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RESEARCH PAPER

A Correlational Study between Parental Awareness of STEM Education and Student's enrolment for STEM-related subjects for Upper Secondary School Level

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Abstract

This survey analysed parental Science, Technology, Engineering and Mathematics (STEM) exposure in three different aspects to predict their student's enrolment in STEM-related subjects in upper secondary level. The parental exposure towards STEM has been determined in three different aspects: parental socio-demographic information, knowledge towards STEM and their level of awareness on STEM approach. Findings revealed parents occupation has a positive correlation towards student's enrolment for STEM related options; inferring that student's enrolment in STEM-related subjects highly increases when the parent's profession is related to STEM-based career. However, the study also revealed parents with low scores in STEM knowledge and awareness could also provide appropriate opportunities for their students to foster an appreciation for courses related to STEM careers. Thus, in addition to improving the opportunities for students in STEM education through courses, materials and opportunities, schools must additionally create opportunities for parents to be exposed and learn more about STEM education and how it would create high profile careers for their children.

Keywords: STEM education; student enrolment; parental knowledge; parental awareness

INTRODUCTION

STEM, an acronym for Science, Technology, Engineering, and Mathematics is an integrated approach to mould students to pursue careers in a high earning and successful field after graduation. The need for highly qualified persons is growing tremendously; the level of students leaving school to enter those fields is not keeping pace with that demand. A vast majority of STEM-related classes display a dominant presence by males with a low percentage of those students coming from minority groups including females (Xu, 2008). The potential for finding some solutions related to the universe, science, health and medicine issues becoming more solvable with the increase in variety of STEM related fields.

However, the need for more highly trained STEM workers is growing at a faster rate than what our education system can provide. According to studies, male representation in STEM courses

that go beyond the scope of required courses in schools is double of that females (Benderly, 2013). Consequently, to maintain balance equilibrium with the demand of STEM-preferred students, parents must play an important role by encouraging their children pursuing their higher secondary level in STEM related subjects regardless of profession, educational level and self-interest of the parents. First and foremost, Malaysia is experiencing a decline in enrolment of science students at secondary and tertiary levels. In 2012, only 33 – 40% students were learning pure sciences at school level (KPM, 2015). With this percentage, the aim of producing 500,000 scientists by 2020 would not be achievable.

Malaysian students' performance in STEM related subjects at international level is far from encouraging. For instance, in the Program for International Student Assessment (PISA), nearly 60% of the Malaysian respondents fail to achieve minimum benchmark in mathematics while 43% get a similar result (Ministry of Education, Malaysian Education Blueprint 2013-2025). Therefore, the purpose of this study was to ascertain the underlying ideas and attitudes of parents to determine if there is any underlying factors that local schools have an impact on, which can balance the population in enrolling in STEM-related upper secondary subjects. For the purpose of this study, the operational definition for parental STEM awareness is defined as the combination of parental knowledge of STEM and their attitudes towards STEM (Yun, Cardella, Purzer, Hsu and Chae, 2010).

Research Objectives:

1. To examine parental socio-demographic information and basic knowledge-awareness of STEM of parents of upper secondary school children.
2. To determine if the parental socio-demographic information, parental STEM knowledge and awareness correlate with student's enrollment in STEM-related subjects for their upper secondary school level.

LITERATURE REVIEW

In order to prepare students in this twenty-first century world, our education system is undergoing a drastic transformation. Steps to reinvigorate the curriculum at school level have already been initiated with our STEM-based learning approaches to make certain that students with good critical thinking skills will be capable to drive the country towards excellence and progress. The importance of STEM has been established through many definitions across the countries in the global education system. According to Bryan, Moore, Johnson and Roehrig (2016), STEM is defined as the teaching and learning of content as well as practice of knowledge in the science and mathematics curriculum, with the integration of engineering and design engineering through technology, for future readiness. In Malaysia, the aim of STEM education is to incorporate the integration of Science, Technology, Engineering and Mathematics in the teaching and facilitation process, beginning at school level , to inculcate interest in the new generation in STEM-related studies and careers (KPM, 2015).

The necessity of STEM approach has been arises due to the demand of STEM related career has exceeded the non-STEM field. STEM skilled employees demand increases day by day and highly observed in Malaysia, with more than one million work force skilled in STEM are needed for 2020 (MOSTI, 2015). The need to fill in the vacuum in the industrial sector is also a critical issue at the global level, as there is a consistent decrease in students' participation in the science-related subjects at secondary school level (Blankenburg, Höffler and Parchmann, 2016; Ismail, Samsudin and Zain,

2014). Malaysian education system has implemented the policy of 60:40 ratio of science: arts stream since 1970 (Academy of Science Malaysia, 2018) to promote 60% of students into Science/Technical options and 40% into Arts/Commerce options. The policy has been implemented for almost half a decade, yet, it is still a long way to reach the targeted ratio. Ministry of Education Malaysia reported the admission of students of STEM related subjects decreased from 48.15% in 2012 to 45.74% in 2017 (Academy of Science Malaysia, 2018). In light of current scenarios in Malaysia, The Malaysian Ministry of Education worked out several strategies through the Malaysian Education Blueprint (2013-2025) to promote STEM education (Ministry of Education Malaysia, 2013).

STEM-based professionals utilize their knowledge and skills of science, technology, engineering and mathematics to rectify and solve any difficulties such as biomedical scientist, computer engineers, web developers, animal scientists and etc. (Vilorio, 2014). Many STEM-related professionals are required in handling some specialized tools or computers. For an example, mathematics is the basic foundation for physics, while physics is one of the required field in medicine. STEM career choice intention can be defined as an individual's inclination and preference to choose a career in STEM fields (Broadbridge and Parsons, 2005; Ozbilgin, Kusku and Erdogmus, 2005). On a similar note, Gokuladas (2010) posited that STEM career choice intention is the self-assessment of one's capabilities and competencies and the evaluation of other career options to effectively match one's needs to the preferred career choice.

According Constantine, Wallace and Kindaichi (2005), and Whiston and Keller (2004), students' intention or interest is highly influenced by parental involvement as parents decide their children's career choice. Parents have a regular interactions and advise sessions with their children compared to teachers, peers, and career counsellors (Clutter, 2010). The career discussion between parents and children started early since their childhood. Children should initiate a comfortable discussion with their parents regarding their own interest and aspiration for the future. By having an open discussion with parents, children should be exposed to various career options that might be a good fit to their interests and competencies (Cheng, Tsai and Kao, 2016). Choosing a career based on parents' preferences hinder children to discover great career possibilities (Chan, 2013). Parents should not control over their own children by deciding on their children's career choice intentions and by exposing them to their own desired and unachievable careers (Vargas-Benitez, 2017). High parental aspirations supported by strong parent-child relationships, open communication, and parents' trust and support, would allow the childen the opportunity to experience career exploration activities, future planning and career choice intentions (Okamopelola, 2014). Parents can influence their children's career choices both deliberately and unintentionally. Hence, it is imperative to speculate the effects of parental influence on the involvement of students in STEM related subjects and activities.

METHODOLOGY

Sample and Procedure

This survey analysed parental STEM awareness through two separate Likert-type scale questionnaires. 30 parents of selected lower secondary school students participated in an online survey to gather data about parental knowledge and attitudes about STEM education. They are parents to the final term students in Year 9 (equivalent to Form 3) who completed their IGSCE (International General Certificate of Secondary Education) Checkpoint examination (equivalent to PT3

examination), who has already selected their choice of subjects (Science or Commerce) for their upper secondary level.

Description of Instrument

The questionnaire constructed was employed to examine parental socio-demographic data and to measure the level of parental knowledge-awareness towards STEM. The questionnaire consisting of the first section on parents socio-demographic details such as parents educational qualification (primary, secondary and tertiary) and parents' occupation (which is divided into STEM related profession and Non-STEM related profession); the second section is 20 items regarding parents' knowledge on STEM education followed by the third section with another 20 items to gauge parental awareness on STEM field careers. A preliminary study has been carried out earlier to determine their children's gender and their enrolment on STEM related subjects for the upper secondary level.

RESULTS AND DISCUSSION

The validity and reliability of the questionnaire constructed was estimated first before the actual study. It was found the questionnaire has a very good internal consistency reliability (Cronbach's alpha $\alpha = 0.988$) and high validity based on the good substantial agreement between two evaluators (Cohen's kappa value = 0.90). Then normality of data was also examined prior to data analysis. A few violations on the normality assumptions called for non-parametric statistical analysis, hence the correlational analysis was done by the Spearman's rho index. Next results are presented according to the research questions.

Research question 1: What is the educational and profession level of parents?

As presented in Table 1, results indicate most respondents successfully completed their primary, secondary and tertiary education. 26.7% of parent's highest qualification was secondary education (e.g. SPM and STPM) and 73.7% of parents with tertiary qualification (e.g. Bachelor degree, Masters degree and PhD). The results also revealed 23.3% of parents are working in STEM-related field such as engineers, software developers, researchers, medical lab technologists, doctors and architect. 76.7% of parents are working under non-STEM related specialization for instance running their own business, lawyers and consultants.

Table 1 Descriptive Data on Parental Socio-demographic Information.

	Frequency	Percent %
Secondary Level	8	26.7
Tertiary Level	22	73.3
STEM-related professions	7	23.3
Non-STEM related professions	23	76.7

Research question 2 analyses parents' level of knowledge and awareness of STEM education. Results yielded unexpected high level of parents' knowledge ($M = 4.66$, $SD = 1.19$) and awareness ($M = 4.86$, $SD = 1.33$) of STEM education (Table 2). In order to examine the parental involvement in their

children's enrolment in STEM related subjects for their upper secondary admission, spearman rank correlation coefficients were conducted between each independent variable and dependent variable.

Research question 3 determines the relationships between parental socio-demographic information, parental STEM knowledge-awareness and student's enrolment in STEM related subjects for their upper secondary level. Bivariate relationship has been evaluated through spearman's correlational analysis. Results showed parents' occupation have a perfect positive relationship with their children's STEM subjects enrolment, $r_s = 1.000$, $p > 0.01$, inferring the enrolment of student's in STEM-related subjects is highly associated with parents working in STEM-related occupations. Students could be well witness the achievements and privileges of parents who working in STEM-related fields compared to those who is working in non-STEM related careers. On the other hand, parent's educational qualification has been reported to have weak negative relationship with students' enrolment in STEM-related subjects ($r_s = -0.333$, $p > 0.01$) indicating parent's educational qualifications does not directly affect the enrolments of students in STEM-related subjects.

Table 2 Relationship between Parental socio-demographic Information and Students enrolment in STEM subjects.

			Students Enrolment for their Upper Secondary
Spearman's rho	Occupation	Correlation Coefficient	1.000**
		Sig. (2-tailed)	
		N	30
	Educational Level	Correlation Coefficient	-.333
		Sig. (2-tailed)	
		N	30

**. Correlation is significant at the 0.01 level (2-tailed).

Parental knowledge-awareness towards STEM approach is reported to have strong negative correlation and weak negative correlation respectively, to student choice of STEM-related subjects ($r_s = -.68$, and -0.319; $p > 0.01$). Parents' knowledge has been assessed through 20 items of likert scale questions such as:

I know the purpose of STEM field,
I know how STEM skills contributes in future,
I know how to use different ideas in applying STEM concept/theories.

The results showed student enrolment in STEM subjects have somehow an inverse relationship with parents' academic qualification ($r_s = -.333$, $p > 0.01$). It seemed that parents with low academic qualification could have encourage their children more on STEM related field compared to those with higher academic qualification. Comparatively, as presented in Table 3, the awareness results have also shown a different perspective from the parents as parents' knowledge seemed to also have an inverse weak relationship with their children choice of STEM-related subject ($r_s = -.319$, $p > 0.01$),

indicating parents' low awareness of STEM does not mean the children would not choose a STEM-related subjects.

Table 3 Relationship between Parental knowledge-awareness towards STEM and Students enrolment in STEM subjects.

			Students Enrolment for their Upper Secondary
Spearman's rho	Parental Knowledge	Correlation Coefficient	-.684**
		Sig. (2-tailed)	
		N	30
	Parental Awareness	Correlation Coefficient	-.319
		Sig. (2-tailed)	
		N	30

**. Correlation is significant at the 0.01 level (2-tailed).

CONCLUSION

As parental involvements in children's education is highly proven through many studies and findings, this study has contributed some possible factors which can act as predictors of student enrolment in STEM-related subjects in upper secondary school level. STEM are known to be a prime skill and knowledge a students supposed to have in order to excel, achieve and succeed in any STEM related professions. As a result of the findings, there is a statistically significant connection to parental socio-demographic factors, STEM knowledge and awareness in their children's enrolment in upper-level STEM subjects. The present study suggests student enrolment in STEM courses increases when the parents work in closely related to STEM-based jobs. However, parents with low scores in STEM knowledge and awareness could also provide appropriate opportunities for their students to foster an appreciation for courses related to STEM careers. In addition to improving the opportunities for students in STEM education through courses, materials and opportunities, schools must additionally create opportunities for parents to be exposed and learn more about STEM education and how it would create high profile careers for their children.

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