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Factors that Discourage Secondary School Students to Enrol in the Civil Engineering Programs

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Abstract
Enrolment of students in Malaysia tertiary level programs related to STEM-based has shown a significant reduction in numbers which resulted in a decreasing number of enrolment in the Degree of Civil Engineering programs. The purpose of this study is to identify the level of student's awareness; factors that influence the students; and suggestions for improvement. The respondents are students from secondary school in Negeri Sembilan and UiTM. The findings of this study indicate that there is a significant difference in the level of awareness according to areas; misled perception towards the program; and lack of participation from school and parent.

Keywords: STEM-based education, Civil Engineering, awareness, secondary-level students

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1.0 Introduction

Science stream and art steam are two major education streams that existed in the Malaysian education system which in the global context, these education streams are recognized as STEM-based education and Non-STEM-based education that represent Science stream and Art steam respectively. Back in the days, one policy has been established by Malaysian Government where the Higher Education Planning Committee (*Jawatankuasa Perancangan Pelajaran Tinggi*) 1967 had set the ratio of enrolment of students in Science/Technical steam and Art stream from 45: 55 to 60: 40 starting from 1980 which is called as 60:40 Policy (Dasar 60:40) and this ratio was suggested by the committee to be implemented at secondary education and higher level (Razali et al., n.d.). Unfortunately, according to the statistic from the Ministry of Education of Malaysia from 1981 to 2010, the enrolment of students in art steam is higher than the science stream and technical stream. Even in 2014, the ratio was only at 47: 53 between the students enrolled in the Pure Science stream and Art stream (Rebecca, R., 2016). According to Norazilawati et al. (2013), the numbers of students who applied for STEM-based programs in the university are rather small compared to the quota that has been provided for STEM students.

In general, Phang et al. (as cited in Razali et al., n.d.) have shown that there is a big gap in terms of the level of understanding of Science and Technology between rural and urban school students. Meanwhile, Fatin et al. (2014) from their study also found that the achievement of urban school students in Science subjects have always been better than rural schools students that are accessed

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through their achievement in PMR (Science & Mathematics subjects) and SPM (Science, Mathematics, Physics and Chemistry subjects) in the year 2008. Based on the study conducted by Rahim & Nurul (n.d.), they have found that there is a significant difference in the level of general knowledge on Civil Engineering subjects between these two student demographics.

Based on the study, the deficiency of women enrolment in STEM-based degree program is affected by their perception toward the STEM career itself that assuming engineering field is a "guy-thing" (Linsday et al., 2016) in fact, according to Kolmos (as cited in Norazilawati et al. (2013)) women also assumed that engineering is a "dirty" profession. Also, this deficiency problem is affected by the lack of awareness about the programs offered for them in STEM-based programs, and some of them do not even know what kind of opportunities they can have once they graduated from STEM-based programs. Not only that, according to Linsday et al. (2016), the lack of interest could also be one of the factors that contribute to this problem.

According to Norazilawati et al. (2013), the negative perception of school students toward Science or STEM is one of the factors that discourage the students from enrolling in STEM-based programs. This perception includes the perception that claims the concept of Science and Mathematics are hard to understand to the point that can "harm" their result later on. In fact, from the study entitled *Kajian Kesedaran Awam Terhadap Sains & Teknologi* in 2004, they have found that 42.3% of Malaysian having a thought that Science subjects are difficult. Norazilawati (2013) also stated that lack of interest in Science also contributes to the deficiency of student enrolment in STEM-based programs because professions like engineers, pharmacists, doctor and accountants are less of interest compare to other professions such as businessmen, entrepreneur, contractor, etc. Another factor that related to the deficiency of student enrolment in STEM is the lack of support from parents (Sidin, Long, Abdullah & Mohamed (as cited in Razali et al., n.d.). According to Fatin et al. (2014), the involvement of Government and non-Government in organizing awareness campaigns such as exhibitions, talk, etc. at school to increase awareness on Science and Mathematics to all secondary school students as well as the parents. This is to be able to attract their attention to participate in Science Stream and thus encourage the students to further their tertiary studies in Science and Mathematics field. On top of that, the involvement of mass media is also expected to solve this problem. In STEM education in Malaysia, the engineering field has the least number of published articles as compared to other STEM fields (Kamaleswaran et al., 2014). Also, Tat (2014) suggested that the radio media in this country could play their role in this matter by providing more STEM-focused topics for children and community through documentaries, for instance, simple videos on how every resource of food, water, air and energy requires qualified engineer, scientist, agriculturalist and such to ensure the sustainability, convenience, production and quality for the future.

2.0 Methodology

A questionnaire survey was adopted in this study, and questions in the questionnaire were designed from the previous researches of journals, newspapers, published papers, articles, etc. which are related to this study. In this study, the Likert scale was used to produce a highly reliable scale and easy to be understood by the respondents. The suitable Likert scale based on the level of agreements (Vagias, 2006) were used as follows: 1 – strongly disagree; 2 – disagree; 3 – moderately agree; 4 – agree, and 5 – strongly agree. The location of the rural and urban schools for this study was determined by the Ministry of Education. The pilot study was conducted before the full-scale survey to ensure the reliability of the questions in the questionnaires. In the pilot study, 16 numbers of the pupil in rural secondary schools and 16 numbers of the pupil from urban secondary schools were selected. Table 1 shows the Reliability test (Cronbach's Alpha) shows value is in the range of 0.8 to 0.9, which is considered as good (Gliem, 2003). Thus, none of the questions in the questionnaire survey should be excluded, and this means that the questionnaire is relevant to the topic researched. Two (2) branches of UiTM (Jengka & Pasir Gudang) involved in this study where first semester students from Diploma of Civil Engineering (EC110) that came from non-technical schools (Sekolah Menengah Teknik) was selected. One rural secondary school in Negeri Sembilan named SMK Mantin was selected that having a large number of students that enrolled in Science Stream (Form 4) in Negeri Sembilan. This information was obtained from the Ministry of Education Malaysia, and this school was nominated in second place for the achievement in SPM 2016 (Syamilah, 2017). Thus, in this study, the students from this school are assumed to be well-educated and fully aware of their studies. This will influence the student in deciding courses that they are likely to choose in their tertiary level. This fact is supported by Hasan (2007) that said those students who are excellent in their study, they know their ambitions well and they know how to achieve that ambition.

Table 1: Reliable Test of the pilot study

Section in Questionnaires	Cronbach's Alpha Coefficient
B	0.942
C	0.716
D	0.868
Overall	0.907

3.0 Results and Discussion

The profile distribution of the respondents of this study is shown in Table 2. The total respondents involved in this study are 334. T-test was conducted for the following hypotheses:

Hypothesis Null: There is no significant difference between the awareness of the Civil Engineering Program among Urban-school

Students and Rural-school Students.
Hypothesis 1: There is a significant difference between the awareness of the Civil Engineering Program among Urban-school Students and Rural-school Students.

Table 3 shows the result from the t-test between school zone and gender against the awareness of civil engineering among secondary school students. For item 1-10 in Table 3, p-value are less than 0.05 except for item 11 (p = 0.316). Therefore, reject Null-Hypothesis where this indicates that there is significantly different on the awareness of Civil Engineering among rural school students and urban school students except for Item 11.

Hypothesis Null: There is no significant difference between the awareness of the Civil Engineering Program among Male Students and Female Students.
Hypothesis 2: There is a significant difference between the awareness of the Civil Engineering Program among Male Students and Female Students.

Table 2: The profile distribution of respondents

Categories of Respondents		No. of Respondent
Zones	Rural	159
	Urban	175
Genders	Male	162
	Female	172
Level of Education	Form 4	54
	Diploma	280
Availability of Engineer in Family	Yes	81
	No	253

Table 3: The t-test result between gender and school zone against the awareness of civil engineering

Item	Description	School Zones			Gender		
		p-Value	Zone	Mean	p-Value	Gender	Mean
1	I know what Civil Engineering about is	0.001	Rural	3.13836	0.947	Male	3.3086
			Urban	3.45714		Female	3.3023
2	I know to further study in Civil Engineering Program requires a good result of Science Subjects (e.g., Physics, Additional Mathematics, etc.)	0.003	Rural	3.91195	0.781	Male	4.0494
			Urban	4.20000		Female	4.0756
3	I know that I still have the chances to further my study in Civil Engineering Program in university even though I did not take any Engineering Subjects (e.g., Lukisan Kejuruteraan, Teknologi Kejuruteraan, etc.) at secondary school	0.000	Rural	3.60377	0.037	Male	3.6975
			Urban	3.98857		Female	3.9070
4	I am aware that "Construction Work" is a part of Civil Engineering	0.000	Rural	3.69182	0.503	Male	3.9568
			Urban	4.13714		Female	3.8953
5	I am aware that "Water Resources" (e.g., Drainage System, Water Treatment, Water Supply System, etc.) is a part of Civil Engineering	0.000	Rural	3.51572	0.360	Male	3.8395
			Urban	4.04571		Female	3.7500
6	I am aware of "Traffic and Transportation." (e.g., Highways and Pavement, Fly-Over, etc.) is a part of Civil Engineering	0.000	Rural	3.65409	0.841	Male	3.9259
			Urban	4.15429		Female	3.9070
7	I am aware that "Designing Structure." (e.g., Designing House, Tower, Bridge, etc.) is a part of Civil Engineering	0.001	Rural	3.79245	0.414	Male	3.9877
			Urban	4.09143		Female	3.9128
8	I am aware that "Land Surveying" is a part of Civil Engineering	0.000	Rural	3.52830	0.433	Male	3.7840
			Urban	3.94286		Female	3.7093
9	I am aware that Civil & Structure Engineering Consultant and Contractor are two different profession	0.008	Rural	3.30189	0.883	Male	3.4383
			Urban	3.57714		Female	3.4535
10	I am aware that Civil and Structure Engineering Consultant and Architect are two different profession	0.000	Rural	3.35849	0.508	Male	3.5247
			Urban	3.74286		Female	3.5930
11	I am aware the demand for Civil Engineers will increase in future	0.316	Rural	3.85535	0.328	Male	3.8580
			Urban	3.95429		Female	3.9535

Table 3 also shows the result from the t-Test between the genders and the awareness of civil engineering among secondary school students. The p-values for all items are more than 0.05 except for item 3. Thus do not reject Null-Hypothesis. This shows that it is no significant difference in the level of awareness of civil engineering among male students and female students. According to Rahim & Nurul (2010), they have managed to prove that there is a significant difference in the level of general knowledge of Civil

Engineering Subject (Pengajian Kejuruteraan Awam) between rural school students and urban school students. Similarly, this finding shows that there is a significant difference between rural and urban school students on the awareness of the Civil Engineering program. These findings are important for the student to aware of the demand for the Civil Engineering profession will increase in the future (Zulita, 2017).

With regard to the genders, Linsday et al. (2016) claimed that one of the reasons that have caused the deficiency of women in STEM-based professions is due to the lack of women's awareness about what STEM-based programs offer to them. This study shows that the level of awareness in the Civil Engineering program is not affected by the genders.

Table 4 shows the factors that discourage students from enrolling in Civil Engineering Courses. All of these factors have been ranked in descending order using the RII method. The first-ranked factor is students thought that the Civil Engineering program in universities is too difficult. This has proven what has been claimed by Norazilawati et al. (2013) where they have found that one of the reasons that have caused the students to do not enrol in STEM-based programs is because of their negative thought that believes Science and Mathematics concept is hard to be understood. Therefore, this factor has been proven to be the most influential in terms of the factors that discourage students from enrolling in the Civil Engineering program, among other items.

Table 4: Ranking Table of the Factors that Discourage Students Enrolling in Civil Engineering Courses

Item No.	Item Description	RII	Rank (Highest-Lowest)	Mean
1	I think the Civil Engineering Program at university is too difficult	0.590	1	2.949
2	My parent (or relatives) do not give me information about Civil Engineering	0.616	2	3.081
3	The school (e.g., from teachers, counsellor, during class sessions, etc.) do not give me information about Civil Engineering	0.623	3	3.114
4	I have no intention to enrol in Science-based programs (e.g., Medicine, Pharmacy, etc.) except than Engineering	0.651	4	3.257
5	Media (e.g., internet, newspaper, magazine, etc.) give me information about Civil Engineering	0.682	5	3.410
6	I can achieve a higher position in an organization as a Civil Engineer.	0.702	6	3.509
7	I do not think I will have a good result in Arts Stream / Non-Science Programs	0.704	7	3.518
8	There would be much job offer in future if I graduated in Civil Engineering Program	0.755	8	3.775
9	It is merely my decision to be in Science Stream/ Diploma in Civil Engineering	0.769	9	3.847
10	I have never wish to be in Arts Stream / Non-Science Programs	0.793	10	3.967

The second-ranked factor is parent's lacking in sharing information about the Civil Engineering program (or profession) to their children. This is relatable as the lack of participation of parent to support their children in making them involve directly in Science and Technology at home to supplement the moral support that has been given to their children has found to be one of the reasons on the deficiency of student enrolment in STEM-based program (Sidin, Long, Abdullah & Mohamed (as cited in Razali et al.,n.d.)).

Finally, the third-ranked factor that is found to discourage the student from enrolling in the Civil Engineering program is the lack of schools in spreading the information on Civil Engineering programs to the students. According to Norazilawati et al. (2013), the role of the school principal is one of the contributions to increase the participation of students in STEM-based education by encouraging the students to enrol in Science Stream during secondary school.

Table 5: Ranking Table of Suggestions to Increase Students' Interest to Enroll in Civil Engineering Program in University

Item No.	Item Description	RII	Rank (Highest-Lowest)	Mean
1	I am aware the Civil Engineering profession can help Malaysia to grow further in future	0.826	1	4.1287
2	More scholarships with certain conditions and qualification to be offered by government or companies to students to further study in Civil Engineering	0.783	2	3.9132
3	Civil Engineering students from Universities to participate in the school program and share information about Civil Engineering programs and courses.	0.771	3	3.8563
4	Media plays important roles to provide information about Civil Engineering contributions to society through documentaries, radio, and such.	0.756	4	3.7784
5	Campaigns (e.g., talk, exhibition, etc.) conducted to distribute more information about Civil Engineering to the students and parents	0.721	5	3.6048
6	Teachers / Counsellor give me more information about Civil Engineering profession during secondary school	0.684	6	3.419
7	Examples used by teachers during class session related to Civil Engineering works	0.674	7	3.3713
8	Engineering subjects to be taught during my secondary school year	0.661	8	3.3054
9	A Civil Engineer invited to the schools and gave a talk to the students about the Civil Engineering profession	0.645	9	3.2246
10	Parents introduce to me about Civil Engineering at the early ages	0.607	10	3.0329
11	Any of my family members works as a Civil Engineer	0.575	11	2.8743

Table 5 shows the list of suggestions on how to increase the students' interest to enrol in the Civil Engineering program in universities. All of the suggestions have been ranked in ascending manner (1 for the most agreed to 11 for the most disagreed) using to RII method. The first suggestion is students will consider pursuing their study in the Civil Engineering program if they are aware that the Civil Engineering profession can help Malaysia to grow further in the future. According to Zulita (2016), the demand for Civil Engineer in Malaysia is expected to boost up as the preparation of this country to attain the developed-nation status. Students should be given more information on how the Civil Engineering profession can assist Malaysia to develop. Therefore, responsible parties such as the government and non-government bodies should play a role in disseminating the information of the Civil Engineering profession and how they can contribute to Malaysia's development. The second-most-agreed suggestion is to offer more scholarships to qualified students to pursue their studies in the Civil Engineering program in universities. As stated by Fatin et al. (2014), Malaysia has already started offering scholarships to excellent students to further their study abroad. Lastly, the third suggestion is that Civil Engineering students from universities to participate in the school's program and share the information about Civil Engineering to the secondary students. For example, an initiative by the students from the University of Tasmania, College of Engineering that has approached two middle school classes from girl school to introduce the female students to the broad field in engineering (Sybil, 2013). Universities should encourage more programs to be held in secondary school organized by the university students as an effort to increase the awareness and interest in secondary school students in enrolling in the Civil Engineering program.

4.0 Conclusion

This study managed to prove that there is a significant difference in terms of the awareness of Civil Engineering programs between rural and urban school students while in respect of gender, there is no significant difference in the awareness of Civil Engineering programs between male and female students except for item 3 (the chances of the students to further their studies in Civil Engineering Program in university even though they do not take any Engineering Subjects). The factors that discouraging students to enrol in Civil Engineering, and suggestions to increase the student's interest were also identified. This finding may assist the government and universities in taking necessary efforts and actions to increase the student interest in Civil Engineering during their secondary level of studies.

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