INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

www.hrmars.com
ISSN: 2222-6990

Investigating Internal and External Motivational Factors in STEM-Based Foundation Programme Enrolment

Zaidi Yaacob, Marziah Mokhtar, G. Nagamany a/p Govindan, Nazira Zubir & Noor Azlinda Zainal Abidin

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v12-i5/12233 DOI:10.6007/IJARBSS/v12-i5/12233

Received: *16* March 2022*, **Revised:** 20* April 2022*, **Accepted:** 30* April 2022

Published Online: 15 May 2022

In-Text Citation: (Yaacob et al., 2022)

To Cite this Article: Yaacob, Z., Mokhtar, M., Govindan, G. N., Zubir, N., & Abidin, N. A. Z. (2022). Investigating Internal and External Motivational Factors in STEM-Based Foundation Programme Enrolment. *International Journal of Academic Research in Business and Social Sciences. 12(5),* 1831– 1846.

Vol. 12, No. 5, 2022, Pg. 1831– 1846

http://hrmars.com/index.php/pages/detail/IJARBSS	JOURNAL HOMEPAGE

INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES
www.hrmars.com
ISSN: 2222-6990

Investigating Internal and External Motivational Factors in STEM-Based Foundation Programme Enrolment

Zaidi Yaacob[a], Marziah Mokhtar[a], G. Nagamany a/p Govindan[a], Nazira Zubir[b] & Noor Azlinda Zainal Abidin[c]
[a]Universiti Teknologi MARA Cawangan Selangor Kampus Dengkil, 43800 Dengkil, Selangor, Malaysia, [b]Department of Biology, Centre for Foundation Studies (CFS), International Islamic University Malaysia (IIUM), Gambang, Pahang, Malaysia, [c]Centre for Modern Languages, Universiti Pahang Malaysia, 26600 Pekan, Pahang, Malaysia
Email: zaidib2905@uitm.edu.my

Abstract
This study investigated the internal and external motivational factors that compelled Malaysian upper secondary school students to opt to study in the science stream after their PT3 examination but abandon STEM stream to enrol in non- STEM programmes for their foundation level studies. Notable is the fact that, although these students were qualified to continue their studies in STEM fields, they declined to continue their studies in STEM fields. The rejection of STEM fields of studies among these students is mirrored in the decline in the enrolment into STEM-based programmes at foundation levels studies. Studies have shown a similar trend in many countries and there has been a lack of studies on the reasons for this phenomenon among Malaysian students particularly those within the period of transition between secondary school and pre-university programmes. The data collection was carried out using a questionnaire in google form that was distributed online, in which the respondents answered all items on a five-point Likert-scale. The questionnaire was adapted from the report on the IRIS (Interest and Recruitment in Science) and the data was analysed using the Statistical Package for Social Sciences Version 27 to deduce the relationships between opting for and rejection of STEM courses among the population of students under study, as proposed by the research model. The findings of the study indicate the motivational factors that influenced the student's choices for and against STEM to differ between the two contexts of study namely the post PMR and post SPM.
Keywords: STEM, Internal Motivation, External Motivation, Foundation Studies

Introduction

Science and engineering courses at institutions of higher learning are seen to be challenging for students to pursue. Due to the perception that these courses are complex, the preference for these courses are observed to be the least favoured by the students. The Science, Technology, Engineering and Mathematics or known as STEM based programmes at degree level in the institutions of higher learning, for example, are facing an inadequate number of students to fill the allocated quota. Goy et al (2017) stated that when young students apply for placement in universities, some qualified students irrespective of gender switch to non-STEM disciplines as their major. Potvin and Hasni (2014) reported that there is a decline in interest in Science and Technology (S&T) which is a globally accepted phenomenon. Falk et al (2015) summed up that there is a dramatic decline in youth interest in STEM during adolescence in the USA and internationally. The decline being the immediate problem faced by institutions of higher learning, would lead to a long-term problem by which the country will face a severe shortage of experts in the field of STEM that would in turn affect the status, development, and prosperity of the country. The contribution of the nation in the aspects of invention and innovation in the fields of medical science and technology would be significantly reduced. As a result, the nation would cease to possess the competitive edge in the said fields and would no longer be a partner and contributor of a parallel stature with fully developed nations. Previous studies from all around the world have reported that the declining numbers of intakes in these programmes are worrying as it might affect the future generation and the development of our nation. In developing countries, the number of intakes has also shown a decline. Anito, Morales and Palisoc (2019) cited in Rafanan, De Guzman and Rogayan (2020) found that there are insufficient STEM graduates in the Philippines. Similarly, in Nigeria, Aina and Ayodele (2018) reported that student enrolment for science education in colleges of education reduces every year.

A similar trend is observable among pre university and tertiary level students in Malaysia where the number of students applying to enrol in science courses at pre university level has been on a drastic decline in recent years and requires immediate remedial actions. Noteworthy is the fact that a significant number of students who underwent two years of upper secondary education in the science stream have opted to pursue their pre tertiary level studies in the arts and humanities or social science courses. Table 1 indicates the number of applicants who applied and the number of applicants who were eligible to pursue STEM based courses between the years 2010-2017.

Table 1
Statistics of SPM leavers' application and eligibility to Public Universities (Science and Arts)

	2010/2011	**2011/2012**	**2012/2013**	**2013/2014**	**2014/2015**	**2015/2016**	**2016/2017**
Apply to science programme	105,852	102,237	101,943	105,123	100,855	100,551	96,601
Apply to Arts Programme	75,826	111,779	112,485	112,570	107,006	99,951	84,216
Eligible to do Science	99,452	96,452	97,260	100,038	96,962	90,968	92,946
Eligible to do Arts	63,767	88,532	92,699	91,256	89,295	69,558	70,494

Source:http://ic.umt.edu.my/wp-content/uploads/sites/90/2016/07/Ideas-and-Ideals-on-STEM-v5_DATO-ASMA-Keynote.pdf

There has been an insufficient number of studies in Malaysia that examined the reasons for students opting out to social sciences and humanities. Jayarajah et al (2014) in their review of Malaysian STEM education research listed out the topics of interest which were limited to teaching tools, learning strategies, gender inequality and assessment. In another research, Ismail et al (2019) studied the issues and challenges in empowering STEM on science teachers in Malaysian schools. Studies on reasons for Malaysian students not opting for STEM programmes at undergraduate level have also been conducted. The data were obtained by Phang et al. (2014) through an extensive analysis of Masters and PhD theses produced by Malaysian public universities during a ten-year period to explore factors that lead to the decrease in the number of STEM stream students. The current study, however, taking into consideration the mindset of the students throughout their post PT3 until their foundation level studies, focuses on post 'Pentaksiran Tingkatan Tiga' (PT3) students who opted for STEM and later as post 'Sijil Pelajaran Malaysia' (SPM) students chose to abandon STEM courses to continue in non-STEM programmes although they are qualified to pursue higher education in STEM. PT3 is the national assessment administered centrally to the secondary three students while the SPM examination is the national main examination, administered also centrally at the end of secondary education.
Records have shown that the number of students enrolled into science-based programmes in the various pre-degree programmes (Foundation, Matriculation, STPM) managed by the Ministry of Higher Learning and Ministry of Education Malaysia has been in a declining mode over the past 5 years. Universiti Teknologi MARA (UiTM) is experiencing a similar trend where, the targeted numbers of 2300 for Foundation in Science and 1200 for Foundation in Engineering have not been achieved. It is also reported that the number of students registered in the science stream at SPM level is also not encouraging. It is a well-known fact that the schools provide qualified post-SPM students to enrol at the tertiary level education programmes, Therefore, the scope of this study is centred on post PT3 students who later as post SPM students choose to reject STEM education.

The objectives of the study are to:
i. examine the internal and external motivational factors that impacted the post PT3 students to choose STEM based foundation programmes2. examine the internal and external motivational factors that impacted the post SPM students to abandon STEM courses and continue in non-STEM programmes3 to compare and analyse internal and external motivations between science and engineering students.

Literature Review

In 1962, a committee under the Malaysian Educational Planning and Research Division was formed to study the direction of human resource development (Bahagian Perancangan dan Penyelidikan Dasar Pendidikan (BPPDP), 1989). In 1967, Higher Education Planning Board introduced the enrolment policy of 60% Science: 40% Arts for the form four and form five students and this policy was first implemented in 1970. It was introduced to increase the number of students in the science stream which is to fulfil the future demands of a developing country (Edy et al., 2017). Greater number of students in the Science stream at the school level means greater supply to the institution of higher learning.
However, the intended ratio has never been achieved as only one third of all upper secondary school students in Malaysia take up STEM subjects (Khazanah Research Institute, 2018). In 2011, the percentage of form three students who met the requirements to further their

studies in science at the upper secondary level but chose not to do so has increased to approximately 15% (Ministry of Education Malaysia, 2013).

Beginning from 1980, the education system was restructured, reformulated, and redesigned so that the science curriculum would be constantly dynamic enough to compete with advanced countries (Fazilah et al., 2018). The National Science, Technology and Innovation Policy was introduced by the Ministry of Education in 1986 to support the policy of 60:40 ratio of science students to arts students. The Seventh Malaysia Plan (1996-2000) placed a strong emphasis on the increase in student enrolment at secondary school level in the science, engineering, or technology related streams, so as to increase skilled labour 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, which outlined 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.

Based on the study carried out by Yoon and Strobel (2017) in Texas, USA, the enrolment rates of the STEM related courses had wide variations by types of courses, gender, and race/ ethnicity. Overall, student enrolment rates increased across time in selective and advanced mathematics, science, and CTE-STEM courses, which indicates a promising prospect for the STEM pipeline. However, there were exceptions in several courses with gender and racial/ethnic differences in the trends.

Jaremus et. al (2019) in their study in the state of New South Wales (NSW), Australia confirmed declining enrolment in digital technologies and mathematics, especially for girls. In contrast, enrolment in almost all NSW science courses has been increasing since 2001, at a rate faster than many non-STEM courses. Declining enrolment in advanced mathematics was less substantial nationally, and participation in intermediate level mathematics increased in 2017 for the first time since 1991. Despite these promising signs, the researchers' analysis also shows that students are selecting fewer challenging courses, while one in four girls in NSW currently undertakes no mathematics in Year 12.

These findings in the USA and Australia are significant since the rates of enrolment into similar STEM courses in Malaysia is contrary to the trend in the USA and Australia which is a cause for concern and is the basis for the current study. A study by Ramli and Talib (2017) showed that teachers' understanding in implementing STEM is insufficient. This was due to lack of information from the authorities.

Research Framework

Figure 1 represents the research framework of the study that illustrates the independent variables which include (1) selection of science stream after PT3 and (2) selection of non-STEM based foundation programmes after SPM. The dependent variables are internal and external motivational factors for both situations.

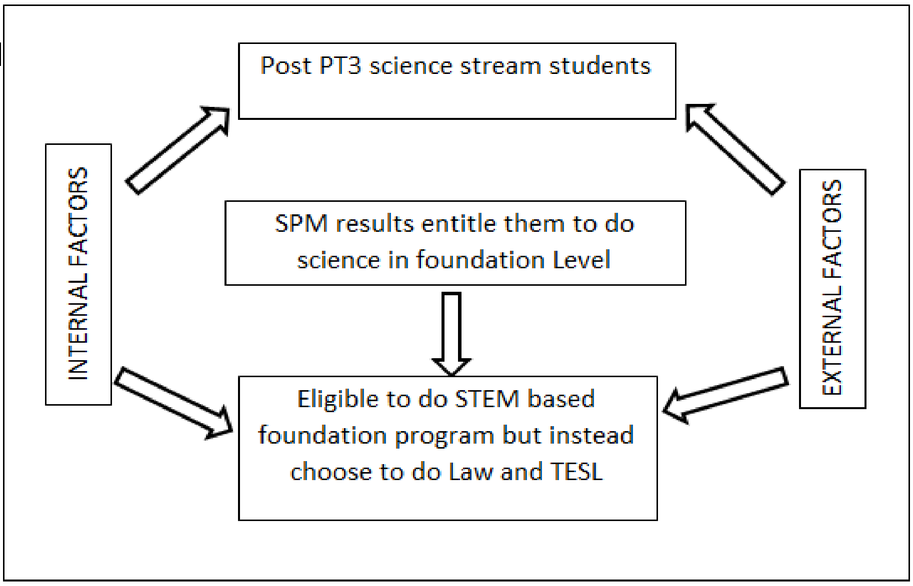

Figure 1: Research Framework

Methodology

i) Methodology Research Design

This research applied the Statistical Package for Social Sciences Version 27 to analyse the relationships proposed by the research model. The data collection was through a questionnaire in google form that was distributed online in which the respondents answered all items on a five-point Likert-scales ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was adapted from the report by Henriksen et al (2015) on the IRIS (Interest and Recruitment in Science) project which sought to achieve a better understanding of how young people evaluate STEM as an option when making their educational choices.

ii) Sample and Data Selection

The study selected students from UiTM Centre of Foundation Studies and Centre for Foundation Studies (CFS), Islamic International University of Malaysia (IIUM) respectively who are currently undertaking non-science foundation programmes as samples to represent respondents. There are two important criteria to be considered before these students were chosen as respondents. The first criterion was, they must be from science stream during the upper secondary level. The respondents were directed to a Web-based survey to answer the questionnaire. Secondly, the selected students should be eligible to be accepted into Foundation in Science or Foundation in Engineering respectively.

iii) Survey Instrument and Measurement

This study adopted a questionnaire survey method to investigate the internal and external factors that cause students not to opt to further their studies in STEM based areas. This study used 53 items to assess the internal and external factors that influence students. Prior to the distribution of questionnaires, a pilot test was carried out to see whether the questions were clear, and the language was comprehensible as well as to record the time taken by the respondents to answer the questionnaire. Overall, 650 questionnaires were distributed and only 588 usable questionnaires were used for data analysis.

The questionnaire was designed to collect the respondents' demographic information such as gender, student identification, location of home, institution, department or programme, type of school and result obtained in SPM. The questionnaire was divided into two parts in which part A consists of items related to the reasons why students had chosen science stream when they were in upper secondary. The focus of this section is to know more about the students' decision to enrol in the science stream and the factors that influenced their choice. Besides that, section B contains items that are related to the reasons why students did not choose the STEM courses for their pre-university studies after SPM.

iv) Normality, Reliability and T-test

Normality test was conducted to determine whether the data set is well-modelled and has been drawn from a normally distributed population. Reliability test was also conducted to ensure the consistency of the results in research. Reliability is important since it measures the degree to which a research method/the construct being measured produces stable and consistent results. T-test has been conducted to determine if there were any significant differences between the means of two groups.

Result and Discussion

i) Respondents’ Demographic Characteristics

Table 2 indicates the respondents’ demographic characteristics that have been outlined by their profile and classification. There are 588 students’ profiles collected for this research. Majority of the respondents at 76.6% were female and 23.4% were male respondents. 71.4% of the respondents were located in urban areas while only 28.6% were located in rural areas. 84.3% of the respondents were from UiTM whereas 15.7% were from IIUM.

Table 2

Respondents’ Demographic Characteristics

Demographic	**Characteristics**	**Frequency**	**%**
Gender	Male	152	23.4
	Female	498	76.6
Location of home	Urban	464	71.4
	Rural	186	28.6
Institution	UiTM	548	84.3
	IIUM	102	15.7
Type of school	Day school	340	52.3
	MRSM	82	12.6
	SBP	137	21.1
	Religious school	78	12.0
	Technical/vocational	13	2.0

Note: MARA Junior Science College (MRSM)
Fully Residential School (SBP)

The type of schools that the respondents attended were divided into five categories. 52.3% of the students went to day school, 12.6% were from MRSM, 21.1% from SBP and 12% from religious schools. The lowest number or 2% were from technical or vocational schools.

ii) Normality Test

Normality test was run to ensure the normality of data distribution and the results in Table 3 show that the value of skewness and kurtosis is within +/- 1.96. Thus, the data for all the variables were normally distributed.

Table 3
Normality Test

Items	Skewness	Kurtosis
Average post PT3 internal motivation for joining STEM stream	-0.335	0.234
Average post PT3 external motivation for joining STEM stream	-0.220	-0.315
Average post SPM internal motivation for leaving STEM stream	-0.396	-0.086
Average post SPM external motivation for leaving STEM stream	0.063	0.102

iii) Reliability Test

Table 4 shows the results of the reliability test that was conducted on the items used to measure the internal and external motivation on the decision of the post PT3 students to enrol in the STEM stream. It also measured items on the internal and external motivation of those students who choose the non-STEM-based foundation programmes. The Cronbach's Alpha value is 0.782 for the items that measured the internal motivation and 0.625 for the items that measured external motivation of post PT3 students in enrolling in the STEM stream respectively. Both values are above 0.5 indicating the items tested are reliable.

Similarly, the Cronbach's Alpha value for post SPM internal motivation and external motivation to leave STEM stream are 0.635 and 0.673 respectively which also indicates the items used were reliable. According to Babbie (1992), Cronbach Alpha values of 0.30-0.69 are considered moderate while Sekaran (2003) concluded that Cronbach Alpha values must be greater than 0.5.

Table 4
Reliability Test

Items	Cronbach's Alpha	No of items
Post PT3 internal motivation for joining STEM stream	0.782	8
Post PT3 external motivation for joining STEM stream	0.675	5
Post SPM internal motivation for leaving STEM stream	0.635	9
Post SPM external motivation for leaving STEM stream	0.673	9
All the selected items	0.777	31

iv) Descriptive Analysis

Table 5 shows the items to test the construct of post PT3 internal and external motivation in choosing STEM streams for their upper secondary level. There are eight items for post PT3 internal motivation and five items for post PT3 external motivation.

Table 5
Post PT3 internal and external items

Post PT3 internal motivation	**N**	**Mean**	**Std Deviation**	**Rank**
Sure to do well in science	588	3.54	0.957	4
Enjoy science because they are interesting	588	3.84	0.982	3
Easier to do science subjects	588	2.78	1.126	8
Did well in science examination	588	3.25	1.053	6
Wanted to be respected in school and	588	3.26	1.343	5
society	588	4.23	0.979	1
Wanted a good job	588	4.02	1.037	2
Studying science will help me in life	588	2.91	1.196	7
I will be rich				
Post PT3 external motivation				
Parents wanted me to do science	588	3.26	1.350	4
Advice from teacher/counsellor	588	3.38	1.292	3
Influence of social media	588	2.85	1.288	5
Influence of friends	588	3.46	1.280	2
Support from school and government	588	3.47	1.187	1

The results show there are three compelling internal motivational factors which are firstly to secure a good job, secondly, the knowledge of science would help the students in life and thirdly, science as an interesting subject for the students, with the mean values of 4.23, 4.02 and 3.84 respectively. Notably, the perception that science subjects are easier to learn, with the mean value of 2.78 ranked last, indicating that the students were aware of the complexities and challenges in learning STEM subjects. Holmegaard et al (2014) in his research on the Danish post-secondary students' choice to either opt for science or otherwise, found that their choice had to do with the prospect of an interesting future. Our result is comparable to the findings of DeWitt et al (2019) on the reason for students to take up Physics at A-level. They discovered that the most popular reasons chosen were firstly the usefulness of the subject for the students' job prospects or career, followed by the enjoyment of the subject and finally the students believe that good performance in the subject would help the students enrol at the university. Maltase and Tai (2011) indicated that majority of the students choose STEM during high school due to their interest in mathematics and science rather than their performance in the subjects. Feelings of belonging and interest in STEM contribute to a student's STEM identity or the degree to which someone perceives STEM to be a key component of their sense of self (Kim & Sinatra, 2018; Robnett et al., 2018). Another academic mindset that can influence STEM participation is whether the students view intelligence as fixed and something they cannot change (fixed mindset) or at the other end of the spectrum, view it as something that can be developed over time with effort and dedication (a growth mindset).

As for the most significant external motivation factors for post PT3 students, it was found that support from school and government has the highest ranking at mean value of 3.47 followed by influence of friends with the mean value of 3.46 and thirdly advice from teacher or counsellor with mean value of 3.38. On the other hand, the influence of social media with a mean value of 2.85 has the least impact. Vedder-Weiss and Fortus (2012) found the motivation to study science is not only influenced by oneself but also by the peers' goal orientation. Nugent et al (2015) further emphasized the role of peers in the students' choice of studying STEM. They found that educators, peers, and family were the factors that influenced youths' interest in STEM, which in turn predicted their STEM self-efficacy and career outcome expectancy. Additionally, Staus et al. (2020) in their research that compared the attitude of STEM-interested and STEM-disinterested students stated that participation in out-of-school STEM activities and positive parental attitudes towards science were significant predictors of persistent STEM interest.

In several other studies, such as that conducted by Kutnick et al (2020); Dou et al (2020) found non-school factors that influenced students' STEM interest and efficacy. A study conducted by Kutnick et al. on 24 secondary school students in Hong Kong revealed that students' engineering aspirations were largely supported through personal pathways. They were influenced by the experience offered by family and friends rather than the school-based ecosystem. e/STM efficacy was more likely to be developed outside of school, noting a lack of continuity or direction within schools. This is further affirmed by Dou et al.'s (2020) exploration of the connection between childhood informal STEM learning experiences of Hispanic or Latino students at a Hispanic Serving Institution, their identification with STEM, and the factors that contribute to their STEM identity (recognition as a STEM person and interest in STEM). Results demonstrated science talk or discussion with friends and family was the only informal learning experience associated with students' STEM identity or the factors contributing to STEM identity development. Moreover, talking with close family about science was more relevant to their identity formation than talking with extended family or friends.

Table 6 shows the items to test the construct of post SPM internal and external motivation in leaving STEM streams for their foundation programmes. There are nine items for post SPM internal motivation and eight items for post SPM external motivation.

Table 6
Post SPM internal and external items

Post SPM internal motivation	**N**	**Mean**	**Std Deviation**	**Rank**
Previous science results not encouraging	588	3.64	1.338	7
Lack of interest in lab work	588	3.33	1.437	9
Can't see relevance of subjects	588	4.30	0.754	4
Felt course suits to the kind of person I am	588	4.16	0.928	5
I am confident that I am good at the subjects	588	3.63	0.873	8
I am very motivated to study	588	3.91	0.951	6
Getting a secure job	588	4.74	0.571	1
Opportunities to earn high income	588	4.54	0.745	2
Able to make money after graduate	588	4.40	0.810	3
Post SPM external motivation				
No clear feedback from teachers	588	2.56	1.137	7
No clear explanation from teachers	588	2.52	1.153	8
Lesson not engaging	588	2.78	1.233	6
Good learning facilities of the universities	588	4.24	0.852	3
Institution provides enough support	588	3.89	0.959	4
Government provides opportunities and support	588	3.84	1.030	5
Working with something that is important for society	588	4.56	0.723	2
Helping others	588	4.66	0.631	1

The results show there are three cogent internal motivational factors which are firstly to get a secure job, secondly, the opportunity to earn high income and thirdly, the ability to make money after graduation with the mean values of 4.74, 4.54 and 4.40 respectively. Notably, the lack of interest in lab work with the mean value of 3.33 was ranked last, indicating the absence of interest in science subjects. Future career and change of self-identity are the reasons for students to leave the STEM stream. Holmegaard et al (2014) listed out three perspectives of STEM related careers in the eyes of the students who plan not to choose science; STEM jobs are perceived as a lonely career path; STEM professionals are the worker bees who have no power to control their job and finally the inability to see a job prospect.
As for the most significant external motivation factors for post SPM students, it was found that helping others has the highest ranking at mean value of 4.66 followed by working with something that is important for the society with the mean value of 4.56 and thirdly good learning facilities with mean value of 4.24. On the other hand, no clear explanation from teachers with a mean value of 2.52 has the least impact.
To determine if there were any significant differences between the motivation for the students to join the STEM stream after PT3 and later leave the STEM stream after SPM, paired ttest were conducted. Since the STEM foundation programme consists of Science and Engineering, samples were taken from those programmes to investigate the internal and external motivation for students.

v) Paired ttest for internal and external motivation for students eligible to do science
There were 165 respondents that are eligible to do Foundation in Science who are currently doing the non STEM foundation programme
a) Paired t-test for internal motivation for students eligible to do foundation in science

Table 7
Paired t-test for internal motivation students (science)

	Mean	**Std. Deviation**	**Std. Error Mean**	**t**	**df**	**Sign (2-tailed)**
Average post PT3 & SPM internal motivation	-0.39907	0.87858	0.06840	-5.835	164	0.000

At 95% Confidence Interval of the Difference

The hypotheses for internal motivation for post PT3 science students are as below:
H_0: There is no difference in the average post PT3 and post SPM internal motivation
H_1: There is difference in the average post PT3 and SPM internal motivation

For those respondents who are eligible to take up Foundation in Science, the paired t-test (-5.835) in Table 7 shows that the difference in their internal motivation in joining STEM stream after PT3 and leaving the STEM stream after SPM is significant and therefore the null hypothesis is rejected. Since the minus sign can be ignored when comparing the two t-values, the computed value is 5.835. Hence, at the 95% confidence interval there is a difference between internal motivation among post PT3 students for choosing science stream and post SPM students for rejecting STEM courses although they are eligible to do science foundation.

b) Paired t-test for external motivation for those eligible to do foundation in science

Table 8
Paired t-test for external motivations (science)

	Mean	Std. Deviation	Std. Error Mean	t	df	Sign (2-tailed)
Average post PT3 & SPM external motivation	-0.24337	0.95376	0.07425	-3.278	164	0.000

At 95% Confidence Interval of the Difference

The hypotheses for external motivation for post PT3 science students are as below:

H_0: There is no difference in the average post PT3 and SPM external motivation
H_1: There is difference in the average post PT3 and SPM external motivation

As for the external motivation, paired t-test (-3.278) in Table 8 shows that the difference in their external motivation to join STEM stream after PT3 and leave STEM stream after SPM is significant and therefore the null hypothesis is rejected. Hence at 95% confidence interval there is a difference between external motivation for post PT3 and SPM students that are eligible to do science foundation. However, the computed t-value is 3.278 (since the minus sign can be ignored) is smaller for external motivation between post PT3 and SPM indicating that the motivational factors are almost similar.

vi) Paired t-test for internal and external motivation for students eligible to do engineering
There were 219 respondents who were eligible to take up Foundation in Engineering and were used for the t-test to compare their internal and external motivation to join the STEM stream after PT3 and leave the STEM stream after SPM.
a) Paired t- test for internal motivation for those eligible to do foundation in engineering

Table 9
Paired t-test for internal motivations (engineering)

	Mean	Std. Deviation	Std. Error Mean	t	df	Sign (2-tailed)
Average post PT3 & SPM internal motivation	-0.40994	0.86116	0.05819	-7.045	218	0.000

At 95% Confidence Interval of the Difference
The hypotheses for internal motivation for post PT3 engineering students are as below:

H_0: There is no difference in the average post PT3 and SPM internal motivation
H_1: There is difference in the average post PT3 and SPM internal motivation

The paired t-test (-4.076) in Table 9 shows that their internal motivation for joining the STEM stream and leaving the STEM stream after SPM is significant and therefore the null hypothesis is rejected. Hence, at 95% confidence interval there is a difference between internal motivation for post PT3 and post SPM students that are eligible to do foundation in engineering.

Furthermore, the value of paired t-tests for engineering programme is higher due to lower minimum entry requirements compared to science. The compelling factors for post PT3 to choose STEM based courses and post SPM students to reject STEM are the internal motivation factors. This is due to higher t-value for the internal motivation factors as compared to external motivational factors.

b) Paired t- test for external motivation to do foundation in engineering

Table 10
Paired t-test for external motivations (engineering)

	Mean	**Std. Deviation**	**Std. Error Mean**	**t**	**df**	**Sign (2-tailed)**
Average post PT3 & SPM external motivation	-0.25063	0.90995	0.06149	-4.076	218	0.000

At 95% Confidence Interval of the Difference
The hypotheses for external motivation for post PT3 engineering students are as below:

H_0: There is no difference in the average post PT3 and SPM external motivation
H_1: There is difference in the average post PT3 and SPM external motivation

The paired t-test (-7.045) in Table 10 shows that their external motivation for joining the STEM stream after PT3 and leaving the STEM stream after SPM is significant and therefore the null hypothesis is rejected. Hence, at 95% confidence interval there is a difference between external motivation for post PT3 and post SPM students that are eligible to do engineering foundation.

DeWitt et al (2019) stated that self-factors such as cultural arbitrariness of the subject (eg: difficulty, masculine) play an important role in determining the persistence of students in the STEM academic path. Most of the respondents of this survey are girls who are found to think that STEM subjects are masculine which is in line with the findings of Holmegaard et al., 2014 and Jeremus et al., 2019. STEM subjects are admitted to being perceived as demanding and challenging. Holmegaard et al. (2014) also pointed out that students' perception on science education changes as they change their interest from science to other fields when they are exposed to new career prospects. The students might perceive STEM as not suitable for them due to their two years' experience preparing themselves for SPM. Goy et al. (2017) found that the reason to which students' dropout from their initial STEM fields could be a loss to science endeavour. Fazilah (2021) emphasized that the factors that lead to persistent interest in science include the right attitude towards STEM She also found that students were less interested in STEM education as they were not really exposed to the potential careers in STEM.

Conclusion

To sum up, the study has shown there are three compelling internal motivational factors for post PT3 students to opt for STEM which are, to secure a good job, the knowledge of science would help the students in life and science is an interesting subject for the students. As for the most significant external motivation factors for the same group of students, it was found that support from school and government, influence of friends and advice from teacher or counsellor have encouraged them to opt for STEM.

Getting a secure job, the opportunity to earn high income and to be able to make money after graduation are the three prominent internal motivational factors which influenced post SPM students to leave STEM. While helping others, working with something that is important for the society and good learning facilities were the most significant external motivation factors for this group.

The statistical inference showed both internal and external motivational factors for the students to join STEM stream after their PT3 but later leave for non-STEM foundation programmes are significantly different either for those who are eligible to take up Foundation in Science or Foundation in Engineering. As a simple analogy they have different reasons to choose an apple but later change their mind in choosing an orange.

Acknowledgements

The authors would like to extend our sincerest gratitude to IIUM-UMP-UiTM Research Collaboration Grant 2020 for providing funding to support this research and publication. Special thanks to the UiTM Centre of Foundation Studies and IIUM Centre of Foundation Studies for allowing us to use their student as the respondents.

References

Aina, J. K., & Ayodele, M. O. (2018) The Decline in Science Students’ Enrolment in Nigerian Colleges of Education: Causes and Remedies. International Journal of Education and Practice. 6(4) 167-178

Babbie, E. (1992). The Practice of Social Research. California: Wadsworth Publishing Company.

Borrego, M., & Bernhard, J. (2011). The Emergence of Engineering Education Research as an Internationally Connected Field of Inquiry. Journal of Engineering Education, 100(1), 14-47.

BPPDP. (1989). Dasar Pendidikan Berasaskan Sains dan Teknologi: Ke arah Pencapaian Nisbah Penyertaan 60;40 Sains: Sastera. Kuala Lumpur: BPPDP

DeWitt, J., Archer, L., and Moote, J. (2019). 15/16-Year-Old Students’ Reason for Choosing and Not Choosing Physics at A Level. International Journal of Science and Mathematics Education 17: 1071-1087

Dou, R., & Cian, H. (2020). The Relevance of Childhood Science Talk as a Proxy for College Students’ STEM Identity at a Hispanic Serving Institution. Research in Science Education, 1-13.

Economic Planning Unit of the Prime Minister's Department. (1996). Seventh Malaysia Plan (1996-2000)

Edy, H., Ihsan, I., & Lilia, H. (2017). STEM Education in Malaysia: Policy, Trajectories, and Initiatives. Science and Technology Trends: Policy Trajectories and Initiatives in STEM Education, 122-133

Evans, C. A., Chen, R., & Hudes, R. P. (2020). Understanding Determinants for STEM Major Choice Among Students Beginning Community College. Community College Review, 48(3), 227-251.

Falk, J. H., Status, N., Dierking, L. D., Penuel, W., Wyld, J., & Bailey, D. (2015) Understanding Youth STEM Interest Pathway Within a Single Community: the Synergies Project. International Journal of Science Education, Part B, DOI:10.1080/21548455.2015.1093670

Fazilah, R. (2021) Exploring Crucial Factors of an Interest in STEM Career Model among Secondary School Students. International Journal of Instruction. 14(2) 386-404

Fazilah, R., Othman, T., Umi, K. A. M., & Siti, A. H. (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) 962-976 Getting Formal Education Retrieved from https://www.malaysia.gov.my/portal/content/29552

Goy, S. W., Wong, Y. L., Low, W. Y., Noor, S. N. M., Fazlikhalaf, Z., Onyeheno, A. G., Daniel, E., Azizan, S. A., Hasbullah, M., & Uzoigwe, A. G. (2017). Swimming Against the Tide in STEM Education and Gender Equality: a Problem of Recruitment or Retention in Malaysia. Studies in Higher Education. DOI:10.1080/03075079.2016.1277383

Henriksen, E. K., Dillon, J., & Ryder, J. (2015) Understanding Student Participation and Choice in Science and Technology Education. ISBN 978-94-007-7792-7 ISBN 978-94-007-7793-4 (eBook) DOI 10.1007/978-94-007-7793-4 Springer Dordrecht Heidelberg New York London

Holmegaard, H. T., Madsen, L. M., and Ulriksen, L. (2014) To Choose or not to Choose Science: Construction of Desirable Identities Among Young People Considering a STEM Higher Education Programme. International Journal of Science Education 36(2) 186-215

Ismail, M. H., Salleh, M. F. M. & Nasir, N. A. M. (2019). The Issues and Challenges in Empowering STEM on Science Teachers in Malaysian Secondary Schools. International Journal of Academic Research in Business and Social Sciences, 9(3) 360-375

Jaremus, F., Gore, J., Fray, L., & Prieto-Rodriguez, E. (2019). Senior Secondary Student Participation in STEM: Beyond National Statistics. Mathematics Education Research Journal, 31(2), 151–173. https://doi.org/10.1007/s13394-018-0247-5

Jayarajah, K., Saat, R. M., & Rauf, R. A. A. (2014). A Review of Science, Technology, Engineering & Mathematics (STEM) Education from 1999-2013: A Malaysian Perspective. Eurasia Journal of Mathematics, Science and Technology Education 10(3) 155-163

Kementerian Pendidikan Tinggi. (2018) Ideas and Ideals of STEM Education. Retrieved from http://stem.umt.edu.my/wp-content/uploads/sites/90/2016/07/Ideas-and-Ideals-on-STEM-v5_DATO-ASMA-Keynote.pdf

Khazanah Research Institute. (2018). The School-to-Work Transition of Young Malaysians. Kuala Lumpur: Khazanah Research Institute

Kim, A. Y., & Sinatra, G. M. (2018). Science Identity Development: An Interactionist Approach. International Journal of STEM Education, 5(1), 1-6.

Kricorian, K., Seu, M., Lopez, D., Ureta, E., & Equils, O. (2020). Factors Influencing Participation of Underrepresented Students in STEM Fields: matched mentors and mindsets. International Journal of STEM Education, 7(1), 1-9.

Kutnick, P., Lee, B. P. Y., Chan, R. Y. Y., & Chan, C. K. Y. (2020). Students' Engineering Experience and Aspirations Within STEM Education in Hong Kong Secondary Schools. International Journal of Educational Research, 103, 101610.

Maltese, A. V., & Tai, R. H. (2011). Pipeline Persistence: Examining the Association of Educational Experiences with Earned Degrees in STEM Among US Students. Science Education, 95(5), 877-907.

Ministry of Education Malaysia. (2013) Malaysia Education Blueprint 2013-2025 (preschool to Post-Secondary Education). Putrajaya: Ministry of Education Malaysia

Nugent, G., Barker, B., Welch, G., Grandgenett, N., Wu, C. R., and Nelson, C. (2015) A Model of Factors Contributing to STEM Learning and Career Orientation. International Journal of Science Education. 1-22

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes Towards Science: A Review of the Literature and its Implications. International Journal of Science Education, 25(9), 1049-1079.

Phang, F. A., Abu, M. S., Ali, M. B., & Salleh, S. (2014) Faktor Penyumbang Kepada Kemerosotan Penyertaan Pelajar dalam Aliran Sains: Satu Analisis Sorotan Tesis. Sains Humanika. 2(4) 63-71

Potvin, P., & Hasni, A. (2014) Interest, Motivation and Attitudes Towards Science and Technology at K-12 Levels: a Systematic Review of 12 years of Educational Research. Studies in Science Education, 50(1) 85-129

Rafanan, R. J. L., De Guzman, C. Y., & Rogayan, J. D. V. (2020) Pursuing STEM Careers: Perspective of Senior High School Students. Participatory Educational Research. 7(3) 38-58

Ramli, N. F., & Talib, O. (2017) Can Education Institution Implement STEM? From Malaysian Teacher’s View. International Journal of Academic Research in Business and Social Sciences. 7(3)721-732

Rattan, A., Savani, K., Chugh, D., & Dweck, C. S. (2015). Leveraging Mindsets to Promote Academic Achievement: Policy Recommendations. Perspectives on Psychological Science, 10(6), 721-726.

Robnett, R. D., Nelson, P. A., Zurbriggen, E. L., Crosby, F. J., & Chemers, M. M. (2018). Research Mentoring and Scientist Identity: Insights from Undergraduates and their Mentors. International Journal of STEM education, 5(1), 1-14.

Sekaran, U. (2003). Research Methods for Business: A Skill Building Approach (2nd Edition). New York: John Wiley & Sons, Inc.

Staus, N. L., Falk, J. H., Penuel, W., Dierking, L., Wyld, J., and Bailey, D. (2020) Interested, Disinterested, or Neutral: Exploring STEM Interest Profiles and Pathways in A Low-Income Urban Community. EURASIA Journal of Mathematics, Science and Technology Education. 16(6)

Vedder-Weiss, D., and Fortus, D. (2012) Adolescents’ Declining Motivation to Learn Science: A Follow-up Study. Journal of Research in Science Teaching

Yoon, S. Y., & Strobel, J. (2017). Trends in Texas High School Student Enrollment in Mathematics, Science, and CTE-STEM courses. International Journal of STEM Education, 4(1). https://doi.org/10.1186/s40594-017-0063-6