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The Relationship between Career Interests and STEM Careers of Secondary School Students

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Abstract

Career choice is important and usually be influenced by knowledge and environmental factors during the career choice process. This study aimed to identify the STEM career interest tendencies of Form 3 students and measure the correlation between career interests and STEM careers. The study design was a quantitative survey study. Participants consisted of 329 students aged 15 years old; 140 males and 189 females. The instruments used in this study were questionnaires related to individual profiles, STEM semantic survey, and Career Interest Inventory (IMK). Data were analyzed using SPSS Windows version 23.0 to obtain the descriptive and inferential statistics. The findings of the study indicated Holland's three-point code for STEM careers was Investigative-Conventional-Social (I-C-S). The findings showed that students were more likely to choose Investigative interest and Science careers. The level of students' perception of STEM careers was at a high level. The result of chi-square analysis, $\chi 2 = 50.509$ and p-value = 0.000. The study conducted had shown that Form 3 students had an I-C-S personality pattern that was consistent with the STEM career profession. The implications of this study for career counselors are to ensure that career interest tests were used to help students make career choices and decisions more confidently and responsibly.

Keywords: Career interests, STEM Careers, career aspiration, secondary school student

Introduction

Society today is based on technology and information. As technological knowledge and expertise become more specialized and more economically important, more jobs in the STEM domain are needed and this demand is expected to continue to increase in the coming years (Vennix et al. 2018). Meanwhile, the lack of knowledge and misperceptions about STEM careers limits the selection of STEM as a career among students. Students with low vocational identities and job information are more likely to doubt the career choices they made. Lack of knowledge related to the field of employment contributes to the difficulty of building a vocational identity and thus can cause students not to choose a new career field or make inappropriate career decisions (Ibrahim, et al., 2017).

In addition, school students, especially secondary school students often face problems in career choice. Common problems are related to their inability to make decisions, lack of information about self and career, lack of certainty about the chosen career, lack of interest in planning, and inability to solve problems (Mohd Izwan et al., 2017). Job intentions change dramatically among 24,000 students aged 12-14 years and therefore the relationship between STEM intentions and motivation is very sensitive (Blotnicky et al. 2018). Devic & Babarovic (2018) described the circle of children in class 7 (13 years old) and try to fit them into a broader general development context of the vocational interests. The 13-year-olds appear to be a turning point in the formation of vocational interest.

The emergence of a new wave of technology known as, The Fourth Industrial Revolution (Industry 4.0) and the era of "Digital Economy" which resulted in an increasing employment opportunity for graduates specializing in STEM careers. According to the Ministry of Science, Technology, and Innovation (MOSTI), Malaysia needs 500,000 workers in the field of STEM by 2020. However, STEM field involvement among students in Malaysia is declining, not only in schools but in institutions of higher learning (Chiu, 2016). STEM careers require highly skilled individuals with complex problem-solving skills, oral and written communication skills, emotional intelligence, creative and the ability to be a leader as well as team members and to adapt to the world of Industrial Revolution 4.0 careers. STEM education is a lifelong learning that integrates science, technology, engineering, and mathematics formally based on the curriculum. STEM education can also be implemented informally through co-academic and co-curricular activities. STEM education can contribute towards producing a society with STEM literacy as well as providing a highly skilled STEM workforce that can contribute to new innovations (Ministry of Education, Malaysia 2013)

The level of STEM knowledge of an individual has a direct impact on the intention to pursue STEM careers in the future (Blotnicky et al. 2018). Lack of knowledge will put students at risk by rejecting STEM-based career paths as a potential option for them in the future. As a result, students' interest in a STEM career will diminish, which will negatively affect their desire to participate in activities that serve to enhance STEM career knowledge and awareness. School counselors play an important role in exposing students to the field of STEM that is being actively promoted in the outside world. In short, it is important for students to be equipped with specialized knowledge and skills to face the challenges of STEM career, thereby continuing to contribute to the national productivity and the development through innovations. In addition, the importance of career fields alignment for each student in terms of personality will be studied because it determines the success of a student in a career. Career alignment is said to be able to help deal with any job-related dissatisfaction and problems to avoid the occurrence of job changes in a short time. This is because job alignment enhances motivation, satisfaction, achievement, productivity, and job retention (Ismail & Noah 2012). In relation to the above discussion, this study presents some research questions to be studied: (1) What is the specific profile of the STEM career interest characteristics of secondary school students? (2) Is there congruen between career interest and STEM careers?

Career Interest in STEM

Past studies related to the tendencies towards STEM careers interest have been extensively conducted to understand current needs and issues. The Malaysian government set a 60:40 ratio target in its national education policy in 1967 (Sufean Hussin & Norliza Zakuan. 2009). Therefore, the Ministry of Education Malaysia (MOE) has made an internal policy to promote the dimensions of Science, Technology, Engineering & Mathematics (STEM) and Technical & Vocational Education Training (TVET) among secondary school students (Minstry of Education Malaysia, 2013). These two dimensions of education are given high emphasis from time to time to ensure that Malaysia has adequate professional human resources in science and technical fields that meet the needs of local industries.

A study by Mohd Izwan and Abu Yazid (2019), has identified the need for module-assisted interventions for secondary school students aimed at fostering career interest in STEM. Fostering career interest at an early stage in Forms One and Two can help students improve their achievement in the PT3 examination. Correspondingly, the study by Betsworth & Fouad (1997) and Hidi et al. (2010), found that attraction would be a motivator for individuals to cultivate an important interest in STEM careers. Previous research related to Hope Value Theory suggests that evaluating science for self or society will be linked to both affinities for STEM careers and STEM career goals (Eccles & Wigfield 2002; Jacquelynne S Eccles & Wigfield 1992). Evaluation of science is an important predictor of career relationships. There is a new pattern, evaluating science is more strongly correlated with the affinity of technology and engineering than against science or mathematical relations (Dorph et al., 2018).

Gifted and talented students have the characteristics of observing, analyzing, rationalizing, researching, intellectual, introvert, introspective, optimistic, high curiosity, theorist, and accurate. Social codes, on the other hand, show that they have the characteristics of being sociable, helpful, cooperative, friendly, patient, extroverted, empathetic, kind, responsible, and trustworthy. On the whole, the results based on the Holland Code of Career Interests have shown that most gifted and talented students tend towards science namely; Realistic, Investigative, and Conventional. These people have strong cognitive abilities and talents, which can be fully developed to contribute to the country's high-quality human capital, thus contributing towards the development of a high-income nation (Yusof, et al. 2020).

STEM education is a lifelong education that encompasses learning which integrates science, technology, engineering, and mathematics formally based on the curriculum. STEM education can also be implemented informally through co-academic and co-curricular activities. STEM education can contribute towards creating a society with STEM literacy and providing a highly skilled STEM workforce that can produce innovations (Ministry of Education, Malaysia 2016).

Lack of interest or aspiration of students in science, technology, engineering, and mathematics (STEM) careers is a worldwide concern (Wang 2018). Lack of interest is associated with limited career knowledge among secondary school students and they do not seem to be aware of their limited knowledge of STEM (Blotnicky, 2018). Participation in STEM competitions is aimed to keep students who are already interested in STEM rather than attracting students who are previously not interested (Majlis Presiden, 2010). Fostering interest in STEM in the early stages of school and participation in STEM competitions during secondary school is a prognosis for interest in STEM in the late secondary school (Miller, et al., 2017).

Method

The research design was quantitative in the form of a survey towards form three students. A total of 329 Form Three students, consisted of 189 females and 140 males were selected as respondents because they were at the stage to make the most suitable major course choice and field of study based on career intentions, interests, and aspirations. This study used a questionnaire as a research tool to measure the variables of Career Interest and STEM Career Interest. Data were analyzed descriptively and inferentially using SPSS version 22 software.

STEM Semantic Survey

STEM Semantic Survey Version 2.0 constructed by Knezek & Christensen (2010) has questions containing 25 items by using likert scale 7. Meanwhile, the researcher only focused on the last scale question which is a set of questionnaires assessment on the evaluation of perception by respondents towards STEM career.

Career Interest Inventory

Additionally, the Career Interest Inventory was also used. The Career Interest Inventory (CII) Instrument for Form 3 was developed by the Examination Board of the Ministry of Education Malaysia based on the Career Interest Inventory (KPM 2012b). CII was used to collect all information on career interests. Several improvements had been made by using graphics and descriptions to increase students' understanding of the information conveyed. A new component added to this inventory was competency on Part C. Form 3 CII had three parts; Part A: Interest, Part B: Occupation, Part C: Competency. The CII instrument contains 6 constructs namely Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C). Each construct had 30 items and the total number of items was 180.

CII has verified on 1000 Form 1 student and 1000 Form 2 students from 47 secondary schools in Malaysia from 5 April 2012 to 26 April 2012. Data were processed to see the reliability and validity values of the items. Similar to the general personality instrument, CII reliability values were tested on items that remained after the analysis factor using the Cronbach's Alpha values. The items had a loading factor value > 0.7 and the Cronbach's Alpha reliability value > 0.8. Therefore, the high

validity and reliability indicated that this inventory was suitable for use in this study.

Results and Discussion

This study focused on Form three students and a total of 329 people were involved in this study. A total of five demographic characteristics were used such as gender, race, occupation of parent, and subject of interest were presented in tabular form based on the number and percentage of respondents. The demographic distribution of the respondents is shown in Table 1.

Table 1

Demographic distribution of respondents

Demographics	**Sub-profile**	**Number**	**Percent (%)**
Gender	Male	140	42.6
	Female	189	57.4
Race	Malay	9	2.7
	Chinese	316	96.0
	Indian	3	0.9
	Others	1	0.3
Father's occupation	Realistic	98	29.8
	Investigative	18	5.5
	Artistic	2	0.6
	Social	17	5.2
	Enterprising	164	49.8
	Conventional	13	4.0
	Others	17	5.2
Mother's occupation	Realistic	9	2.7
	Investigative	2	0.6
	Artistic	6	1.8
	Social	37	11.2
	Enterprising	74	22.5
	Conventional	90	27.4
	Others	111	33.7
Subject of interest	Science	228	69.3
	Mathematics	74	22.5
	Design and Technology	4	1.2
	Computer Science	6	1.8

Language	17	5.2

Patterns of Interest Tendencies for Career and STEM Careers

Overall Table 2, shows that out of the 329 students involved, the results of the study in the first dominant showed that the majority of students i.e. 101 people (30.7%) were more likely to choose Investigative interest. Followed by a total of 93 people (28.3%) chose the Conventional interest and a total of 60 people (18.2%) chose the Social interest.

Table 2

Distribution of psychometric tests of career interest selection of form 3 students

Dominant Category	R	I	A	S	E	C	Total
First Dominant	11 (3.3)	101 (30.7)	41 (12.5)	60 (18.2)	23 (7.0)	93 (28.3)	ICS
Second Dominant	13 (4.0)	59 (17.9)	35 (10.6)	92 (28.0)	54 (16.4)	76 (23.1)	SCI
Third Dominant	15 (4.6)	64 (19.5)	51 (15.5)	90 (27.4)	43 (13.1)	66 (20.1)	SCI

Table 3 shows that the majority of students, 161 people (48.9%) were more likely to choose a career in Science. Followed by a total of 75 people (22.8%) chose a career in Mathematics, a total of 63 people (19.1%) chose a career in Technology and the remaining 30 people (9.1%) chose a career in Engineering.

Table 3

Distribution of STEM career selection semantic tests

	Number	Percent (%)
Science	161	48.9
Technology	63	19.1
Engineering	30	9.1
Mathematics	75	22.8
Total	329	100.0

The results of the study found that these students had the tendency towards the I-K-S personality type and had similarities with the study by Yusof, et al. (2020). In contrast, Abu Yazid and Mohd Izwan (2020) found that the dominant career interest patterns were Social (S), Investigative (I), and Realistic (R). The Investigative personality liked to observe, investigate, analyze and make judgments. They were also skilled in math and science (Rabie, 2017). They liked to work alone and prefer to be involved with ideas rather than humans and equipment. In addition, they were also curious, logical, accurate, intelligent, and independent. Meanwhile, humans in the Conventional personality type have excellent clerical and

calculation skills. Very organized, they abided by the rules and loved to plan. They were practical, meticulous, efficient, diligent, and careful. Furthermore, the Social personality group enjoyed working with humans in the form of helping, educating, guiding, training, and giving encouragement. They were very adept at using words and interested in human relationships. They were kind, generous, patient, friendly, and responsible (Su, et al., 2015; & Rabie 2017).

Therefore, the comparisons with previous studies had shown that the Investigative interest (I) is the most important among all career interest types in STEM careers. This is because most types of fields in STEM require the ability to focus, research, analyze, and explore tasks with strong commitment and perseverance in finding solutions to problems or making discoveries. This is in line with the characteristics of constant curiosity that involves in-depth observation and the ability to focus over long periods in a chosen field. (Yusof et al. 2020).

Students' Perceptions of STEM Careers

The findings of this section as in Table 4 showed the level of students' perceptions of STEM careers, which was measured by 5 items. The results showed that all five items had high scores with a mean range between 5.04 and 5.56. Therefore, it could be summarized that item P1 which was "*Meaningful*" recorded the highest mean of 5.56 and standard deviation of 1.372. Meanwhile, item P4 which was "*Fascinating*" recorded the lowest mean of 5.04 and standard deviation of 1.382. On the whole, the score on the level of students' perception of STEM careers (mean = 5.21, SD = 1.176) was at a high level.

Table 4

Levels of students' perceptions of STEM careers

No	Statement	ASTS	STS	TS	N	S	SS	ASS	Min	SP
P1	Meaningful	2	7	14	54	66	76	110	5.56	1.37
		(0.6)	(2.1)	(4.3)	(16.4)	(20.1)	(23.1)	(33.4)		
P2	Interesting	2	8	22	56	75	97	69	5.31	1.34
		(0.6)	(2.4)	(6.7)	(17.0)	(22.8)	(29.5)	(21.0)		
P3	Exciting	3	11	30	73	68	85	59	5.08	1.41
		(0.9)	(3.3)	(9.1)	(22.2)	(20.7)	(25.8)	(17.9)		
P4	Fascinating	3	8	30	81	75	74	58	5.04	1.38
		(0.9)	(2.4)	(9.1)	(24.6)	(22.8)	(22.5)	(17.6)		
P5	Attractive	3	12	19	86	73	74	62	5.08	1.39
		(0.9)	(3.6)	(5.8)	(26.1)	(22.2)	(22.5)	(18.8)		
	Overall								5.21	1.17

(Level: Low = 1.00 - 3.00, Medium = 3.01 - 5.00, High = 5.01 - 7.00)

The level of students' perceptions of STEM careers has a direct impact on the intentions to pursue STEM careers in the future. Lack of good perceptions will bring risks to students by rejecting STEM-based career paths as a potential option for their future. As a result, students' interest in a particular STEM career will decrease, which will negatively affect their desire to participate in activities that serve to increase STEM career knowledge and

awareness. Attitudes toward STEM and science motivation models have gone through a systematic validation process and have been assessed by testing the direct and indirect influence of each of the variables involved (Razali et al. 2020).

This study found that students' perceptions of STEM careers are important. These results are also supported by several reviewed graduate studies. According to the studies by Watters, et al. (2016) and Ünlü & Dökme in 2018, the development of students' interest in STEM careers can be achieved by participating in design technology activities in and out of school. This is important to enable students to better understand job-related science-based technologies and to work on practical tasks allowing students to reconsider careers in the engineering industry by the end of secondary school. Moreover, according to the Presidential Council (2010) and Schleicher (2007), participation in STEM competitions and international Science Olympics can foster students' interest in STEM careers and drive the development of their twenty-first-century skills.

The Correlation between Career Interests and STEM Careers

The results of the Chi Square test analysis in Table 5 show the correlation between career interests and STEM careers giving a chi-square value = 50.509 and a p-value = 0.000. Since the p-value is < 0.05, then the null hypothesis, Ho is a rejected.

Table 5

Correlation between Career Interests and STEM Careers

	Science	**Technology**	**Engineering**	**Mathematics**	**Chi-Square**	**Dk**	**p-value**
Realistic	5 (45.5)	2 (18.2)	1 (9.1)	3 (27.3)	50.509	15	.000
Investigative	69 (68.3)	12 (11.9)	11 (10.9)	9 (8.9)			
Artistic	17 (41.5)	14 (34.1)	3 (7.3)	7 (17.1)			
Social	33 (55.0)	10 (16.7)	6 (10.0)	11 (18.3)			
Enterprising	5 (21.7)	5 (21.7)	1 (4.3)	12 (52.2)			
Conventional	32 (34.4)	20 (21.5)	8 (8.6)	33 (35.5)			

However, the findings of this study are not consistent with the findings of the previous studies (Abu Bakar & Mahmud 2020; Yusof et al. 2020). Therefore, the results of this study are expected to be utilized by counselors by understanding the impact of career interests on students' STEM career choices in the future. The researchers concluded that there was not enough evidence to suggest a correlation between STEM careers and career interests. This pattern is indeed present in variations of the patterns found by other researchers and the Investigative features that dominate this combination are consistent with the characteristics of the STEM career profession assumed by Holland. This personality acquisition is important because the STEM career tasks require them to emphasize concepts guided by 4C components namely communication, collaboration, creativity, and critical thinking as contained in 21st-century learning (PAK-21) as well as the higher-order thinking skills (HOTS) (Pertiwi 2017; Rabie 2017; Devic & Babarovic 2018).

Implication and Conclusion

This study can provide some information to students by recognizing their personalities, realizing their abilities and potential career interests. Meanwhile, parents can identify the child's personality and help them plan a career direction that suits their personality. Moreover, school teachers can plan more effective teaching and learning appropriate to the abilities of the

pupils. The results of this study have shown that there is a significant alignment between career interests and STEM careers of Form 3 students, but this study can suggest to students the importance of understanding the alignment of career fields pursued by each student in terms of personality because it determines the success of a student in work. This study also provides information to many parties including students, parents, and schools if they can equip themselves with specific knowledge and skills to face the challenges of STEM careers. This study gives awareness to students to better understand their personalities and interests in the STEM career selection process. Students should be aware of the importance of job alignment with career interests in the long run.

Furthermore, with the availability of this study, exposure to the alignment of career interests and STEM careers can help address any job-related problems and dissatisfaction to avoid the occurrence of job changes in a short time. This individual will show motivation, satisfaction, achievement, productivity, and will stay long in his or her job (Ismail & Noah 2012). This study can make the community aware of the importance of alignment of career fields pursued by each student in terms of personality as a determinant of a student's success in a job. The results of this study provide important implications for Malaysian education policymakers to encourage school students to pursue education in STEM, namely exposing them to the field as early as secondary school level and providing career development programs through counseling services.

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