.9 0.0</td>
<td>3.9</td>
</tr>
<tr>
<td>I chose Engineering because I like to work on projects in teams to solve problems.</td>
<td>31.4 47.1 15.7 3.9 2.0</td>
<td>4.0</td>
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Category 3: Professional and Personal Desire
I chose Engineering because I feel I have the ability to present new systems/products to the public than marketing professionals.

Category 3 Average

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<th>19.6</th>
<th>45.1</th>
<th>33.3</th>
<th>2.0</th>
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Category 4: Scientific Capabilities

I chose Engineering because I like science subjects.

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<th>31.4</th>
<th>39.2</th>
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I chose Engineering because I have been always doing great in Math and my grades were always high.

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<th>41.2</th>
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I chose Engineering because I have been always doing great in Physics and my grades were always high.

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<th>11.8</th>
<th>39.2</th>
<th>41.2</th>
<th>5.9</th>
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I chose Engineering because I have been always doing great in both Math and Physics and my grades were always high.

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<th>43.1</th>
<th>5.9</th>
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I chose Engineering because I like to experiment things, analyze and conclude results.

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<th>51.0</th>
<th>17.6</th>
<th>5.9</th>
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Category 4 Average

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preparatory year. Therefore, it would be beneficial information to also investigate student’s motivation through their grade performance. Using the same scale as was used in the survey, it can be seen that the grade average in this course is 3.0 or falls within C in term of grade, slightly below C+ that is normally used as the average mark for assumed normal grade distribution. This could be interpreted as student’s math and science skills are slightly below the expectation at the freshmen level. In conjunction with the survey result in the Scientific Capabilities category, there is inconsistency that could indicate high confident of students regarding their math and science ability. This is a positive observation with respect to motivational behavior. However, it is still premature to conclude that students do not have good math and science skills because majority of students who took this course have just started college math and science.

![Figure 1: Student grade distribution](image)

Selected student evaluations in the introduction to engineering course were analyzed. It is normal practice at PMU at the end of semester to have student’s evaluation regarding the course and its instructor satisfaction. Out of 25 regular student evaluation items, 6 items related to the students motivational behavior were selected (Table 1). The rating was also based on five scale-rating similar to the survey mentioned previously. As shown in Table 3, each question item has response average of 4.2 out of 5 except for the question ‘The link between this course and other courses in my total program were made clear to me’ had the average response of 2.1 out of 5. The results indicated that students confident were high with respect to intellectual challenges, knowledge, and communication skills developed in the course. Also, the students felt that the course is important and will be useful for them in the future. The students criticized about not having clear correlation between the course and upper lower courses in respected engineering program. This could have negative impact on student motivation to joint engineering program. Therefore, teaching strategies that correlate or map the introduction to engineering course to upper level courses is needed.

VI. CONCLUSION

Based on the survey results, it can be concluded that the majority of freshmen students who are in path toward their engineering career realize about engineers role in contributing to solving society technical problems. Specifically, Majority of them also realize that good knowledge in math and science is paramount to the study success in engineering. However, their confidents and motivations in studying engineering need to be strongly supported with the actual skill in mastering math and science. To maintain confident and motivation high, students also needs to be informed as early as at the freshmen level about how basic engineering course including math and sciences are correlated with upper level engineering courses.
ACKNOWLEDGEMENT

Thanks are due to freshmen engineering students who participated in the survey.

REFERENCES


