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STUDENTS' AWARENESS OF SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) IN PAHANG

Maizatul Akmar Mohd Rasli (a)*, Fadhilah Abdul Ghani (b), Nurul Huda Ahmad Razali (b), Jegatheesan Rajadurai (b), Muhammad Abdul Fatah Bin Mohammed Mukhtar (c), Hamzah Bin Ahmad (d)
*Corresponding author

(a) College of Business Management and Accounting, Universiti Tenaga Nasional, Pahang, Malaysia, Maizatul@uniten.edu.my
(b) College of Business Management and Accounting, Universiti Tenaga Nasional, Pahang, Malaysia
(c) Faculty of Engineering, DRB-Hicom Automotive University, Pahang, Malaysia
(d) Faculty of Electrical, Universiti Malaysia Pahang, Malaysia

Abstract

Malaysia is now moving into Industrial Revolution 4.0., a transition that requires the number of experts and skilled workers to be increased. Therefore, the government has realized that the education system needs an improvement by introducing STEM education in schools. Unfortunately, despite the government's best efforts to strengthen STEM through a number of policies and initiatives, student interest in STEM has continued to decline over the past few years. Hence, this study aims to examine how students perceive the contents of STEM i.e. "Science, Technology, Engineering and Mathematics". Data from 63 secondary school students gathered using a cross-sectional method for the survey. The "STEM Semantics Survey" from past researchers was adopted and adapted. Findings show that secondary school students have positive perceptions of STEM content. The schools' administrators, especially teachers, can focus on the scores of each semantic element for STEM content as a guide when creating a lesson plan. This is important to ensure that students are interested in joining the activities and engaging with the teachers and peers during learning sessions.

Keywords: Science, technology, engineering, mathematics, STEM Education.

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1. Introduction

Education system needs an improvement from time to time to keep it in line with the times and the needs of society. Improvements to the education system can come through "Science, Technology, and Engineering and Mathematics Education" or in short known as "STEM". In the early 1990s, the term "STEM" came into common use in the United States (Koehler et al., 2016). Initially, the term SMET i.e. "Science, Mathematics, Engineering, & Technology" was practically use. However, after a few moment, the National Science Foundation (NSF) changed it to "STEM" in order to facilitate its pronunciation and clarify its meaning (National Academy of Science, 2007).

1.1. Overview of STEM Education in Malaysia

The objective of the STEM initiative is to produce students who are not only have the knowledge, but also the skills to increase the number of experts in industry in the future. As reported by the (MOE, 2016), the number of scientists/researchers is one of the indicators of a developed country. Developing countries have more than 78 scientists/researchers per 10,000 workers; however, Malaysia had only 57 scientists/researchers per 10,000 workers in 2012. This number is considerably fewer than other developed countries and is a problem for Malaysia, which aspires to become a developed and high-income country by 2020. Therefore, to achieve the goal of economic development in the future, the Ministry of Education Malaysia is trying to strengthen STEM education so that the number of skilled workers and experts in research and industry will be increased (Ministry of Education [MOE], 2016).

According to Azman et al. (2018) "STEM education" can be defined as a comprehensive education that includes "STEM-based informal curriculum learning process through co-academic and co-curriculum practises and indirect learning for all levels and age ranges, starting in early childhood and progressing through primary education, lower secondary education, secondary education, tertiary education, and industrial level" (p. 3117).

STEM education, emphasizes the concepts inspired by the 4C components namely communication, collaboration, creativity and critical thinking, as embodied in 21st century learning (PAK-21) and high-level thinking skills (EAT) (Lah, 2018).

In STEM education, students learn to collaborate and participate in problem based learning or problem solving activities. They learn through a problem solving process (see Figure 01). These learning experiences are vital in preparing students to face future challenges and become part of a competitive labour force (Ng, 2016).

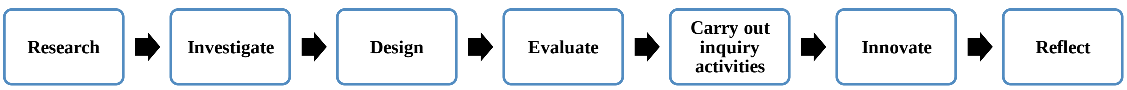

Figure 01. Problem solving process (Ng, 2016)

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1.2. STEM Policies in Malaysia

Malaysia Education Blueprint 2013 – 2025 sees STEM education as an important agenda in transforming students in readiness for the 21st century. In this Blueprint, STEM education implemented in three phases (MOE, 2013) (see Figure 02):

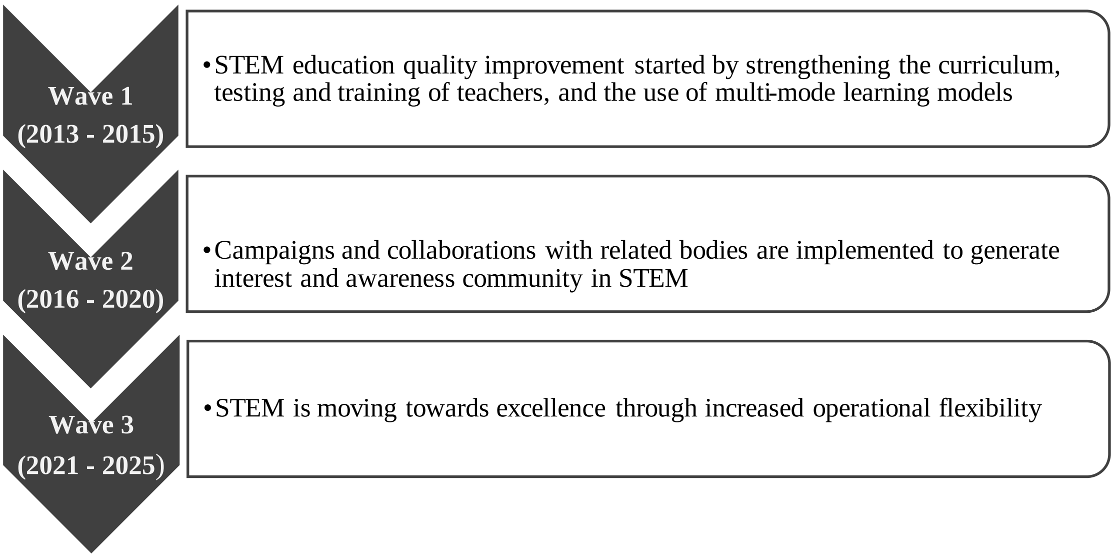

Figure 02. Implementation of STEM (Malaysia Education Blueprint 2013 – 2025)

Since 1967, the Malaysian government has been introducing the 60:40, Science: Art policy. The objective of the policy is to growth the percentage of students undertaking STEM education compared to those who focus on the Arts. The policy implemented for both schools and higher education (MOE, 2013).

In line with the times, Malaysia's policies regarding STEM changed and improved to suit current needs. The policies may change, but the spirit and desire is still the same - growth the number of students undertaking STEM education in Malaysia to produce more experts in industry. See Figure 03 for policies related to STEM in Malaysia (Hamdan, 2017).

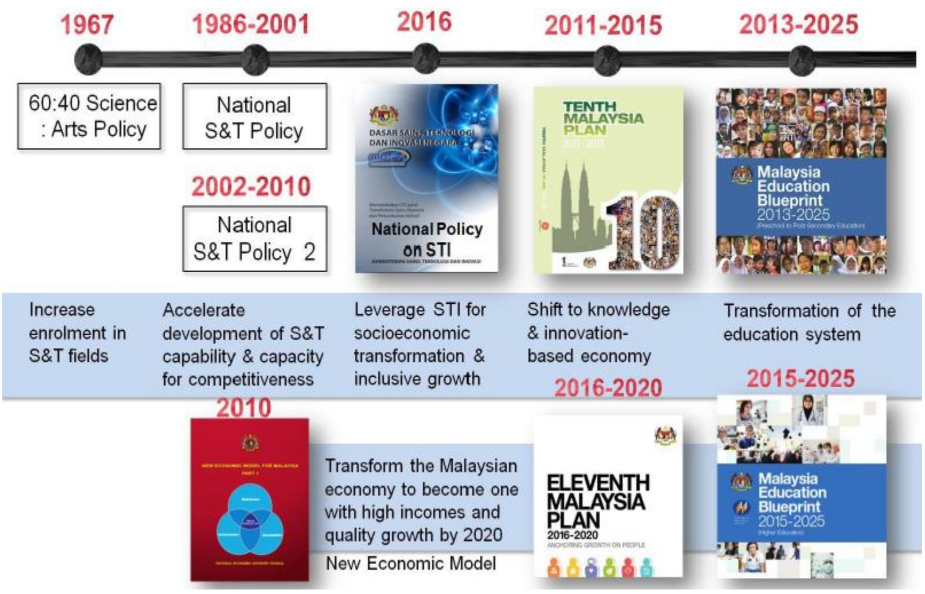

Figure 03. Policies related to STEM in Malaysia

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2. Problem Statement

Besides policies, the government has introduced initiatives to promote STEM education. These have included such programs as the STEM4ALL campaign, with the ultimate goal of making all Malaysians aware of STEM education. The government encourage schools to organize extra STEM activities and curriculum clubs to inspire students to enrol in the Science stream. The government also wants to extend access to STEM learning to rural communities, low-income families and students with special needs (Bernama, 2019).

Unfortunately, despite government efforts to strengthen STEM education through a number of policies and initiatives, student interest in the STEM stream continues to decline in Malaysia. Based on statistics presented by Dr. Maszlee in his keynote address at the BETT Asia 2019, compared to 48% in 2012, only 44% students enrolled in STEM stream in 2018. This translated into around 6,000 fewer students taking STEM each year (Mustafa, 2019). The decreasing number is a concerning and serious issue. On a practical level, it shows clearly, in schools that previously had four or five classes taking STEM, there are now only one or two classes (Bernama, 2019).

The low number of students taking the STEM stream is a disturbing downward trend and threatens Malaysia's labour market because the demand for STEM related positions or roles has been growing (Bernama, 2019). According to a report by the (MOE, 2013), there is a perception among students that it is more difficult to excel in STEM subjects compared to the Arts. This perception has caused many students to choose the Arts instead of the Science stream.

A study by Sadler et al. (2012) It suggested that the chances of becoming involved in a STEM career was 2.9 times higher for males than for females at the end of high school. Young women consider that science and technology are not important to their potential career aspirations (Lent et al., 2005). In a more social sense, girls seem to prefer to read and need to see ties between school assignments and the real world. A significant aspect that is frequently absent for girls in STEM areas is formal role models (McCrea, 2010).

It is very important to know what comes to students' minds or beliefs about the contents of STEM education. Their perceptions are vital to determine their decision to choose or not to choose a Science stream. Therefore, with these issues and factors in mind, this study carried out.

3. Research Questions

RQ1: What are the students' perceptions of STEM contents?

4. Purpose of the Study

The purpose of this study is:

1. To examine the students' perceptions of STEM contents.

5. Research Methods

5.1. Population and sampling

The research design employed in this study is mainly descriptive and investigative, with the perceptions of students described in terms such as fascinating, appealing, exciting, means a lot, and

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interesting. This research used a cross-sectional survey where data was gathered from a population at a specific time (Hall, 2008).

The population of this study is students who participated in the Carnival STREAM Challenge 2019 which involved 400 students from secondary schools who registered during the registration session. All of the students were from schools that teach the same Malaysian curriculum known as the Standard Based Curriculum for Secondary Schools (KSSM). The table for determining sample size for a given population, according to past researcher is 196 (Krejcie & Morgan, 1970).

5.2. Instrument Development

A back to back translation of the native language was used and adopted from the STEM Semantics Survey from (Knezek & Christensen, 1998) to ensure that respondents understood the objects being surveyed clearly. As descriptors for target sentences reflecting meanings of STEM subjects, the five most consistent adjective pairs of the ten used on the TAT have been integrated.

Each of the five scales composed of a goal assertion such as "Technology is ...... to me," accompanied by five polar pairs of adjectives covering a seven-choice spectrum. For starters, "Science is for me: exciting unexciting." The internal reliability of high school students' understanding of science, mathematics, architecture, electronics, and STEM as a profession usually differed from alpha = .84 to alpha = .93 (Tyler-Wood et al., 2010).

5.3. Questionnaire Distribution and Data Collection

Researchers undertook Systematic Random Sampling based on 1 in every 3 students attending the event. Questionnaires were distributed according to the lists drawn up during the registration session and the respondents were asked to submit the completed questionnaire at the registration desk at the end of the event. 63 questionnaires were completed which is equal to a response rate of 32%.

6. Findings

6.1. Demographics

The respondents were 54% male and 46% female, with half of them Malay. There were equal numbers of students from both secondary school levels. This Carnival was held in Pekan, Pahang and was open to all schools in Pahang. The total number of schools, by district, that participated in this carnival is as shown in Table 1 below. The highest number of schools was from Rompin, followed by Pekan and Kuantan, Temerloh and Bentong.

Table 01. Distribution of students by demographics

Variables	Description	Frequency
Gender	Male	34
	Female	29
Race	Malay	33
	Indian	27
	Chinese	2

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	Others	1
Age	13-15 years old	30
	16-18 years old	33
District	Pekan	3
	Kuantan	1
	Rompin	4
	Temerloh	1
	Bentong	1

6.2. Descriptive statistics

Mean scores of secondary school respondents attending the Carnival STREAM Challenge 2019 are shown in Table 2. Notice that all 7-point Semantic Differential Scales are classified positive to negative scales ((Positive) 1, 2, 3, 4 (Neutral) 5, 6, 7 (Negative)). The smaller the point, the more positive the perception, while the larger the point, the more negative the perception.

Table 02. Descriptive statistics of STEM (n=63)

	Mean	**Std. Deviation**
SCIENCE	3.022	1.622
MATHEMATIC	3.181	1.383
ENGINEERING	3.114	1.589
TECHNOLOGY	3.257	1.488
Valid N (list wise)		

As shown in Table 2, within the semantic differential measures, the most positive arrangements towards science were (mean = 3.02/ 7.0) while dispositions towards Technology were the least positive (mean = 3.26/7.0). This study also looked into the semantic perception of respondents by referring to the mean scores of each semantic perception of STEM. As illustrated in Table 3 and Figure 4, Science has been perceived as a fascinating subject, Mathematics as an exciting subject, Engineering and Technology as appealing subjects. Looking at Figure 4, the radar graph for mean scores of each semantic element for STEM, the plots show the comparisons of all mapping; the nearer the plot to the centre of the radar graph, the more positive the student perceptions of STEM content.

Table 03. Mean scores by semantic perceptions of STEM.

	Fascinating	**Appealing**	**Exciting**	**Means a lot**	**Interesting**
Science	2.810	3.000	3.000	3.190	3.110
Math	3.490	3.410	2.840	3.130	3.030
Engineering	2.980	2.680	3.370	3.270	3.270
Technology	3.540	2.780	3.270	3.210	3.490

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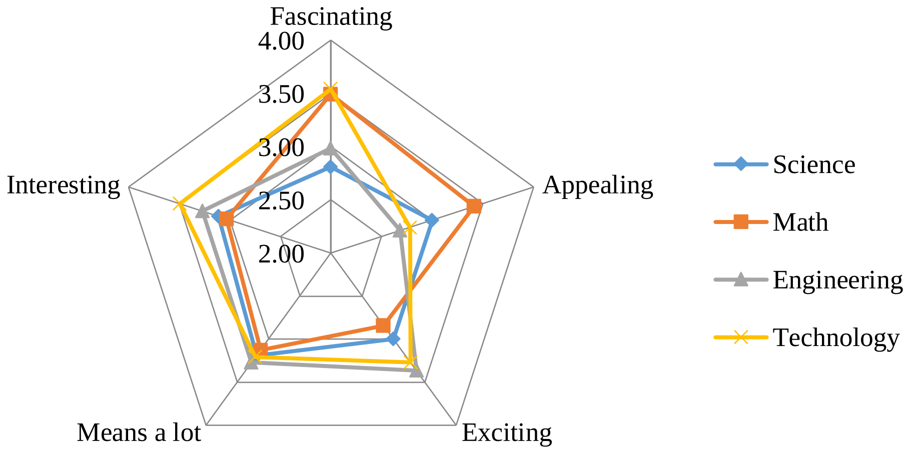

Figure 04. Mean scores for all semantic perceptions of STEM

7. Conclusion

Findings show that secondary school students have positive perceptions of STEM content. The schools' administrators, especially teachers, can focus on the scores of each semantic element for STEM content as a guide when creating a lesson plan. This is important to ensure that students are interested in joining the activities and engaging with the teachers and peers during learning sessions. However, additional research is needed to determine the people who influence students' STEM interests and their perceptions of STEM careers because most of the students' decisions are influenced by people around them. It is also vital to study student intentions and the stakeholders who influence the students to pursue careers in the STEM field.

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