# FROM YOUTH TO YOUTH: ENGINEERING UNDERGRADUATES ATTRACTING SCHOOL STUDENTS TO ENGINEERING EDUCATION

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**Abstract**
Malaysia is moving forward to increase the number of profesional engineers in five years ahead. Some four new technical universities have been established since 2000. Unfortunately, the interest to study engineering among young generation does not increase as much as anticipated by the government. Most of the students were reluctant to choose engineering as their first choice and yet some were forced by their parents to choose the engineering programs. Having established as an engineering university, University Tun Hussein Onn Malaysia has identified some approaches to improve the situation and one of which involves its undergraduates as coordinators. As a part of university's generic skills assessment program, a group of 70 engineering undergraduates had organized a motivational project called Student's Guided Motivational Program to 395 school students. A study was conducted on the learning motivation and the interest of school students towards their future career. Pre-survey showed that only 8.4% of the students were interested to become engineers whereas the rest opted for other careers. However, post-survey conducted at the end of the program had surprisingly recorded the increasing percentage to 67.8% students opted for engineer as their future career. Thus, this proved the success of the program in enhancing the interest of school students towards engineering education.

*Keywords:* undergraduates, motivation, guidance, engineering education

## 1. INTRODUCTION

As a developing country, Malaysia is moving forward to increase the number of profesional engineers in five years ahead to cater for the increasing demand on the technological advancement. In her Third Outline of Long Term Plan 2001-2010, Malaysia has projected to have 137,236 undergraduates in engineering education "pipeline" [1]. Based on this high demand, the government has to double up their efforts and one of which is to establish more public technical universities. Four new technical universities have been established since 2000 namely Universiti Teknikal Malaysia Melaka (UTeM) in the central state of Malacca, Universiti Malaysia Pahang (UMP) in the east coast state of Pahang Universiti Malaysia Perlis (UniMAP) in the northern state of Perlis and finally Universiti Tun Hussein Onn Malaysia (UTHM) in the southern state of Johore. Each of the university is supposed to focus more on technical and engineering education.

## 2. STUDENTS' INTEREST IN ENGINEERING EDUCATION

Establishing new universities is only an early step and it becomes a part and parcel of more important efforts to develop the strength in science and technology particularly to meet the market demand for profesional engineers and technological advancement of the country [2]. Other aspects were also taken into serious consideration including the need to increase the interest of the school students to engineering education as the global interest was seen as significantly declined. EE Times report on December 16 2008 alarms the decline on the interest of the students to engineering education not only

in the US but also in Europe and Japan while nations like China and India were exploding in engineering field [3]. In early 2000, China has 3.7 million engineering students in its pipeline [4].

In Malaysia, the interest to study engineering among young generation does not increase as anticipated by the government. As mentioned earlier, Malaysia has projected to have in her undergraduates pipeline a total number of 137,236 engineering undergraduates in various engineering fields before 2010 [5]. In 2006, a study on the "Future of Engineering Education in Malaysia" (FEEM) under the auspices of the Ministry of Higher Education estimated only 80,000 engineers which is the engineer-population ratio was only 1:312. The study recommended to the Government to set the nation benchmark at 1:100 as in developed countries the ratio ranging from 1:75 to 1:141[6]. Unfortunately, the intake to the technical universities has shown some unpleasant facts. Most of the students were reported to be reluctant to choose engineering as their first choice and yet some were forced by their parents and family to choose the engineering programs.

A survey on a motivation program conducted by a group of university students at a prestigious boarding school in Selangor, Malaysia in September 2008 showed that most of the excellent Malaysian students do not favour for engineering education as their first choice [7]. In 2004, there was another shocking news at national level when 128 excellent STPM (Malaysian Higher Certificate of Education - equivalent to the UK GCE Advanced Level examination) students were refused to accept the offer to study engineering and other technological courses by public universities. Instead, they were eager to apply for medical program [8].

One interesting case related to the negative role of parent in interfering the career path of their children was reported in one of the public university. "Ahmad" (is not a real name) was a science student at a science secondary boarding school. Since his school day, he was very interested to study law and become a lawyer. But after finishing his secondary school he was forced by his parent to apply for an engineering program at a public university. He was accepted and during the first year of his study, he has faced with many difficulties in learning engineering and performed very poor in the examination and was subsequently dismissed from the university. He has never give up and was then applied and accepted to study law at a private university [9]. Ahmad story is one of the most common indecisive future career problems faced by many excellent school students due to the influence from their parent.

## 3. WHAT COULD BE THE MOST CRITICAL FACTORS?

What could be the most critical factors for the declining of interest in engineering education particularly in US and Europe? According to Johnson and Jones [10] there are many reasons for the decline of students' interest in engineering education throughout US and Europe in early milenium. First is due to the difficulty of the engineering curriculum. Second is due to the densely packed and inflexible engineering curriculum. Third is due to the emergence of other paths to good jobs. Fourth, engineers were treated as commodities by employers and they are likely to be laid off when the company's production plunges. Fifth, traditional entry level jobs for engineering are being offshored. Finally, the negative media reports on engineering career. In conclusion, the factors for the declined of students' interest on engineering education as mentioned by Johnson and Jones could be summarized into three, namely the curriculum, the current and future career of engineers and the perception of society and industry. Thus, the efforts to bring back the students' interest should also be focussed on these three matters seriously without sacrificing the basic requirement and outcomes of engineering education programs as outlined by US Accreditation Board for Engineering and Technology since 2000 and other international engineering accreditation bodies in each country. In terms of curriculum, more efforts need to be taken on developing the interest on learning mathematics and science subjects since the primary and secondary schools[11].

## 4. DEVELOPING INTEREST ON ENGINEERING EDUCATION: A MALAYSIAN PERSPECTIVE

In Malaysia, there was no formal report so far on the declining interest of the students in engineering education. However, their interest is also does not increase significantly. Each year engineering programs at public universities recorded a sufficient number of students' enrolment. But the difficulty is to fill in the large opportunities created by the government for studying engineering with the most talented and excellent students who have a high interest in the field. This is the most critical issue

currently addressed by academic leaders and as well as public in general. Cases such as "Ahmad" who failed to perform during his study in engineering program due to the lack of interest is not an isolated case. It was reported nationwide on the poor performance of Malaysian engineering students in early 2000 due to many circumstances including to the intensive nature of three-year programmes [12] (it's now back to four years) [13], lack of the foundational knowledge such science and mathematics [14], lack of information about what engineering field is all about [15] and the lack of interest to study engineering since their secondary school [16].

Thus, based on this Malaysian scenario, efforts should be made not only to develop the interest of the students on engineering education since their primary and secondary school but also to help them identify the pre-requisite knowledge and skills and inculcate in them the interest through experiential learning approach. At macro level, Malaysian government and other profesional engineering bodies such as Institute of Engineers Malaysia (IEM) have taken some landmark decisions to improve this situation. The introduction of a new Malaysian Engineering Education Model (MEEM) since 2000 [17] and the Outcome Based Education (OBE) in 2004 [18] are two most important landmarks in engineering education at macro level.

At micro level, many institutions of higher learning particularly from the technical universities and various agencies under the government umbrella are very serious in doing their jobs to introduce and inculcate the interest to study engineering. For instance, University Malaysia Perlis (UniMAP), an engineering university situated at northern state of Malaysia, Perlis has organized a motivation course to 100 secondary school students in August 2008 purposely to develop the interest of the students on science and engineering [19]. Ministry of Education Malaysia was also taking part in developing and inculcate the interest to study engineering. Some related programs have been organized annually including the innovation and creativity competition throughout the school level to the state and national levels [20]. National Science Center, an agency under the Ministry of Science, Technology and Innovation Malaysia had also organized a program called *Jurutera Tunas* or Young Shoot Engineer Program to expose young kids from 4-6 year old to an experience of being an engineer [21].

## 5. STUDENT'S GUIDED MOTIVATIONAL PROGRAM (SGM)

Having established as a technical and engineering higher learning institution, University Tun Hussein Onn Malaysia has identified some approaches to increase the interest on engineering education among students at primary and secondary schools. Initiated by a group of lecturers from various engineering and humanities faculties, a program called Student's Guided Motivational Program (SGM) was designed to cater for a series of motivational courses at primary and secondary school levels. As a part of university's generic skills assessment program, some 70 engineering undergraduates were selected as coordinators and facilitators. Thus, the program contains two-fold objective; to contribute to the community and to cater for the generic skills' assessment process of the engineering undergraduates. For 2008 program, some 395 school students from 4 schools were selected to be the participants. Among the participants, 215 or 54.4% are boys and 180 or 45.6% are girls.

### 5.1 Three Phases Program

This program is a systematic organized program conducted in three phases. The first phase focuses on the goal to develop the learning awareness of the school students. The program in this phase consists of three-day-two-night staying at a motivation camp. During this program, the participants were exposed to the activities related to the development of self esteem, sense of respect and grateful to their parents, teachers and others, spiritual and learning awareness and as well as an approach to develop a clear future ambition. At the end of the first phase, the participants are expected to develop all these values and be ready to participate in the second phase.

Second phase of the program focuses on developing the skills of learning mathematics and science. The participants were invited to stay at the university's residential college for three days so that they would have an experience of a student in an engineering university. The activities were conducted in classrooms inside university campus. For most of the participants, this is their first time entering an engineering university campus and be able to spent their night at a state of the art residential college. For some, it might be a dream comes true. The activities during this phase were totally directed to develop the learning skills of the students including to sharpen their learning skills in mathematics and science.

The third phase of the program focuses on developing the students' interest in engineering studies through modelling and experiential learning activities. The students were invited to learn some basic theories and skills in engineering at laboratory. They were also visited some laboratories and were shown to some inventions that has won medals at national and international competition. A forum entitled "An Experience of Excellent Engineering Students" was also organized in which it features a fourth year excellent engineering student and a former student of UTHM who was now a profesional engineer. Most of the participants were so excited about this forum because they have been exposed to the real stories of an engineer. This paper is intended to share some interesting findings related to the experience of the students participated in the SGM program and their interest to study engineering before and after the program. The data was collected using three types of instrument including a set of questionnaire, a set of learning style inventory test and a pre and post survey forms.

### 5.2 The Questionnaire

The questionnaire was designed to identify the students' learning background and factors affecting their learning interest particularly in science and mathematics. Each question consists of 5 Likert scales of 1 = Extremely Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree and 5 = Extremely Agree. Originally, 66 questions were developed based on the general intended objective of SGM. However, this paper will only focus on some questions related to the interest of the students in engineering education including;

1. 5 questions regarding the support and encouragement for learning and career selection
2. 8 questions on learning skills in math and science subjects

The data was then analysed and reported in mean score using Statistical Package for Social Science (SPSS) version 13.0. Table 1 below shows the interpretation of mean score data.

| *Score* | *Level* |
|---|---|
| 5.00 – 4.10 | Extremely agree |
| 4.00 – 3.10 | Agree |
| 3.00 – 2.10 | Uncertain |
| 2.00 – 1.10 | Disagree |
| 1.00 – 0.00 | Extremely disagree |

TABLE 1: The interpretation of mean score for the questionnaire

### 5.3 Support and Encouragement for Learning and Career Selection

The participants were asked about the support and encouragement they have gained during their learning process and for the selection of their future career. Data in table 2 shows the rank and mean score of the main supporters for the students.

| *Rank* | *Support* | *N* | *Mean* | *Std. Deviation* |
|---|---|---|---|---|
| 1 | Parent | 395 | 4.79 | .510 |
| 2 | Teachers | 392 | 4.57 | .664 |
| 3 | Siblings | 395 | 4.24 | .876 |
| 4 | Peers | 391 | 3.87 | .869 |
| 5 | Society | 393 | 3.32 | 1.054 |

TABLE 2: Support and encouragement for learning and career selection

The data indicates that the students extremely agreed (mean scores are between 4.10 – 5.00) that there are five main supporters in their learning process and the selection of their future career. They are parents, teachers, siblings, peers and society. But, as the rank shows, parents are the most important supporters with the mean score of 4.79. Thus, parent should play their role in motivating the students to learn and choose a proper future career. In doing so, they should understand the interest of their children and guide them through their learning process without forcing them. Enforcement will only resulted in the declining of the students' learning interest. This could explain the emergence of

mismatching cases as experienced by "Ahmad" who love to study law but was forced by his parent to study engineering.

### 5.4 Learning Motivation in Math and Science Subjects

Strong foundation in mathematics and science subjects at primary and secondary Malaysian schools is among the most critical pre-requirement for the students to excel at higher level of engineering studies. This is among the most important aspects taking into consideration when SGM module was developed. For the second phase of the program, the students were exposed to various motivational activities related directly or indirectly to math, science and engineering fields. At the same time a survey on their learning motivation in math and science was also conducted. Table 3 below shows the result of the survey in which all mean scores indicate the agreement of the students to 8 related questions posted to them. In summary, the survey shows that most of the students are having a special allocation time for math and science. In terms of the dedication to learn math and science, the survey indicates that most of the students are so inquisitive, love to learn and be able to conduct self learning. While in terms of the ability to identify their skills of learning, survey shows that most of the students are having the ability to know the best way to learn, their strength, weaknesses and how to learn math and science in group.

| *Statement* | *N* | *Mean* | *Std. Deviation* | *Interpretation* |
|---|---|---|---|---|
| Special allocation time for math and science subjects | 395 | 3.33 | 1.159 | Agree |
| Ability to complete tasks in math and science subjects in due time | 394 | 3.76 | .888 | Agree |
| Conduct self learning on math and science | 394 | 3.60 | 1.000 | Agree |
| Inquisitive and love to ask the question on math and science | 395 | 3.86 | .933 | Agree |
| Know how to best learn math and science | 394 | 3.99 | .900 | Agree |
| Know my own strength in math and science | 393 | 3.90 | .940 | Agree |
| Know my own weaknesses in math and science | 393 | 3.93 | .965 | Agree |
| Know how to learn math and science in group | 395 | 3.90 | .971 | Agree |

TABLE 3: Learning skills in math and science subjects

### 5.5 Learning Style Inventory Test

A set of Memletics learning style inventory [22] was utilised to test the students' learning styles. The inventory consists of 70 questions related to seven main learning styles of the students including social, visual, physical, visual, aural, verbal, logical and solitary. The students were asked to choose one of three options from each question; 0 = *the description sounds nothing like me*, 1 = *the description sounds partly like me*, 2 = *the description sounds exactly like me*. The data collected from the inventory test is very crucial for further understanding of the students' ability and mastery to study engineering particularly the style of learning related to the study of science and mathematics. The highest score for each learning style is 20 and four scales were used to interpret the mean score of the test, i.e. 15.10 – 20 (excellent), 10.10-15 (Good), 5.10-10 (Fair and 0-5 (weak). The result of the test was analysed and table 4 below shows the mean score of the overall learning styles of the students and the rank according to the most dominant score. Generally, the students' mastering of these seven learning styles are good which means that most of the students know their own learning styles. However based on the level of mean score and the rank, more efforts should be made by teachers at school and as well as the facilitators of the SGM program. The assumption is that the students should score higher in logical learning style so that they would be seen as having a good foundation in learning mathematics. Mean score 11.91 in logical learning style is not an adequate amount for the students to be excellent in

mathematics and this would affected their ability to pursue the study in engineering education. Other learning styles should also need to be enhanced to the higher level so that the students would be ready to learn engineering subjects in the future.

| *Rank* | *Learning Style* | *N* | *Mean* | *Std. Deviation* | *Interpretation* |
|---|---|---|---|---|---|
| 1 | Social | 395 | 13.94 | 2.846 | Good |
| 2 | Visual | 395 | 12.26 | 2.996 | Good |
| 3 | Physical | 395 | 12.25 | 3.120 | Good |
| 4 | Aural | 395 | 12.20 | 3.476 | Good |
| 5 | Verbal | 395 | 12.18 | 2.755 | Good |
| 6 | Logical | 395 | 11.91 | 3.172 | Good |
| 7 | Solitary | 395 | 10.20 | 3.042 | Good |

TABLE 4: Mean score of students' learning styles

**5.6 Pre and Post Surveys on Students' Future Career**

A pre and post survey forms were used to identify the students' future career ambition. The students were asked to fill in the pre-survey form before SGM program indicating their future career ambition. As soon as finishing the final SGM program session the student were asked to fill in the post-survey form indicating their future career ambition after experiencing motivational activities in SGM. Students' career selection before and after the SGM program was then compared. In pre-survey, as shown in table 5, the data shows that only 33 out of 395 or 8.4% of the students are interested to become engineers whereas the rest opted for other careers. Medical doctor is the most attracted career in which it recorded 84 or 21.3% of the respondents. Engineer was only in fifth place after teacher, army officer and scientist.

| *Future Career* | | *Frequency* | *Percent* | *Valid Percent* | *Cumulative Percent* |
|---|---|---|---|---|---|
| Valid | Engineer | 33 | 8.4 | 8.4 | 8.4 |
| | Medical Doctor | 84 | 21.3 | 21.3 | 29.6 |
| | Teacher | 61 | 15.4 | 15.4 | 45.1 |
| | Army Officer | 52 | 13.2 | 13.2 | 58.2 |
| | Scientist | 46 | 11.6 | 11.6 | 69.9 |
| | Lecturer | 30 | 7.6 | 7.6 | 77.5 |
| | Police Officer | 25 | 6.3 | 6.3 | 83.8 |
| | Air Force | 21 | 5.3 | 5.3 | 89.1 |
| | Pharmacist | 15 | 3.8 | 3.8 | 92.9 |
| | Businesswoman | 10 | 2.5 | 2.5 | 95.4 |
| | Fire Brigade | 7 | 1.8 | 1.8 | 97.2 |
| | Nurse | 6 | 1.5 | 1.5 | 98.7 |
| | Others | 5 | 1.3 | 1.3 | 100.0 |
| | Total | 395 | 100.0 | 100.0 | |

TABLE 5: Result of pre-survey on the future career of the respondents

However, post-survey conducted at the end of program had surprisingly recorded the increasing number of the respondents choosing engineer as their career. Data in table 6 shows a tremendous increase of the percentage to 67.6% of the students choosing engineer as their future career. In comparison with the pre-survey, the data shows the increasing number from 33 to 268 respondents or almost 60%. Thus, this percentage is a clear evidence of a major transformation of students perspective upon their future career particularly to the engineering field after having participated in SGM program. It should be understood that the transformation occurred consciously after the students were exposed on the experience of engineering education by the undergraduates of the field and not from outsiders.

| Future Career | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Engineer | 268 | 67.8 | 67.8 | 67.8 |
| | Medical Doctor | 16 | 4.1 | 4.1 | 71.9 |
| | Teacher | 17 | 4.3 | 4.3 | 76.2 |
| | Army Officer | 14 | 3.5 | 3.5 | 79.7 |
| | Scientist | 24 | 6.1 | 6.1 | 85.8 |
| | Lecturer | 34 | 8.6 | 8.6 | 94.4 |
| | Police Officer | 11 | 2.8 | 2.8 | 97.2 |
| | Air Force | 11 | 2.8 | 2.8 | 100.0 |
| | Total | 395 | 100.0 | 100.0 | |

TABLE 6: Result of post-survey on the future career of the respondents

## CONCLUDING COMMENTS

The participation of engineering undergraduates in motivating and enhancing the learning interest among school students is among the most critical contribution to the development of students future career in engineering education. As part of engineering education pipeline, young engineering undergraduates should not focus only on their study. Once in a while they have to outreach to their former schools and bring along their experience of studying engineering so that the juniors would be able to see the engineering world clearly. This would certainly help the school students to develop their interest and overcome the fear of learning engineering. The role of engineering higher institution on the other hand, is to provide more opportunities to these young engineering undergraduates to share their learning experience with school children and it could be one of the most important community services of the institution and the undergraduates. The generic skills enhancement program as proposed by the Malaysian Higher Education Ministry should be taken as a landmark program in the future and not only as a small portion of many other programs. In 2009, University Tun Hussein Onn Malaysia has enhanced the SGM program and more than 36 schools have been selected to be the participants of the program. The program has been launched by the Minister of Higher Education in March 2 2009 along with other community engagement programs organized and conducted by engineering undergraduates at University Tun Hussein Onn Malaysia.

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