Factors Influenced the Students’ Intention to Study STEM Stream in Upper Secondary School

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ABSTRACT

STEM is an important stream in Malaysia education to become a developed country. However, students show less interest in this stream as there is a declining trend of students taking STEM subjects. The objective of the study is to investigate the factors that influence students’ intention to study science stream in upper secondary school. The study framework has three independent variables named attitude towards science, normative social influences, and self-efficacy and the dependent is students’ intention to study science stream. By using cluster-sampling, a total of 339 data were collected through the questionnaire survey method from two schools out of 16 schools in the rural area of Kota Bharu, Kelantan. The data was analysed using Correlation Analysis, Multiple Linear Regression, Independent T-test, and One-Way ANOVA test. The main finding of the study shows that attitude towards science, normative social influences, and self-efficacy had a significant relationship with students’ intention to study science stream in upper secondary. This study offers an insight to parents, teachers, and policymakers in improving policy and encouraging students to pursue their study in the STEM stream to achieve the government goal that earlier set the ratio of science to art students at 60:40.

Keywords:
Intention; attitude towards science; normative social influences; self-efficacy; STEM

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1. Introduction

In 2001, the STEM (Science, Technology, Engineering, and Mathematics) acronym was introduced where the education curriculum is based on disciplines of science and mathematics in preparing students to expand the existing workforce of scientists and engineers [1]. In Malaysia, the concept of STEM education is divided into three perspectives, which are STEM field, STEM stream, and STEM approach. STEM field covers traditional discipline such as Mathematics, Computer Sciences, Chemistry, and others subject that leads to specialized disciplines such as Mechanical Engineering,
Medical, Bio-chemistry, and Computing & Information Systems [2]. STEM stream (called as science stream) refers to the participation of students in an upper secondary school who are chosen to study science stream and these students need to study Physics, Chemistry, Biology, and Additional Mathematics at the upper secondary level. STEM approach is referring to teaching and learning strategies that involve the application of Science, Engineering, Technology, and Mathematics in solving a problem in daily life [2].

As a part of the National STEM stream Action Plan, many strategies have been created such as science practical training for teachers, outreach programs initiated by higher learning institutions, hands-on STEM sessions and STEM camps with the collaboration between government and private sector, organizing various competitions, implementing colloquiums and conference on STEM and others programs to encourage STEM development in the country [3]. However, the enrolment of students in the Science stream never reaches 60% [4]. The declining number of students taking the science stream in high school affected the number of students pursuing study science course in higher education. If this problem is not addressed, countries will face the problem of shortage of skilled labor and expertise in the field of STEM to be absorbed into the industry. This led to the barrenness of innovations in science and technology whereas innovation in science and technology is fundamental to the economy of a country [5]. Among the factors that contribute to the loss of intention of students in taking science stream is the wrong perception towards science stream, feeling of science subject is difficult, limited career prospects, incorrect information about STEM, lack of educators’ readiness, and low students’ self-efficacy [6-7].

Although much work has been done to date, more studies need to be conducted related to STEM education. The purpose of this study was to ascertain the effect of attitude towards science, normative social influences, and self-efficacy on the students’ intention to study science in upper secondary school. This topic was identified as being important to educators and the management team in providing them the necessary background of the factors affecting student’s intention to pursue their study in the science stream.

2. Methodology

The study conducted survey research by using a cross-sectional design in the data collection process. The target population for this study is all Form 3 students in rural Kota Bharu schools consist of 2379 students. Based on the Sample Size Determination table, the appropriate minimum target sample is 331 [8]. The target sample was chosen using the cluster sampling technique which resulted in 2 schools (SMK Kubang Kerian 1 and SMK Tanjung Mas) are selected out of 16 schools. As many as 363 students were involved as respondents.

The measuring instruments were divided into five parts which are Section A, Section B, Section C, Section D, and Section E. Section A explained the demographic profile of the respondent. It has four questions including gender, parents’ educational background, a grade that always students got in Science and Mathematics subjects. Section B explained the students’ intention of the respondent to study sciences and there are five questions provided in this section. Besides that, Section C explained the normative social influences that had influence the respondents to study science and there are five questions provided in this section. Meanwhile, Section D explained the attitudes of respondents towards science subjects which consist of five questions. Lastly, Section E explained about self-efficacy of the respondents to study science which consists of seven questions. Likert Scale is used to examine how strongly the subject agrees or disagrees with the given statements about the stimulus object. A five-point Likert rating of Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), and Strongly Agree (SA) has been used in sections B, C, D, and E. The summary of the
questionnaires is shown in Table 1. The study used the Self-Administered Questionnaires as a survey method in this study. The 363 questionnaires had been distributed to all students in the selected school which are SMK Kubang Kerian 1 and SMK Tanjung Mas and resulted in a 94% response rate.

| Table 1  | Summary of Questionnaires  |
|----------|-----------------------------|
| Section  | Construct                  | No of Item | Authors                  |
| A        | Demographic Information     | 4          | None                     |
| B        | Intention to study science  | 5          | Mohammed & Alwahabi (2016) |
| C        | Normative Social Influences | 5          | Salleh (2013)             |
| D        | Attitude Toward Science     | 5          |                         |
| E        | Self-Efficacy               | 7          | Montebon (2015)          |

3. Results

3.1 Descriptive Analysis

Table 2 shows the summary of descriptive analysis. There are 63.5% of female respondents and 36.5% of male respondents. 43.3% of parents have SPM or PMR, 28.7% of parents have diploma or degree qualification, 8.5% of parents have a Master or Ph.D. holder. Next is the percentage of students who always getting A’s in mathematics. It is revealed that 74.5% of students have responded no, 5.3% of students have answered yes and 20.2% of students have responded sometimes. The percentage of students who always getting A’s in Science is 64.9% of students replied no, 2.9% of students answered yes and there are 32.2% of students responded sometimes.

| Table 2  | Summary for Descriptive Analysis  |
|----------|-----------------------------------|
| Variable | Frequency (n) | Percent (%) |
| Gender   |                      |             |
| Male     | 125                  | 36.5        |
| Female   | 217                  | 63.5        |
| Parents Education Background |                      |             |
| SPM/PMR  | 148                  | 43.3        |
| Diploma/Degree | 98              | 28.7        |
| Master/PhD| 29               | 8.5         |
| None of Above | 67          | 19.5        |
| Students always getting A’s in Mathematics |                      |             |
| Yes      | 18                   | 5.3         |
| Sometimes| 69                   | 20.2        |
| No       | 255                  | 74.5        |
| Students always getting A’s in Science |                      |             |
| Yes      | 10                   | 2.9         |
| Sometimes| 110                 | 32.2        |
| No       | 222                  | 64.9        |

3.2 Indicator and Internal Reliability Consistency Measurement

The pilot study involved 30 students of form 3 that randomly selected from Sekolah Menengah Kebangsaan Dato’ Ahmad Maher, Kota Bharu, Kelantan. All the factor loading for each item in students’ intention to study science, normative social influences, attitude toward science, and self-
efficacy towards science variable also indicate acceptable loading value, and Cronbach alpha (above 0.7) as in Table 3.

Table 3
Factor Loading and Cronbach’s Alpha Result

| Variables                        | Items | Factors Loading | Cronbach’s Alpha |
|----------------------------------|-------|-----------------|------------------|
| Students’ Intention to Study Science |       |                 |                  |
| B1                               | 0.804 |                 |                  |
| B2                               | 0.816 |                 |                  |
| B3                               | 0.821 |                 | 0.843            |
| B4                               | 0.766 |                 |                  |
| B5                               | 0.716 |                 |                  |
| Normative Social’s Influences    | C1    | 0.653           |                  |
| C2                               | 0.651 |                 |                  |
| C3                               | 0.661 |                 | 0.682            |
| C4                               | 0.705 |                 |                  |
| C5                               | 0.653 |                 |                  |
| Attitude Towards Science         | D1    | 0.717           |                  |
| D2                               | 0.718 |                 |                  |
| D3                               | 0.731 |                 | 0.791            |
| D4                               | 0.789 |                 |                  |
| D5                               | 0.746 |                 |                  |
| Self-Efficacy Towards Science    | E1    | 0.785           |                  |
| E2                               | 0.799 |                 |                  |
| E3                               | 0.795 |                 |                  |
| E4                               | 0.795 |                 | 0.879            |
| E5                               | 0.778 |                 |                  |
| E6                               | 0.685 |                 |                  |
| E7                               | 0.698 |                 |                  |

3.3 Pearson Correlation Analysis

Pearson correlation analysis is used to determine whether there is any statistical relationship between two variables of interest before conducting Multiple Linear Regression. Table 4 shows the variables normative social influence has the lowest positive correlation between students’ intention to study science with the value of 0.369. However, the attitude toward science has the highest positive relationship between students’ intention to study science with 0.718 while self-efficacy toward science has a moderate positive relationship between students’ intention to study science with the value of 0.641.

Table 4
Summary of Correlation Analysis

| Variables                        | Normative Social Influences | Attitude Towards Science | Self-Efficacy Toward Science |
|----------------------------------|-----------------------------|--------------------------|----------------------------|
| Students Intention to Study Science | 0.369                       | 0.718                    | 0.641                      |

3.4 Model Adequacy Checking

In multiple linear regression analysis, the error term required to be normally distributed and achieved the homoscedasticity assumption. Figure 1 shows that most of the point lies along the straight line and said to be normally distributed. Figure 2 shows that most of the points are randomly scattered indicates that homoscedasticity is achieved.
3.5 Multicollinearity

Multicollinearity is a phenomenon in which independent variables are correlated with each other. Based on Table 5, there is no multicollinearity problem exist since the values of all tolerance for variable normative social influences is 0.860, attitude toward science and self-efficacy toward science 0.403 which are less than 10. Furthermore, the value of TOL for normative social influences, attitude toward science and self-efficacy toward science are 1.162, 2.480 and 1.162 respectively which are greater than 0.1.

| Variables                      | VIF   | TOL   |
|--------------------------------|-------|-------|
| Normative Social Influences    | 0.860 | 1.162 |
| Attitude Toward Science        | 0.403 | 2.480 |
| Self-Efficacy Toward Science   | 0.403 | 1.162 |

3.6 Multiple linear Regression Analysis

Multiple Linear Regression is used to describe whether there is a relationship between the dependent variable students' intention to study science and dependent variables which attitude toward science, normative social influences, and self-efficacy.

Analysis of Variance (ANOVA)

ANOVA in regression analysis is used to provide information about levels of variability within a regression model and form a basis for test significance. Based on Table 6, the significance value is 0.000 which is less than alpha 0.05 indicates the regression model is significant to explain the dependent variable. The variables normative social influences, attitude towards science, and self-efficacy towards science are valid to explain factors influencing students’ intention to study science in upper secondary school.
Table 6
Summary of ANOVA

| F-value | Significance Value | Finding       |
|---------|-------------------|---------------|
| 134.885 | <0.001            | There exist a significant model |

Overall Model Fit

Overall model fit in the regression describes how well the model fits the data. As in Table 7, the R-Square value indicates that 54.7% of the total variation in students’ intention to study science in upper secondary school is explained by normative social influences, attitude toward science, and self-efficacy towards science while 45.3% of the total variation is explained by other factors.

Table 7
Summary of Overall Model Fit

| R       | R-Square | Adjusted R Square |
|---------|----------|------------------|
| 0.740   | 0.547    | 0.543            |

Direct Relationship

The statistical significance of the independent variables explains the relationship between each of the independent variables and the dependent variable. Based on Table 8, the significance value for normative social influences, attitude towards science, and self-efficacy towards science are 0.004, less than 0.001 and 0.001 respectively, which are less than alpha 0.05. Therefore, there is a significant relationship between students’ intention to study science and normative social influences, attitude towards science, and self-efficacy towards science.

Table 8
Summary of Significance Value for Each Variable

| Direct relationship | Significance Value | Finding |
|---------------------|-------------------|---------|
| There is a significant relationship between attitude towards science and student’s intention to study science | 0.004 | Supported |
| There is a significant relationship between normative social influences and student’s intention to study science | <0.001 | Supported |
| There is a significant relationship between self-efficacy and student’s intention to study science | 0.001 | Supported |

Differences in Students’ Intention among Different Demographic

The study used independent samples t-test to identify the difference in students’ intention to study science stream in upper secondary school among different gender. Table 9 shows the p-value for Levene’s test is 0.782 (p-value>0.05) indicates that equal variances are assumed. The significance value for the T-test is 0.300 (p-value<0.05), which is greater than alpha 0.05 concluded that there are no significant differences between male students and female students towards intention to study science stream in upper secondary school.

Table 9
Test for Equality of Variances and Means

| Levene’s Test | Statement | Significance Value | Finding |
|---------------|-----------|--------------------|---------|
| p=0.782       | Male and female are different in intention to study science stream | 0.300 | Not supported |
One-Way ANOVA is conducted to check whether different parents’ education background has the different intention of students to study science stream. The study also identifies if the different grade of mathematics and science subject has a different intention of students to study science stream. Table 10 shows that the student with different parents’ education background has different intention level to study science stream. The results also indicate students with different grades in mathematics and science subjects lead to different intentions to study science stream in upper secondary school.

Table 10
Result for one-way ANOVA

| Statement                                           | Significance Value | Finding |
|-----------------------------------------------------|--------------------|---------|
| Different parents’ education background has a different intention of students to study science stream | 0.011              | Supported |
| Different grade of mathematics subject has a different intention of students to study science stream | 0.000              | Supported |
| Different grade of science subject has a different intention of students to study science stream | 0.000              | Supported |

4. Discussion

Figure 3 summarizes the result of the analysis in the path diagram. The result shows that the attitude of students towards science is significantly linked to the intention of studying the science stream. If the attitudes of students towards science increase, the intention of the students to pursue the science stream will also increase. The attitude of students was closely related to their intention to study science subjects in high school [9]. The result also found a significant relationship between self-efficacy and the intention of students to study science. This result is consistent with previous research that shows high-science self-efficacy pupils appear to do well in academic tasks and have less worry about science subjects [10]. Students with high self-efficacy have a higher level of confidence that they can manage difficult tasks and be able to complete the task given, and on the contrary, low self-efficacy causes situations of stress and anxiety towards some given task due to the avoidance of a task and poor functioning on a task [11]. Moreover, the normative social influences and the student’s intention to study science are also significantly linked. The previous study did mention that teachers and parents play a significant role in the students' positive attitude to the subject of physics [12]. Peers provide a context that affects the decision-making of students [13]. Family members were also helpful in providing feedback on the scientific knowledge that could help them decide whether or not to study science [14].

Fig. 3. Result summary using a path diagram
The study also found that males and females do not differ in intention to study the science stream and it is consistent with a study conducted by Omondi [15] and Adams et al., [16]. Based on the One-Way ANOVA, the result shows that there is a significant difference between parents’ education background towards students’ intention to study science stream. This is similar to Reardon’s [17] study on “The widening academic achievement gap between the rich and the poor: new evidence and possible explanations” said that the influence of education and parents’ work influence their children’s education. Children with a low background education in parents are less likely to pursue their science and mathematics studies compared to students with a high background education in parents [18]. The result also shows that there is a significant difference between students who always get A’s in mathematics and science towards students’ intention to study science stream.

5. Conclusions

The attitude towards science, normative social influences and self-efficacy had a significant relationship with students’ intention to study science stream in upper secondary. A student with different parents’ education background, grade of mathematics and science subject has a different intention level to study science stream. Students’ gender did not show a significant difference in intention to study science stream. Although this analysis had confirmed the observed relationships between the independent and dependent variables, it is important to determine the results considering the limitations of the research. The current study provided very minimal generalizability as it was considered mostly for students from schools in the rural area of Kota Baharu and not included Chinese School, Maktab Rendah Sains Mara, Sekolah Berasrama Penuh, and some others school in Malaysia. Therefore, to generalize the outcome, future studies are needed to include students from various schools. Besides, there is also a need for future studies to concentrate on other possible factors that could affect students’ intention to study science stream in upper secondary school.

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