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Malaysian Students' Career Interest and Perception towards STEM Programmes and Strategies

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Abstract: Malaysia will need one million STEM workers by the year 2020 and eight million workers with STEM skills by 2050. However, Malaysia is suffering from STEM talent depletion due to lack of interest in STEM among students. The Ministry of Education thus implemented various changes to its education system to instil STEM interest among students and introduced STEM programmes and strategies to increase students' participation in STEM in Malaysia. Therefore, this study aimed to examine students' career interest and their perception on whether STEM programmes and strategies would enable them to choose a career in STEM. A total of 204 Form Four STEM stream students from Perak, Selangor and Federal State of Kuala Lumpur participated in this study. The data was analysed using MANOVA, followed by ANOVA. The results from MANOVA revealed that there was a statistically significant difference across the states in students' career interest at $p = .02$ and their perception on STEM programmes and strategies at $p = .01$. The findings of this study could be considered for enhancement of STEM initiatives to support STEM education in Malaysia.

Keywords: Career interest, STEM Programmes and Strategies, Malaysia

1. Introduction

STEM refers to science, technology, engineering and mathematics. In Malaysia, STEM is often linked to a nation's development. Jobs in STEM fields are often of high demand in the global workforce including Malaysia. Academy of Sciences Malaysia (2018) reported that Malaysia needs one million STEM workers by the year 2020 and eight million workers with STEM skills by 2050. The urgent need to fill the in-demand vacancies in the STEM workforce reflects the importance of effective STEM education in training and producing the desired pool of talents. Unfortunately, students' involvement in STEM has not met the expectations to fulfil the needs of the STEM workforce in Malaysia (Razali, Talib, Manaf, & Hassan, 2018).

STEM in education has become a crucial key to produce competent STEM talents who will be able to solve real-life challenges. In reality, STEM talent reduction has been an issue in Malaysia due to lack of interest in STEM among students (Haron et al., 2019). Low supply of STEM talents from schools to workforce would further worsen the current scenario.

Therefore, the Ministry of Education (MoE) of Malaysia through the Malaysia Education Blueprint 2013-2025 has established several initiatives to instil students' interest in STEM and encourage them to enrol into STEM subjects or STEM stream at school levels (MoE, 2013; Razali et al., 2018; Academy of Sciences Malaysia, 2018). In effort to consolidate STEM education in Malaysia, the MoE also introduced the Secondary School Standard Curriculum (*Kurikulum Standard Sekolah Menengah*, KSSM) to replace the previous curriculum, Integrated Secondary School Curriculum (*Kurikulum Bersepadu Sekolah Menengah*, KBSM) (MoE, 2013; Shahali, Ismail, & Halim, 2017). This newly introduced curriculum has been implemented nationwide since 2017 with STEM electives offered at the upper secondary school level. STEM electives that are offered among the upper secondary school students are Physics, Chemistry, Biology, Additional Mathematics, Additional Science, Technical Graphic Communication, Basics of Sustainability, Agriculture, Home Science, Invention, Computer Science, and Sport Science **(**Shahali, Ismail, & Halim, 2017).

Alongside with the reformation of the school curriculum to promote STEM in education, a wide range of STEM programmes and strategies have also been carried out to support students' involvement in STEM outside the classroom (MoE, 2013, 2016; Shahali, Ismail, & Halim, 2017). Among them are colloquiums and conference on STEM, interactive video learning, STEM projects, and STEM-based activities, outreach programmes, as well as competitions, hands-on sessions, festival and camps that are related to STEM (Shahali, Ismail, & Halim, 2017). Through these initiatives, MoE aims to deliver the STEM education aspirations as proposed in the national education blueprint to foster STEM education within the country.

Given that curriculum reformation and STEM initiatives have been implemented in schools nationwide in Malaysia, this raised the question: Do students from Malaysia differ in STEM career interest (CI) and their perception towards STEM programmes and strategies (SPS)? For that reason, this study aimed to investigate students' CI and their perception towards SPS within Malaysia, by focusing on three states namely Perak, Selangor and Federal State of Kuala Lumpur (KL).

2. Literature Review

2.1 Differences across States in Malaysia

The Malaysian education system has been on a constant strive to develop a knowledge-intensive nation to nurture adequate STEM workers for its workforce. According to its education blueprint, students begin to choose their career pathway at Form Four where streaming into the various vocations takes place (Academy of Sciences Malaysia, 2018). Generally, students in Malaysia are given the opportunity to opt for STEM, arts or vocational major after they have completed their lower secondary school (MoE, 2013).

Though this system is implemented nationwide throughout all the states in Malaysia, the education blueprint indicated that equal access to education remains a challenge in the country (MoE, 2013). Ministry of Science, Technology and Innovation (MOSTI) affirmed that equal access would strengthen STEM education in Malaysia (MOSTI, 2017). However, several reasons have been reported to be detrimental contributors of this phenomenon. Among them are low awareness of opportunities in STEM careers, and lack of STEM resources such as inadequate STEM teacher training (MOSTI, 2017).

MoE (2013) also reported that there are substantial variations across states in Malaysia as there are gaps and inequalities in terms of resources and access. Inequality between states could lead to discrepancy in informed choices on career opportunities, access to information about education pathways, and in students' performance (MoE, 2013). Therefore, this study aimed to investigate whether students' CI and SPS differ across the states in Malaysia, by comparing Perak, Selangor and KL.

2.2 Career Interest

CI is known as vocational interest which the pattern of likes, dislikes, and indifferences in terms of activities pertaining to a career or an occupation (Bonitz, Larson, & Armstrong, 2010). In this study, CI refers to a secondary school student's likes, dislikes, and indifferences towards a STEM career.

Vulperhorst, Wessels, Bakker, and Akkerman (2018) reported that research on students' choice of career in STEM has been on a rise due to high demand of STEM labour in the international workforce. In Malaysia, it was suggested that students' career choices in STEM is mainly influenced by their interest in STEM subjects (Shahali, Halim, Rasul, Osman, & Zulkifeli, 2017). Wang, Ye, and Degol (2017) explained that interest is the main element that shapes students' career pathway in STEM, and it often occurs at upper secondary school level. This is supported by Shahali, Halim, Rasul, Osman, and Zulkifeli (2017) which reported students' interest towards their career goals have greater impact at secondary school level than any other stage in life because that is where they start to make decisions about their career pathways.

Unfortunately, students' interest to pursue STEM has been on a constant drop (Academy of Sciences Malaysia, 2016; Sadler, Sonnert, Hazari, & Tai, 2012). This phenomenon could threaten the supply chain of STEM talents from the Malaysian education system to the industry (Academy of

Sciences Malaysia, 2016). In line with it, the Malaysian labour market will suffer from shortage of STEM workers in the STEM fields (Nasa & Anwar, 2016).

In Sadler et al. (2012), it was indicated that students' interest towards STEM drop from the early stage of high school, thus affect their choice of career pathways. Therefore, it is necessary to look into upper secondary school students' CI as it is an important stage where decision making on STEM career takes place. The following hypothesis was proposed considering students from different states would differ in their behaviour (MoE, 2013):

H1: There is a significant difference in students' CI across Perak, Selangor and KL.

2.3 Perception towards STEM Programmes and Strategies

In tandem with the worldwide demand of STEM workforce, many countries including Malaysia have integrated complementary STEM activities into its curriculum. According to Nasa and Anwar (2016), Malaysia has held nationwide activities to promote STEM education in the country. These are programmes or strategies that offer STEM-related exposure to students, encourage students' interest for STEM learning, and to attract more students to STEM careers (Balakrishnan and Azman, 2017; MOSTI, 2017; Nasa & Anwar, 2016).

SPS are STEM-based activities initiated by the Malaysian MoE, MOSTI, and Ministry of Higher Education, other government agencies, non-government organisations, universities, members of private sectors, and industrial players to engage people to STEM (Shahali, Ismail, & Halim, 2017). SPS encompass a wide range of activities such as camps, clubs/societies, exhibitions/expos/fairs, workshops, competitions, festivals/carnivals, projects, study tours, hands-on practical sessions and mentor-mentee programmes in STEM (MOSTI, 2017; Shahali, Ismail, & Halim, 2017).

Many past studies concerning SPS in Malaysia investigated the effectiveness of specific SPS in a given group of sample (Balakrishnan & Azman, 2017; Haron et al., 2019; Halim, Soh, & Arsad, 2018). Haron et al. (2019) found that "Fun Learning Toy Library", a STEM project which was executed in a rural school in Kelantan, Malaysia could enhance STEM learning among preschool students. Besides, Balakrishnan and Azman's (2017) research revealed that a STEM outreach programme named "Professionals Back to School" successfully spurred school students' interest in STEM.

In spite of numerous SPS being executed in Malaysia, literature discussing students' perception towards SPS in general is scarce. Research on students' perception towards SPS across states in the country is also extremely limited. Given that students across the states in Malaysia would likely to perceive SPS differently (MoE, 2013), the following hypothesis was proposed:

H2: There is a significant difference in students' perception towards SPS across Perak, Selangor and KL.

3. Research Methods

3.1 Instrument

This study used a survey design using questionnaire to test the research hypotheses. Three experts in relevant research areas were invited to review the questionnaire, and it was revised based on their comments to improve the content and face validity of the questionnaire.

Cognitive interviews were conducted with fifteen students to ensure the research instrument was appropriate for the target sample of the present study (Beatty & Willis, 2007). The questionnaire was subsequently amended according to the participants' feedback. The final questionnaire was made up of two sections.

The first section entailed participants' demographic information such as name and location of school. CI and perception towards SPS were measured in the latter section with twelve and ten items respectively. Each item was measured on a seven-point Likert scale from 1= Disagree to 7= Agree. The Cronbach's Alpha values for CI and perception towards SPS were 0.83 and 0.92 respectively, which were above the recommended value at 0.7 (Pallant, 2013). Hence, both the CI and SPS constructs had good internal consistency within the sample of this study.

3.2 Participants

This study was scoped to three states located in the Peninsular Malaysia. As shown in Table 1, the participants of this study were 204 students from Perak, Selangor and Federal State of Kuala Lumpur (KL). All of them were Form Four school students from the STEM stream. The data was collected from October 2018 to January 2019.

Table 1

Number of Participants

State	*N*
Perak	70
Selangor	70
KL	64
Total	204

3.3 Procedures

The researchers received approvals from the MoE, state offices of education, and the researchers' affiliation Scientific and Ethical Review Committee prior to the commencement of data collection. Before the interviews and surveys, all participants were informed on the purpose of the research. The researchers also emphasised that the research was on a voluntary basis that the participants had the rights to opt not to participate and withdraw from the study at any time of the survey. The interviews and surveys were conducted after each participant gave their informed consent to participate in the study. Each cognitive interview took approximately 30 minutes, whereas students generally spent around 20 minutes to complete the survey questionnaire.

4. Findings

4.1 Assumption Testing

The data was analysed using a one-way between-groups multivariate analysis of variance (MANOVA) with Social Science Statistical Package (SPSS) 23. Preliminary assumption test was carried out for tests on linearity, normality, homogeneity of variance-covariance matrices, univariate and multivariate outliers, and multicollinearity. There were no violations according to the results of the tests.

According to Pallant (2013), Mahalanobis distances was used to test multivariate normality for MANOVA. The recommended maximum value for two dependent variables was 13.82. The results revealed that the Mahalanobis distance value was 12.48 which was less than the recommended critical value (Pallant, 2013). Hence, there were no substantial multivariate outliers in this set of data.

Box's Test in MANOVA provides information on whether the data violates the assumption of homogeneity of variance-covariance matrices (Pallant, 2013). Results from Box's Test of Equality of Covariance Matrices shows that the significant value was at $p = .34$, hence the assumption of homogeneity of variance-covariance matrices of the data in this study was not violated.

Besides, Pallant (2013) also suggested that if each group had more than 30 subjects (or cases), the data could be considered safe from violations of normality or equality of variance. Each state in this study had over 30 participants (as shown in Table 1), thus the data did not violate the assumptions of normality and variance equality.

4.2 MANOVA

MANOVA was performed to investigate students' CI and perception towards SPS across three states namely Perak, Selangor and KL. Table 2 shows a statistically significant difference across the states on the combined dependent variables at $p < .05$ level, F (4, 400) = 2.95, $p = .02$; Wilks' Lambda = .94; partial eta squared = .03.

Table 2

Multivariate Tests

		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
State	Wilks' Lambda	.944	2.948	4.000	400.000	.020	.029

From the results in Table 3, when the results for the dependent variables were regarded separately, both CI and perception towards SPS reached statistical significance.

Table 3

Tests of Between-Subjects Effects

		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
State	CI	7.876	2	3.938	4.024	.019*	.039
	SPS	11.416	2	5.708	4.352	.014*	.042

* The mean difference is significant at the 0.05 level.

4.3 One-Way ANOVA

According to Pallant (2013), it is important to perform follow-up univariate analyses (ANOVA) and post-hoc tests to identify where the significant difference lie. Besides, Abdullah, Halim and Zakaria (2014) also highlighted the importance of conducting ANOVA after MANOVA to determine the significance difference in each specific comparison. Hence, one-way ANOVA was performed to further assess difference in CI and SPS across Perak, Selangor and KL.

4.3.1 ANOVA for CI

ANOVA was performed to examine students' CI across from three states namely Perak, Selangor and KL. Table 4 shows that there was a statistically significant difference in CI scores for the three groups of students F (2, 201) = 4.02, p = .02.

Table 4

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CI	Between Groups	7.876	2	3.938	4.024	.019*
	Within Groups	196.684	201	.979		
	Total	204.560	203			

*. The mean difference is significant at the 0.05 level.

The difference in mean scores between the groups was rather small, though there was statistical difference. The effect size as calculated using eta squared was .04. Tukey HSD test in post-hoc comparisons (Table 5) showed that the CI mean score for Perak (M = 5.24, SD = .91) was significantly different from Selangor (M = 4.85, SD = 1.02) and KL (M = 4.81, SD = 1.03).

From the results in Table 5, it can be concluded that there was a significant difference in CI between students from between Perak and Selangor (p = .05), and Perak and KL (p = .03). However, students' CI did not differ significantly between Selangor and KL (p = .98).

Table 5

Tukey HSD

Dependent Variable	(I) State	(J) State	Mean Difference (I-J)	Std. Error	Sig.
CI	Perak	Selangor	.39524*	.16721	.050
		KL	.43177*	.17108	.033

	Selangor	Perak	-.39524*	.16721	.050
		KL	.03653	.17108	.975
	KL	Perak	-.43177*	.17108	.033
		Selangor	-.03653	.17108	.975

*. The mean difference is significant at the 0.05 level.

4.3.2 ANOVA for Perception towards SPS

On the other hand, ANOVA was also conducted to compare students' SPS across Perak, Selangor and KL. As shown in Table 6, the results indicated statistically significant difference in perception towards SPS scores across the three states F (2, 201) = 4.35, p = .01.

Table 6

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SPS	Between Groups	11.416	2	5.708	4.352	.014*
	Within Groups	263.618	201	1.312		
	Total	275.034	203			

*. The mean difference is significant at the 0.05 level.

Similar to CI, the actual difference in mean scores was between the groups calculated using eta squared. The eta squared value was .04 which suggested that the effect size was small. Besides, Tukey HSD test in post-hoc comparisons (Table 7) indicated that there was a significant difference, p = .01 in students' SPS between Perak (M = 5.42, SD = .99) and Selangor (M = 4.85, SD = 1.17). Nevertheless, students' perception towards SPS did not differ significantly between Perak and KL (p = .15), and Selangor and KL (p = .59).

Table 7

Tukey HSD

Dependent Variable	(I) State	(J) State	Mean Difference (I-J)	Std. Error	Sig.
SPS	Perak	Selangor	.56286*	.19358	.011
		KL	.36780	.19806	.154
	Selangor	Perak	-.56286*	.19358	.011
		KL	-.19506	.19806	.587
	KL	Perak	-.36780	.19806	.154
		Selangor	.19506	.19806	.587

*. The mean difference is significant at the 0.05 level.

Overall, the hypotheses in this study were supported by the statistical results in the findings from MANOVA, while specific significant differences were examined through ANOVA. Table 8 is a summary of the results based on the hypotheses of this study.

Table 8

Summary of Results

Hypothesis	Description	Analysis	*p*-value	Result
H1	There is a statistically significant difference in students' career interest across Perak, Selangor and KL.	MANOVA	.02*	Supported
	CI: Perak - Selangor	*ANOVA*	*.05**	*Supported*
	CI: Perak - KL	*ANOVA*	*.03**	*Supported*
	CI: Selangor - KL	*ANOVA*	*.98*	*Not Supported*

H2	There is a statistically significant difference in students' perception towards SPS across Perak, Selangor and KL.	MANOVA	.01*	Supported
	Perception towards *SPS: Perak - Selangor*	*ANOVA*	*.01**	*Supported*
	Perception towards *SPS: Perak - KL*	*ANOVA*	*.15*	*Not Supported*
	Perception towards *SPS: Selangor - KL*	*ANOVA*	*.59*	*Not Supported*

*. The mean difference is significant at the 0.05 level.

5. Discussions and Conclusions

In sum, three findings could be drawn from the results. Three main findings of this study were (i) there was a significant difference in students' CI and perception towards SPS in comparison of Perak and Selangor, (ii) there was a significant difference in students' CI, but no significant difference in students' perception towards SPS in comparison of Perak and KL, and (iii) there was no significant difference in students' CI and perception towards SPS in comparison of Selangor and KL.

First, when considered the results as a whole, it was revealed that there was a significant difference on students' CI and perception towards SPS across Perak, Selangor and KL. This finding echoed the reports from MoE (2013) and MOSTI (2017) that there are disparities between different regions in Malaysia concerning access and resources, specifically in STEM awareness and opportunities. Thus, students' interest in STEM careers and their perception towards STEM activities were different across the states in Malaysia.

Second, in further explorations through ANOVA, findings showed that students from Perak reported significant differences in their CI and SPS with Selangor. It is also reflected in the results that students' CI and perception towards SPS did not differ between Selangor and KL. This finding may be due to the location of the states in which Perak is located in the northern region of Peninsular Malaysia, whereas Selangor and KL are located in the central region. Students from the central region have higher awareness of opportunities in STEM careers, informed choices on STEM career opportunities, and STEM resources (MoE, 2013) compared to Perak because the central region is the hub of the country where resources and access are prioritized. As such, CI and perception towards SPS of students' from Selangor and KL were similar but different from students from Perak.

Third, in comparison of Perak and KL, there was a significant difference in terms of students' CI but not students' perception towards SPS. Students' CI is shaped at upper secondary school level based on various elements that influence their likes, dislikes, and indifferences towards career-related activities (Bonitz et al., 2010). As such, it leads to the difference of students' CI between Perak and KL. On the other hand, there was no difference in students' perception towards SPS between Perak and KL. This is because the STEM initiatives executed in Perak and KL could be similar as the programmes and strategies were implemented nationwide through the National STEM Action Plan, hence there was no significant difference in students' perception towards SPS between Perak and KL (Shahali, Ismail, & Halim, 2017).

There are a number of limitations in this study. This study was scoped to focus on only Form Four STEM stream students from three states in Malaysia due to restrictions of the authorities, hence the findings can only be generalised to Form Four STEM stream students from Perak, Selangor and KL. Besides, the data was collected through a self-report survey which could have caused common method variance. A qualitative approach such as focus group interview and grounded theory study could potentially provide more in-depth details and underlying factors that are yet to be explored. Future studies may explore students' CI and perception towards SPS in other states within the country or beyond the current context of the present research.

The findings of this study would contribute to the understanding of career interest in STEM among the Malaysian students, as well as their perception on the STEM initiatives implemented deemed nationwide. This study would also offer meaningful data about the STEM scenario in Malaysia from the perspectives of the current STEM stream students. The findings from this study could be a meaningful up-to-date reference for the authorities and researchers and stakeholders for enhancement of STEM initiatives to support STEM education and workforce in Malaysia.

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