

Students Attitude towards Science, Technology, Engineering and Mathematics in Developing Career Aspiration

Fazilah Razali, Othman Talib, Umi Kalthom Abd Manaf, Siti Aishah Hassan

To Link this Article: <http://dx.doi.org/10.6007/IJARBSS/v8-i5/4242>

DOI:10.6007/IJARBSS/v8-i5/4242

Received: 27 March 2018, Revised: 17 April 2018, Accepted: 29 April 2018

Published Online: 08 May 2018

In-Text Citation: (Razali, Talib, Manaf, & Hassan, 2018)

To Cite this Article: Razali, F., Talib, O., Manaf, U. K. A., & Hassan, S. A. (2018). Students Attitude towards Science, Technology, Engineering and Mathematics in Developing Career Aspiration. *International Journal of Academic Research in Business and Social Sciences*, 8(5), 946–960.

Copyright: © 2018 The Author(s)

Published by Human Resource Management Academic Research Society (www.hrmars.com)

This article is published under the Creative Commons Attribution (CC BY 4.0) license. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this license may be seen

at: <http://creativecommons.org/licences/by/4.0/legalcode>

Vol. 8, No. 5, May 2018, Pg. 946 – 960

<http://hrmars.com/index.php/pages/detail/IJARBSS>

JOURNAL HOMEPAGE

Full Terms & Conditions of access and use can be found at
<http://hrmars.com/index.php/pages/detail/publication-ethics>

Students Attitude towards Science, Technology, Engineering and Mathematics in Developing Career Aspiration

Fazilah Razali, Othman Talib, Umi Kalthom Abd Manaf,
Siti Aishah Hassan

Faculty of Educational Studies, Universiti Putra Malaysia

Abstract

Integrating Science, Technology, Engineering and Mathematics (STEM) will benefit the national economy. Therefore, educators and school community have given appropriate attention to students that are competitive to fulfill the industrial economy needs. This research studied the nurturing of attitude towards STEM among students in developing interest in STEM careers by using the survey method. Research objective to determine direct influence between attitude towards STEM and development of STEM career interest among Form Four science stream students. A total of 398 Form 4 students from the science stream in secondary school in Selangor, Malaysia have been chosen as respondents. The Student Attitudes questionnaire toward Science, Technology, Engineering, and Math (S-STEM) and interest in STEM career is used to study the influence of attitude towards STEM in developing STEM career aspiration among science stream students. Result of the study shows that the students attitude in developing STEM career recorded the value $p = .002$ and is significant with the value of $p < 0.05$. Besides, the effect of influence for the three attitude sub-constructs towards STEM which are science (0.65), technology & engineering (0.65) and mathematics (0.59) recorded the value of more than 0.3 which give a huge impact of research. Thus, the nurturing of attitude towards STEM among students provide a new dimension in the learning process for future need compared to considering it as a study requirement only for academic purpose.

Keywords: Stem, Careers, Science Curriculum, Attitude towards Stem, Malaysia.

Introduction

Science and Technology was introduced five decades ago, when the Higher Education Planning Board (1967) , introduced the enrolment policy of the ratio of Science students against Arts students. This policy was introduced to increase the number of students in the science stream, compared to the arts stream. The gradual increase in the forecast ratio of student enrolment in the science stream could be seen from 1970, where the ratio of science stream students was 45% to 60% arts stream students, to 1980, when this ratio increased to 60% of science stream students

to 40% arts stream students. Beginning from 1980, the education system was replanned, reformulated and redesigned so that the science curriculum would be constantly dynamic enough to compete with advanced countries. The change in the Malaysian education system brought about the emergence of STEM (Curriculum Development Division, 2016).

In 1986, the Ministry of Education introduced the National Science, Technology and Innovation Policy, in support of the policy of the 60:40 ratio of science students to arts students. The purpose of this was to encourage students to use Science and Technology as a catalyst to economic development (Curriculum Development Division, 2016). Subsequently, the Seventh Malaysia Plan (1996-2000), also placed emphasis on the increase in student enrolment at secondary school level in the science, engineering or technology related streams, so as to increase skilled labours with science and technical skills (Economic Planning Unit of the Prime Minister's Department, 1996).

Besides this, the development of the science curriculum was also the focus of the Ministry of Education, when outlining the importance of integrating science and mathematics, as well as the use of technological application in teaching and learning sessions, beginning from 2001. This was in line with the requirement of the Education Development 2001-2010, to reinforce science with the integration of technological application in teaching and learning sessions. In relation to this, emphasis was given by increasing in-house training sessions to science and mathematics teachers, which brought about the Innovative Teacher Award to reward teachers who practised the integration between curriculum and technology in teaching and learning.

In addition, the Ministry of Education carried out meticulous planning through the education plan, for the implementation of STEM in a more comprehensive manner. The National Education Blueprint 2013-2025 (PPPM 2013-2025), carried out various strategies to strengthen Science, Technology, Engineering and Mathematics (STEM), in its effort to produce more experts to meet the country's needs. This resulted in the formulation of the Standard Secondary School Curriculum (SSSC), which outlined STEM in the school curriculum design.

Students Attitude towards Stem

The formation of students' positive attitude towards STEM that started in secondary school will affect the students' momentum in choosing STEM career (Unfried, Faber, Stanhope, & Wiebe, 2015). In this study, attitude is defined as the tendency to respond towards the environmental factors that are occurring around the students (Ardies, De Maeyer, Gijbels & Keulen, 2014). These factors include psychological objects such as symbol, phrase, learning content and presented ideas. Attitude comprises of three basic components interacting with one another which are cognitive, affective and natural tendency.

However, the cognitive component is more dominant among the three (Soh, Arsada, & Osman, 2010). The cognitive component also can also influence the students' willingness to respond towards the learning outcome that has been mastered in building the students' career interest (Noorhidawati, Ghalebandi, & Hajar, 2015). Furthermore, positive attitude towards

science will provide awareness among the students in comprehending the relationship between knowledge and future career need (Zain, 2010; Prieto & Dugar, 2016).

Attitude towards STEM is one of the important elements in nurturing the students' STEM career interest as stated by Social Cognitive Career Theory (SCCT). A strong relationship between attitude towards STEM and career interest becomes the key factor in the development in this theory towards the requirement of STEM (Brown & Lent, 2016; Lent, Brown, & Hackett, 2000; Lent, D. Brown, & Hackett, 1994). Besides, past researches (Badri et. al., 2016; Rice Barth, Guadagno, Smith, & McCallum, 2013; Valenti, Masnick, Cox, & Osman, 2016) highlighted that students' positive attitude towards STEM is a vital element that is required among students to fulfill the need to achieve students' STEM career aspiration. Thus, accurate information regarding STEM career must be delivered to students by the school community as early as during the secondary school level in forming the students' interest towards STEM career. Emphasis on a positive attitude towards STEM must be carried out during the secondary school level because during that time, the students already decided the rationality of learning science curriculum is for the students' future need (Karahan & Roehrig, 2016; Meng, Idris, Eu, & Daud, 2013; Saxton et al., 2014).

Social Cognitive Career Theory (SCCT)

This study has chosen Social Cognitive Career Theory (SCCT) (2016) that has been formed based on Bandura's Social Cognitive Theory (1986) and Lent, Brown, and Hackett SCCT Theory (1994). SCCT (2016) was developed by Lent and Brown and it stresses on life-long learning and has been adjusted with the current learning environment with the students' STEM career requirement (Dickinson, Abrams, & Tokar, 2016; Flores, Navarro, & Ali, 2016; Sheu & Bordon, 2016).

SCCT (2016) also highlights the relationship between variables which are students, environment and attitude in predicting the students' interest and career choice. SCCT (2016) has outline the main factors that are the key in developing career which are attitude, performance and skill apart from the influence of career sector demand (Chachashvili-Bolotin, Milner-Bolotin, & Lissitsa, 2016; Lent et al., 1994; Sahin, Gulacar, & Stuessy, 2015; Wang, 2013). Parallel with the research, SCCT can explain in more detail the relationship between the designed science curriculum and the students' STEM career selection. In addition, this theory also takes into consideration the students' learning experience in determining a precise career choice (Brown & Lent, 2016). SCCT (2016) covers the conceptual process in development related to academic, interest and performance. In line with STEM's approach in the education system by combining science curriculum knowledge with 21st century skill requirement towards the development of STEM career interest (Fouad & Santana, 2017).

Methodology

Research Procedure and Respondent

The research design is correlational by studying the relationship between independent variable with dependent variable. The research approach employs the survey method by using a questionnaire form to study the influence of attitude towards STEM among the science stream students, towards STEM career interest. The study will develop a model of direct influence that

involves the independent variable which is attitude towards STEM and measure the effect of every element (science, technology, engineering and mathematics) in order to explain specifically the contribution of every element on attitude towards STEM.

The research respondent consists of 398 Form Four science stream students in Sekolah Menengah Kebangsaan in Malaysia. Research sample has been executed by using the proportionate stratified random sampling method.

Research Instrument

Student Attitudes toward Science, Technology, Engineering, and Math (S-STEM)

The questionnaire consists of 26 items covering the 3 sub-constructs from the students' attitude towards STEM, and STEM career interest. The variable attitude towards science is denoted by 9 items, attitude towards mathematics denoted by 8 items while attitude towards technology and engineering is denoted by 9 items and 12 items denotes STEM career interest.

The questionnaire items have gained approval by Unfried et al., (2015), Friday Institute for Educational Innovation, USA to be adapted and adjusted for the research that will be carried out. According to Unfried et al., (2015) S-STEM instrument is important to evaluate the influence of every construct on students' participation in the science stream and the students' consistency in choosing STEM career continually.

Pilot Test Report

The questionnaire instrument is a tool to measure, observe and document the quantitative data (Cresswell, 2012). For that particular purpose, the research instrument used must align with the research's requirement. The internal consistency reliability for the measured instrument based on alpha Cronbach value might differ from past researches. (Zainuddin Awang, 2010; 2012; Hoque et al, 2016). Thus, a pilot test to assess the instrument in ensuring the questionnaire is understood by the respondent and to avoid confusion in terms of words or measurement must be performed. Items that are incomprehensible and unsuitable must be eliminated and the validity and the reliability for each research instruments must be determined (Sekaran, 2013).

Analysis of the Reliability and the Validity of the Research Instrument

Result from the pilot test data (Table 2) that has been executed with the purpose to measure the reliability and the validity of the instrument, clearly shows that the three instruments has a high coefficient value when the Alpha Cronbach is more than 0.7 for survey analysis (Hair, Black, Babin & Anderson, 2010). The validity of instrument is carried out to observe to what extent the instrument can measure the required evaluation (Cresswell, 2012). Besides the validity method is aligned with the theory stated by Nunally (1967) which stated that the validation of the instrument by the experts, the research has also shown that the instrument is valid in terms of the pilot test conducted based on the mean correlation value between the scores with the total scores according to constructs.

In addition, according to Nunally & Bernstein (1994) correlation value that is more than .25 has high item validity for a pilot test instrument. Therefore, all of the research instruments

are valid because the mean correlation value for every instrument is more than .25 and it shows that all of the items can measure the construct effectively.

Meanwhile reliability is related to the ability of instrument to measure with consistency and stability (Creswell, 2014; Sekaran, 2013). The reliability of instruments are highly related to its validity in which the instruments are not valid unless if it is reliable (Tavakol & Dennick, 2011). The reliability of instruments according to Alpha Cronbach value refers to the measurement of the internal consistency of a construct. According to Sekaran (2013) the value of the reliability in measuring the questionnaires that is less than .59 is considered low and cannot be accepted, while the value of Alpha that is more than .80 is high and can be accepted for the next analysis. However Alpha Cronbach value that is more than .60 is usually used in determining the reliability of an instrument (Pallant, 2001). Thus, analysis result shows that the Alpha Cronbach value for all research instruments has a high reliability and can be accepted. Table 2 shows the overall report of the validity and the reliability of the instruments.

Table 2: Validity and Reliability of Research Instrument

Instrument	Construct	Mean Correlation Value between the score of every item with total score	Alpha Cronbach
<i>Student Attitudes toward Science, Technology, Engineering, and Math (S-STEM) and Interest in STEM Career</i>	Attitude	.312	0.838
	Career	.345	0.863

Result

The research data has been analyzed by using structural equation modelling (SEM). Based on the result analysis, it is found that attitude towards STEM has a direct influence towards the development of STEM career interest.

In this research, confirmatory factor analysis (CFA) is a statistic method used to determine the relationship between construct or latent variable and the involved indicator (Byrne, 2010). CFA serves the purpose of determining the fit indexes for the model data. Nevertheless, there is no agreement among researchers regarding a specific use of fit index (Zainuddin Awang, 2015). Hair et al. (2010) recommend the use of at least one fit index from every model fit category. There are three model fit category which are absolute fit, incremental fit and parsimonious fit.

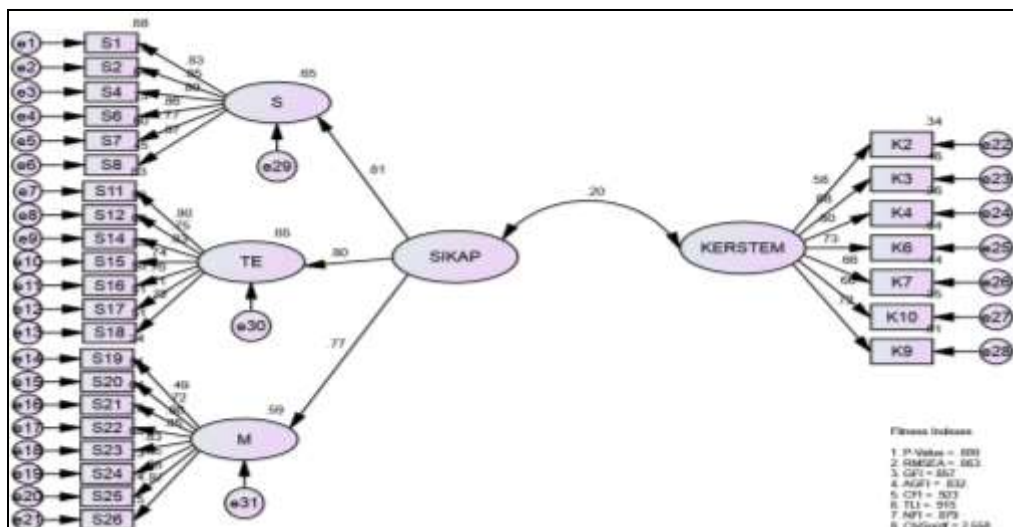


Figure 1: Measurement Model for the Variable Attitude towards STEM and STEM Career Interest

Figure 1 shows the variable attitude towards STEM and career interest among students can fulfill the fit indexes for the measurement model. Attitude has three sub-constructs which are science (S), technology & engineering (TE) and mathematics (M) that represent attitude towards STEM. As for KERSTEM, it is the abbreviation for STEM career interest.

According to Hair et. al, (2010), fit indexes in evaluating a model must achieve at least one index from every category such as below:

- a. Absolute Fit: RMSEA or GFI
- b. Incremental Fit: CFI or TLI
- c. Parsimonious Fit: Chisq/df
- d. Goodness of Fit Index: CFI or TLI or GFI

Modification process is carried out to fulfill the fit indexes by eliminating the items that have low loading factor. Loading factor explains the evaluation for each item of the involved variables. Low loading factor shows that the item is not suitable or it cannot measure the variable efficiently. Therefore, the loading factor must be eliminated to fulfill the requirement of a fit index of an evaluation model (Yi, 2005). The modification process of the evaluation model is continued by looking at the model modification index to achieve fit indexes of an evaluation model. Figure 10 shows the evaluation model for every latent constructs that are involved in the research. After the modification process which is by eliminating the low value loading factor, the evaluation model for the latent construct can fulfill the indexes for every index categories which are P-value, RMSEA, CFI, TLI and Chisq/df (Table 3).

Table 3: Evaluation Model Fit Indexes according to Hair et. al Index (2010)

Categories	Index Name	Accepted Index	Evaluation Model Index
1. Absolute Fit	Chisq	> 0.05	885.014
	RMSEA	< 0.08	.063
	GFI	> 0.90	.857
2. Incremental Fit	AGFI	> 0.90	.832
	CFI	> 0.90	.923
	TLI	> 0.90	.915
	NFI	> 0.90	.879
3. Parsimonious Fit	Chisq/df	< 5.0	2.558
4. Goodness Of Fit Index	CFI	> 0.90	.923
	TLI	> 0.90	.915
	GFI	> 0.90	.857

Validating the Validity and the Reliability of an Evaluation Model

After the CFA procedure for every evaluation model is finished, a few steps must be taken into consideration to show the validity and the reliability of a construct.

Unidimensional

Unidimensional is accepted when every factor loading items that are measured is accepted by every construct. This is to confirm the evaluation model unidimensional; all items with low factor is eliminated (<0.5).

Validity is the ability of instruments to evaluate the items that need to be measured by the construct. There are three types of validity that is required for every evaluation model which are:

1) Convergent Validity

The validity will be accepted when all items in the evaluation model is significant to the statistic. Convergent validity can also be validated by calculating the Average Variance Extracted (AVE) for every construct. This validation is accepted when all items in the evaluation model is significant to the statistic, $AVE \geq 0.5$.

2) Construct Validity

This validation will be accepted when the Fitness Indexes for every construct is accepted according to the required level.

3) Discriminant

This validation is accepted when an evaluation model is free from discriminant. AMOS will identify the pair items that are discriminated in the model based on the measurement that is known as Modification Index (MI).

Reliability

Reliability is a phase where the evaluation model can be trusted to measure the latent construct. The evaluation of reliability for evaluation model can be executed by using the criteria that are as followed:

1) Internal Reliability

Reliability is accepted when the Alpha Cronbach value is > 0.7.

2) Composite Reliability (CR)

The evaluation of the reliability and internal consistency for latent construct (CR value ≥ 0.6).

3) Average Variance Extracted (AVE)

The average variance percentage as explained by item evaluation for latent constructs (AVE value ≥ 0.5).

Table 4 shows the summary of analysis for the validity and the reliability of the research for the variables attitude towards STEM and STEM career interest. Result from the analysis shows that the research is true to the validity and the reliability that has been set.

Table 4: Summary of Confirmatory Factor Analysis for Latent Construct

Construct	Eliminated Item	Alpha Cronbach(>0.7)	CR (≥ 0.6)	AVE (≥ 0.5)
Attitude Towards STEM	S3	.947	.97	.63
	S5			
	S9			
	S10			
	S13			
STEM Career Interest	K1	.807	.89	.50
	K5			
	K8			
	K11			
	K12			

Table 5: Correlation between Constructs for Evaluation Model

Construct	Attitude towards STEM	STEM Career Interest
Attitude towards STEM	*.793	** .195
STEM Career Interest	** .195	*.707

*Square root of AVE

**Correlation between constructs (<.85)

Table 5 shows that the bolded diagonal value is the square root of AVE value for every constructs. The model achieve its validated discriminant when the diagonal values that are bolded is higher compared to the values in the row and column that represent the correlation value for every construct according to the evaluation model (Zainuddin Awang, 2015).

Structural Model

The result analysis indicates that the evaluation model has achieved the fit index that has been set after the execution of modification process towards the model. Thus, the analysis will be resumed by testing the completed model that is also the structural model. The structural model represents the magnitude and the direction of a relationship between a set of latent variables

and enable the researcher to evaluate the relationship that has been hypothesized in the suggested model. Testing the structural model using AMOS can also produce information about the overall effect, indirect and direct effect of the variable that occur based on the result of the model (Byrne, 2010). This component reports on the fit index for the model influence of attitude towards STEM and the development of the students STEM career interest. Generally, the suggested model has achieved the fit index of at least one index for every fit index category is deemed as a good model and can be accepted (Byrne, 2010; Hair et al., 2010; Hair, Gabriel, & Patel, 2014).

Direct Influence

The structural model is measured in terms of direct influence between latent variables such as in Figure 2. STEM career interest is an endogenous variable while attitude towards STEM is an exogenous variable. Based on the model, it can be concluded that the influence of attitude towards STEM can affect the students STEM career interest directly.

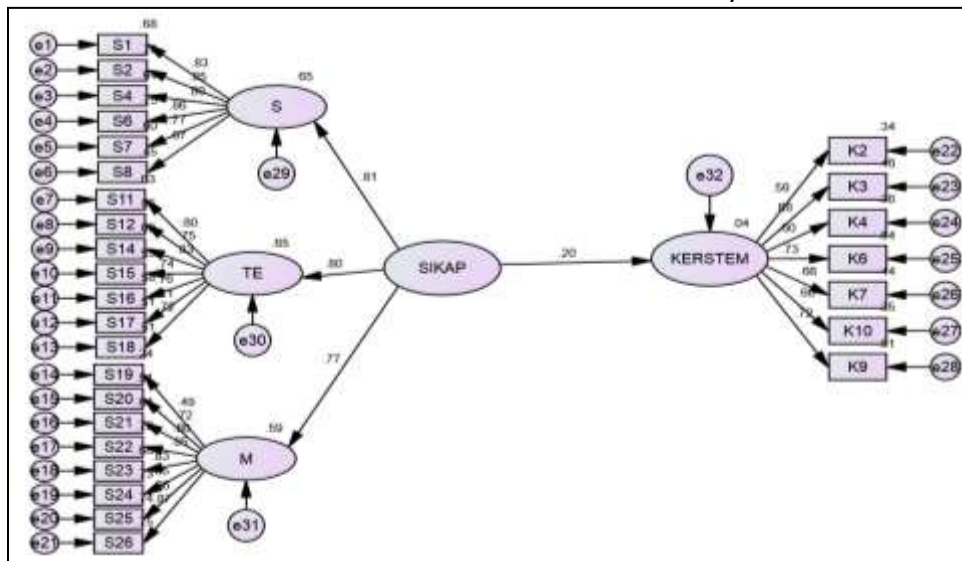


Figure 2: Structural Model between Variables Attitude Towards STEM and STEM Career Interest

Table 6 is the result analysis for the regression weights of the research variables, the result shows that the value of p is less than 0.05 between attitude towards STEM and the development of students STEM career interest recording the value of $p = .01$. The recorded value of p indicates that the attitude towards STEM is significant in the development of students STEM career interest. In addition, the direct influence of independent variable towards dependent variable and the determination of intermediary effects is significant at $p < 0.05$ and has become the basic level in the field of Social Science research (Aytekin, Erdil, Erdogmus, & Akgun, 2016).

Table 6: Weight Regression Projection for the Variables

Construct	Estimation (Non-standard)	Estimation (Standard)	P	Result
ATTITUDE → KERSTEM	.211	.145	.010	Significant

The Effect of Attitude towards Science, Technology, Engineering & Mathematic (STEM)

The direct effect of attitude towards STEM to the development of students STEM career interest can be identified through coefficient determination (R^2) from the model (Table 7). R^2 is important to perceive to what extent the research exogenous construct can explain the influence towards the research endogenous (Kline, 2011).

Table 7: Squared Multiple Correlations

Sub Construct	Estimate
M	.593
TE	.646
S	.651

Table 7 shows the effect of sub-construct for attitude towards STEM represented by M (Mathematics), TE (Technology & Engineering) and S (Science) indicating a high estimation contribution for every sub-construct with a recorded value of variance more than .30 or 30% for every sub-construct. The highest value is recorded by the Science sub-construct which contributes to the variance value of .651 or 65.1% towards the development of the students STEM career interest. Technology & Engineering recorded the second highest with a value of .646 or 64.6% while the last sub-construct which is Mathematics contributes .593 or 59.3%. All of the sub-construct provides a huge contribution towards the development of students STEM career interest. Moreover, Kline (2011), stated the influence effect generally from the R^2 variance value can be explained clearly as seen in Table 8 :-

Table 8: The value of R^2 and the Size of Effect

R^2	Size of Effect
<.01	Small
.10 - .29	Medium
>.30	Large

Discussion

The analysis that has been conducted shows that the research objective is achieved in which there is a significant influence ($p = .010$) between the attitude towards STEM in forming the students STEM career interest and it provides a huge variance value for the effect of every attitude sub-construct towards the formation of students STEM career interest. The outcome of the research is supported by Suprpto (2016) where it is found that the attitude towards STEM has a direct influence and it is the basic key for students to explore STEM career. Next, introduction towards STEM in the education system that begins with the integration of science subject aligns with the research outcome showing Science as having the highest sub-construct effect. The research outcome is also supported by past research (Christensen & Knezek, 2017;

Nugent et al., 2015) stating that a good mastery in science can give a clear view to students to fulfill the student's future career.

Research analysis is based on the data among secondary school students in increasing the nurturing of attitude towards STEM as a preparation for the students to choose a better career and continuously be more consistent until the selection of STEM program at a higher education institution. Hence, they are able to provide a better enrollment in supplying skilled workforce in STEM sector for global industry requirement. The importance of attitude towards STEM based on the research gives a new dimension especially towards the learning process by emphasizing the attitude element towards STEM among school community in order to interpret the curriculum to the students more comprehensively. Nevertheless, the need for future research must be done to strengthen the curriculum frame where STEM becomes one of the main roots by identifying more variables or programs that can give positive input towards students' career aspiration in STEM sector.

Conclusion

The strong correlation between attitude towards STEM and career interest, is the key in the development of the Career Social Cognitive Theory, in relation to STEM needs (Brown & Lent, 2016; Lent, Brown, & Hackett, 1994). Furthermore, emphasise that students' positive attitudes towards STEM is an important, necessary element which is needed to fulfil STEM career aspiration needs of students. Therefore, more accurate information related to STEM careers, needs to be channelled to students in the school setting, as early as secondary school level, in order to develop students' interest towards STEM careers. The emphasis on the development of positive attitudes towards STEM, should be carried out at secondary school level, as at this level, students begin to rationalise about learning the science curriculum for future needs as shown in the findings of this study.

Attitude towards STEM in fulfilling STEM career aspiration can be nurtured in different context or section. This is because STEM has a wide field, but a few modifications in terms of content, demography in the questionnaire form and theory must be adjusted with the environment or research issue that will be carried out. This is due to STEM being a wide field and it gives impact towards the usage of the model that is not only limited among science stream students but also other streams such as Technical Communication Graphic, Additional Science, Agriculture, Home Science, Invention, Computer Science and Sports Science which are also part of STEM department (Curriculum Development Division, 2016). The evaluation of attitude towards STEM is not only for secondary school level but it can also be measured on different level such as matriculation and university to determine the student career interest in STEM. Thus, the evaluation begins with attitude towards STEM among students that will become the key factor in driving optimum diversity from different streams in schools and also in various education levels will give different and more comprehensive finding.

Corresponding Author

Fazilah Razali

Faculty of Educational Studies,

Universiti Putra Malaysia

Email: zila_ixora@yahoo.com

References

- Ardies, J., Maeyer, D. S., Gijbels, D., & Keulen, V. H. (2014). Students attitudes towards technology. *International Journal of Technology and Design Education*, 25(1), 43–65. <http://doi.org/10.1007/s10798-014-9268-x>
- Aytekin, I., Erdil, O., Erdogmus, N., & Akgun, A. (2016). Academicians' Career Capital and Career Satisfaction : The Mediation Effect of Research Productivity *. *Educational Sciences: Theory & Practice*, 16, 1921–1945. <http://doi.org/10.12738/estp.2016.6.0412>
- Badri, M., Alnuaimi, A., Mohaidat, J., Al Rashedi, A., Yang, G., & Al Mazroui, K. (2016). My science class and expected career choices—a structural equation model of determinants involving Abu Dhabi high school students. *International Journal of STEM Education*, 3(1), 12. <http://doi.org/10.1186/s40594-016-0045-0>
- Byrne, B. (2010). *Structural Equation Modeling with AMOS: basic concepts, applications, and programming*. (Taylor & Francis Group, Ed.) (2nd Edition). New York: Taylor & Francis Group.
- Chachashvili-Bolotin, S., Milner-Bolotin, M., & Lissitsa, S. (2016). Examination of factors predicting secondary students' interest in tertiary STEM education. *International Journal of Science Education*, 38(3), 366–390. <http://doi.org/10.1080/09500693.2016.1143137>
- Christensen, R., & Knezek, G. (2017). Relationship of Middle School Student STEM Interest to Career Intent To cite this article : Relationship of Middle School Student STEM Interest to Career Intent. *Journal of Education in Science, Environment and Health (JESEH)*, 3(1), 1–13.
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. *Educational Research* (Vol. 4). <http://doi.org/10.1017/CBO9781107415324.004>
- Creswell, J. W. (2014). *Research Design Qualitative, Quantitative, and Mixed Methods Approaches*. (V. Knight, Ed.) (Fourth). United State of America: SAGE Publications, Inc.
- Cronbach, L. J. (1946). A case study of the split-half reliability coefficient. *The Journal of Educational Psychology*, 37, 473–480.
- Curriculum Development Division. (2016). *Implementation Guide for Science, Technology, Engineering and Mathematics (STEM) in Teaching and Learning* (Mac).
- Dickinson, J., Abrams, M. D., & Tokar, D. M. (2016). An Examination of the Applicability of Social Cognitive Career Theory for African American College Students. *Journal of Career Assessment*, 1–18. <http://doi.org/10.1177/1069072716658648>
- Economic Planning Unit of the Prime Minister's Department. (1996). Seventh Malaysia Plan (1996-2000).
- Fouad, N. A., & Santana, M. C. (2017). SCCT and Underrepresented Populations in STEM Fields : Moving the Needle. *Journal of Career Assessment*, 25(1), 24–39. <http://doi.org/10.1177/1069072716658324>

- Hair, J., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). New York: Pearson Prentice Hall.
- Hair, J., Gabriel, M., & Patel, V. (2014). Amos Covariance-Based Structural Equation Modeling (CB-SEM): Guidelines on Its Application as a Marketing Research Tool. *Brazilian Journal of Marketing*, 13(2), 44–55. <http://doi.org/10.5585/remark.v13i2.2718>
- Hoque, A. S. M. M., & Awang, Z. (2016). The Exploratory Factor Analysis (EFA) of Entrepreneurial Marketing Scale - Development and Validation. *Tourism Conference 20-22 APRIL 2016* (p. 22).
- Karahan, E., & Roehrig, G. (2016). Secondary School Students' Understanding of Science and Their Socioscientific Reasoning. *Research in Science Education*. <http://doi.org/10.1007/s11165-016-9527-9>
- Rex, K. B. (2011). *Principles and practice of structural equation modeling*. New York : Guilford Press,
- Lent, R., Brown, S., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology*, 47(1), 36–49. <http://doi.org/http://dx.doi.org/10.1037/0022-0167.47.1.36>
- Lent, R., Brown, D. S., & Hackett, G. (1994). Towards a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance. *Journal of Vocational Behavior*, 45, 79–122.
- Zain, M. A. N. (2010). the Effect of Instructional Congruence on Students' Interest Towards Learning Science. *European J Of Physics Education*, 1 (ISBN 1309-7202), 20–27.
- Meng, C. C., Idris, N., Eu, L. K., & Daud, M. F. (2013). Secondary School Assessment Practices in Science , Technology , Engineering and Mathematics (STEM) Related Subjects. *Journal of Mathematics Education*, 6(2), 58–69.
- Noorhidawati, A., Ghalebardi, S. G., & Hajar, S. R. (2015). How Do Young Children Engage with Mobile Apps? Cognitive, Psychomotor, and Affective Perspective. *Computers & Education*, 87, 385–395. <http://doi.org/10.1016/j.compedu.2015.07.005>
- Nugent, G., Barker, B., Welch, G., Grandgenett, N., Wu, C., & Nelson, C. (2015). A model of factors contributing to STEM learning and career orientation. *International Journal of Science Education*, 37(7), 1–22. <http://doi.org/10.1080/09500693.2015.1017863>
- Nunnally, J. C. & Bernstein, I. R. (1994). *Psychometric theory* (3rd Ed). New York: McGraw-hill, Inc.
- Nunnally, J. C. (1967). *Psychometric theory*, 2nd ed. New York: McGraw-Hill Book Company.
- Pallant, J. (2001). *SPSS Survival Manual- a step by step guide to data analysis using SPSS for windows programming* (2nded.). New York: Taylor & Francis Group Psychology.
- Rice, L., Barth, J. M., Guadagno, R. E., Smith, G. P. A., & McCallum, D. M. (2013). The Role of Social Support in Students' Perceived Abilities and Attitudes Toward Math and Science. *Journal of Youth and Adolescence*, 42(7), 1028–1040. <http://doi.org/10.1007/s10964-012-9801-8>
- Sahin, A., Gulacar, O., & Stuessy, C. (2015). High School Students' Perceptions of the Effects of International Science Olympiad on Their STEM Career Aspirations and Twenty-First Century Skill Development. *Research in Science Education*, 45(6), 785–805. <http://doi.org/10.1007/s11165-014-9439-5>
- Saxton, E., Burns, R., Holveck, S., Kelley, S., Prince, D., Rigelman, N., & Skinner, E. A. (2014). A Common Measurement System for K-12 STEM education: Adopting an educational evaluation methodology that elevates theoretical foundations and systems thinking.

- Studies in Educational Evaluation, Elsevier, 40, 18–35.*
<http://doi.org/10.1016/j.stueduc.2013.11.005>
- Sekaran, U. (2013). *Research Methods for Business A Skill Building Approach*. (J. C. Marshall, Ed.), *Research methods for business* (Fourth, Vol. 65). John Wiley & Sons, Inc.
<http://doi.org/10.1017/CBO9781107415324.004>
- Sheu, H., & Bordon, J. J. (2016). SCCT Research in the International Context : Empirical Evidence , Future Directions , and Practical Implications. *Journal of Career Assessment, 1–17.*
<http://doi.org/10.1177/1069072716657826>
- Suprpto, N. (2016). Students` Attitudes towards STEM Education : Voices from Indonesian Junior High Schools Students ` Attitudes towards STEM Education : Voices from Indonesian Junior High Schools. *Journal of Turkish Science Education, 13(July), 75–87.*
<http://doi.org/10.12973/tused.10172a>
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach ` s alpha. *International Journal of Medical Education, 2(53), 53–55.* <http://doi.org/10.5116/ijme.4dfb.8dfd>
- Soh, T. M., Arsada, N. M., & Osman, K. (2010). The relationship of 21st century skills on students` attitude and perception towards physics. *Procedia - Social and Behavioral Sciences, 7(2), 546–554.* <http://doi.org/10.1016/j.sbspro.2010.10.073>
- Unfried, A., Faber, M., Stanhope, D. S., & Wiebe, E. (2015). The Development and Validation of a Measure of Student Attitudes Toward Science, Technology, Engineering, and Math (S-STEM). *Journal of Psychoeducational Assessment, 33(7), 622–639.*
<http://doi.org/10.1177/0734282915571160>
- Valenti, S. S., Masnick, A. M., Cox, B. D., & Osman, C. J. (2016). Adolescents and Emerging Adults Implicit Attitudes about STEM Careers : “Science is Not Creative.” *Science Education International, 27(1), 40–58.*
- Wang, X. (2013). Modeling Entrance into STEM Fields of Study Among Students Beginning at Community Colleges and Four-Year Institutions. *Research in Higher Education, 54(6), 664–692.* <http://doi.org/10.1007/s11162-013-9291-x>
- Yi, J. (2005) A measure of knowledge sharing behavior: scale development and validation. *Knowledge Management Research & Practice*. Indiana University. Retrieved from <http://www.palgrave-journals.com/doi/10.1057/kmrp.2008.36>
- Zainudin, A. (2015). *Structural Equation Modeling Using AMOS*. Selangor: MPWS Rich Publication.