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FACTORS AFFECTING STUDENTS' PERSISTENCE TO ENROL IN STEM EDUCATION

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ABSTRACT

Science, technology, engineering, and mathematics (STEM) education is vital in producing a highly skilled and knowledgeable Malaysian workforce to meet the demand for its industries. Malaysia aims to be a developed country that initiates the technology itself instead of just being a user. Despite this ambitious goal, STEM education in Malaysia faces challenges due to low enrolment in STEM elective subjects. This declining trend is transparent in secondary school since students are given a choice to enrol in STEM education or any other stream provided. While STEM elective subjects are viewed as tough and difficult, there is a tendency that students may decide to change to another stream after they have enrolled in STEM education. Due to this, the study focused on what factors may contribute to students' persistence in continuing to enrol in STEM education until they finish secondary school. Therefore, this study has specified three factors to be studied, which are self-efficacy, socioeconomic status (SES), and students' academic achievement towards their persistence to enrol in STEM education. Form 4 students who took STEM elective subjects in Sekolah Menengah Kebangsaan (SMK) Dang Anum have been selected as the population understudied, and 80 respondents were selected to answer a series of questionnaires that comprised 40 questions in total. All the data was collected within a one-week time frame and further analyses through the statistical software Statistical Package for Social Science (SPSS) by using Spearman's correlation test to find the correlation between each independent variable and the dependent variable under study. It was found that there is a positive relationship between self-efficacy, socioeconomic status (SES), academic achievement, and students' persistence to enrol in STEM education.

Keywords: *Academic Achievement, Self-Efficacy, Socioeconomic Status (SES), STEM Education.*

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1. Introduction

Malaysia, like any other developing country, needs expertise in engineering, science, medicine, and any other technological domains to meet the challenges and demands of a STEM-driven economy. The implementation of the curriculum for upper secondary school, as in 2020, allows students to select elective subjects from these electives; Science, Technology, Engineering, Mathematics (STEM) elective, Language elective, Islamic Studies elective, Humanities and Literature elective. A maximum of five elective subjects from the combination of electives may be chosen. However, the students will be screened according to their achievement in Pentaksiran Tingkatan 3 (PT3), Psychometric Test, and Pentaksiran Bilik Darjah (PBD) before they enrol in the elective subjects, especially those who are interested in STEM elective subjects.

In fact, there are three STEM elective packages: pure science, applied science and technology, and vocational subjects which students can enrol in after the screening process end. Even though there is an unclear rule set by the Ministry of Education regarding the trial period, most secondary schools in Malaysia have imposed a three-month trial period to see if the students can follow the stream. Within this duration, students are given the opportunity to change to a non-STEM major if they find that STEM education is not for them. To gain interest in STEAM subjects, especially mathematics, Sajidah (2024) studied the relationship between game-based learning and mathematics achievement. It shows that game-based learning does affect students' achievement in mathematics.

There are some factors that may correlate to students' persistence to continue enrolling in STEM education even after the trial period has ended. The factors under examination are self–efficacy, socioeconomic status (SES), and academic achievement. In fact, according to Wright (2018), a student's grades may play a vital role in their decision to persist or not in their majors and switching to an easier major is related to low performance. In addition, there is no evidence that students persist in completing STEM courses through self–efficacy (Totonchi et al., 2021). Parents may influence students' decisions in education from the beginning of their childhood, and parental beliefs were found to trigger students' intention to choose STEM courses until they graduate from the university (Lapytskaia et al., 2021). Zulqarnain (2022) investigates the short-run and long-run relationship between socioeconomic factors and fertility rates in Malaysia. It can be concluded that income, household consumption expenditure, and the female labour force are related to fertility in the short and long run, which may affect socioeconomic status.

2. Methods

The population of the study are all form 4 students in Sekolah Menengah Kebangsaan (SMK) Dang Anum who enrol in STEM education. They are categorized into four classes: 4 STEM Bio, 4 STEM Teknikal, 4 STEM Komputer, and 4 MPV Mata Pelajaran Vakasional. An online questionnaire consisting of five sections is distributed among all Form 4 students in SMK Dang Anum and 80 students respond through the Google Forms platform. Gender and race are also included in the demographic profile. This research has employed Bandura's theory of self–efficacy that focuses on individual's belief in their ability to successfully perform a particular behavior to achieve desired outcomes. Self-efficacy influences motivation, effort, persistence, and resilience in the face of challenges. The questionnaire, consist of 26 items with 5-Likert scale which includes particular variables, was used to investigate the factors contributing to students' persistence to enrol in STEM education.

After the data has been gathered within one-week, further analyses are carried out through statistical software SPSS version 26 using a statistical test of Spearman's correlation. This study aims at exploring the relationship between students' persistence to enrol in STEM education between three independent variables, which are self-efficacy, socioeconomic status (SES), and academic achievement. The independent variables are choose based on the review of the previous research.The hypothesis of this study is as below:

H_{01}: There is no relationship between **self–efficacy** and **students' persistence** to enrol in STEM education.
H_{02}: There is no association between **socioeconomic status** (SES) and **students' persistence** to enrol in STEM education.
H_{03}: There is no relationship between **academic achievement** and **students' persistence** to enrol in STEM education.

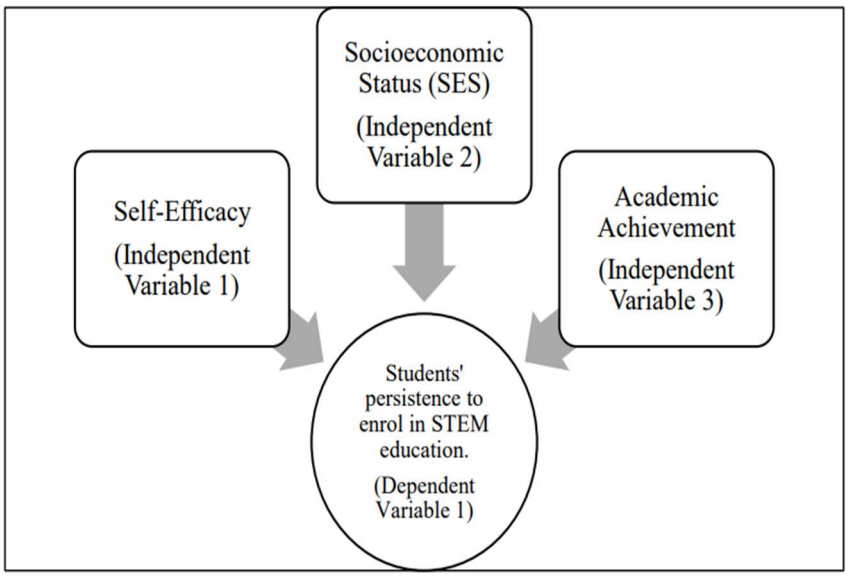

Figure 1. Theoretical Framework

3. Results

3.1 Demographic Profile

Table 1 shows the profile of the respondents. 52.5% of the respondents are female, while the rest are male. Most of the respondents 85.0% are Malay while Chinese and Indian are 8.75% and 6.25% respectively.

Table 1. Frequencies of Respondent Profile

Characteristic	Value	Frequency	Percent
Gender	Male	38	47.5
	Female	42	52.5
Race	Malay	68	85.0
	Chinese	7	8.75
	Indian	5	6.25

According to Table 2, which is shown below, 20% of students strongly concur that they like studying STEM courses. 37.5% are agree, followed by 30% who neutral. But 12.5% of the respondents disagree, saying that mastering STEM subjects is not enjoyable.

Table 2. Demographic background for student's opinion on STEM subjects.

I enjoy learning STEM subjects	Frequency	Percent (%)
Strongly Disagree	-	-
Disagree	10	12.5
Neutral	24	30
Agree	30	37.5
Strongly Agree	16	20

3.2 Reliability Test

To determine the consistency and stability of a measurement instrument, reliability test has been conducted is analysed. Based on Table 3, the Cronbach's Alpha values support that there is a consistency of measured items for all three variables since all value are more than 0.70.

Table 3. Reliability Test

Variable	Items	Cronbach's Alpha	Reliability
Students' Persistence to Enrol in STEM Education	9	.913	High
Self – Efficacy	16	.886	High
Socioeconomic Status	10	.731	High

3.3 Correlation Analysis

Correlation analysis has been carried out to determine whether there is a significant difference between self-efficacy, socioeconomic status, and students' persistence to enrol in STEM education. According to Table 4, Spearman's Correlation value shows that there is a very strong positive and significant relationship between self–efficacy and students' persistence to enrol in STEM education (0.896). Thus, the null hypothesis is rejected. This means there is a relationship between self–efficacy and students' persistence to enrol in STEM education.

For the socioeconomic status there is a moderate and positive and significant relationship between Socioeconomic Status and Students' Persistence to enrol in STEM Education (0.564).Thus, null hypothesis is rejected. This means there is an association between socioeconomic status (SES) and students' persistence to enrol in STEM education.

For the academic achievement there is a strong and positive and significant relationship between Academic Achievement and Students' Persistence to enrol in STEM Education, (0.721). Thus, null hypothesis is rejected. This means there is a relationship between academic achievement and students' persistence to enrol in STEM education.

Table 4. Spearman Rank Correlation Analysis towards Students' Persistence in STEM education.

Variable	Correlation Coefficient	Strength
Self – Efficacy	.896**	Very Strong Positive
Socioeconomic Status	.564**	Moderate Positive
Academic Achievement	.721**	Strong Positive

* If the correlation coefficient closer the value of 1 (positive) or -1 (negative), the stronger the relationship.

3.4 Descriptive Statistics

The descriptive statistics in Table 5(a) and Table 5(b) shows the minimum, maximum values, mean, standard deviation and skewness for all items in each criterion. It is observed from the skewness values around 0 indicates the presence of a normal distribution.

Table 5(a). Descriptive Statistics

Constructs	Scale Items	Mean	Standard Deviation	Skewness
	I am able to focus on STEM subjects.	3.58	0.742	-0.264
	I am confident to score high marks in STEM subjects	3.00	1.019	-0.221
	I do not feel anxious whenever I sit for the test.	3.65	1.020	-0.199
	I will make sure to complete my homework no matter how difficult it is.	4.30	0.786	-0.911
	I am able to work in harmony with my own classmates.	4.70	0.461	-0.890
	I am able to encourage myself whenever I face something unpleasant.	4.14	0.568	0.020
	I can study a chapter for a test without any problem.	3.08	0.911	0.055
	I am planning to pursue my study in STEM career courses in the universities.	3.44	0.777	0.213
	I would be persevered if I encounter any problem with my study.	3.93	0.689	0.098
	I am competitive in my study and will always aim for excellence marks in a test.	3.41	0.910	-0.095
	Learning STEM subjects will benefit me in my future career.	3.98	0.779	-0.121
	I view STEM subjects as easy and interesting.	3.28	0.763	-0.339
	I pursue the STEM subjects due to my own decision.	3.30	0.947	-0.365
	My siblings or my parents are currently working in occupation related to STEM.	2.61	1.522	0.311
Self-Efficacy	I am able to manage my time efficiently.	4.25	0.893	-1.504
	I will ask for others help when I face problems related to my study.	4.36	0.601	-0.347
	Parents' highest education level.	3.01	1.153	1.145
	Father's occupation.	1.88	0.786	1.190
	Mother's occupation.	1.96	0.863	0.194
	Estimated parent's total monthly income.	1.41	0.567	0.995
	Family size.	2.04	0.489	0.097
	I have siblings who currently enrol in STEM subjects in secondary school or STEM courses in the university.	1.49	0.503	0.051
Socioeconomic Status	What does your family and siblings think of your choice of pursuing STEM?	4.33	0.708	-0.561
	Pursuing STEM was my own choice.	3.41	0.901	-0.199
	Parent's expectation is the main reason why I chose to stay in STEM education.	2.44	1.135	0.452
	Overall, my parents / care givers involve in my academic study.	4.00	0.827	-0.414

Table 5(b). Descriptive Statistics

Constructs	Scale Items	Mean	Standard Deviation	Skewness
	Student's Grade Point Average.	3.21	1.435	0.019
Academic Achievement	Out of all STEM subjects (Additional Mathematics, Physics, Chemistry, Biology, Graphic Technical Communication, Science Computer or Digital Graphic Design), what is your current highest mark in any of these subjects?	67.75	11.658	-0.051
Self-Efficacy	I enjoy learning STEM subjects.	3.65	0.943	-0.168
	Learning STEM is not important for my future success.	4.05	0.840	-0.883
	If I could choose, I would not take STEM education during my upper secondary school.	3.53	1.212	-0.191
	I was once considering dropping STEM as my major during my upper secondary school.	3.85	1.254	-0.579
	I will continue to study in a STEM program later at a university.	3.48	0.826	-0.125
	I would like to learn more about STEM.	3.69	0.739	-0.002
	I will not pursue STEM related career in the future.	3.39	0.803	0.227
	I would enjoy working in a STEM related career.	3.69	0.704	0.304
	I am motivated to pursue a career in STEM.	3.61	-.703	0.486

4. Discussion

Self–efficacy is associated much with how well a student believes in his or her capability to achieve the desired outcomes. Thus, having higher self–efficacy really helps in their study which in this context, is their persistence in STEM education. From these, we can identify the importance of having strong self–efficacy to help students stay motivated, thus persisting to continue learning STEM subjects during school. Furthermore, self–efficacy encourages students to persist in the STEM pathway (Rocha *et al*., 2022). Thus, the findings of this study are more supported by Maltese and Tai (2011), Amiruddin (2022) which reveals that most students who specialized in STEM education decided to continue to do so because they are motivated and have a strong interest in mathematics and science subjects during high school.

Besides, the other research Brown *et al*., (2016), found that strong correlation between the variables of students' self–efficacy and students' intention to persist in STEM education. After all, the study of self–efficacy is important since it connects to the STEM field and students' persistence in STEM education (Sublett & Plasman, 2007). Plasman *et al*., (2021)highlights parents' occupation and family income in determining whether students should stay in STEM education in high school. Besides, the number of parents who work in the STEM field also has significance to students' decision to STEM education. This previous study is related much to this recent finding since our questionnaires asked questions related to parents' occupations, family income and the number of family members who work in the STEM field.

Higher SES and educated parents are associated with increased STEM course selection and persistence among students (Wang & Degol, 2013; Eddy & Brownell, 2016). Students from higher SES backgrounds were more likely to continue taking math courses throughout secondary school (Harden *et al*., 2020). STEM subjects are regarded as rich and easy subjects as long as the students are provided with a strong support system and one of the important support systems besides teachers is the parents themselves (Novi & Ansor, 2022). Academic achievement and students' persistence to remain in STEM education are both positively associated (Lam & Zhou, 2019). Measuring students' academic achievement is vital since Solanki *et a*l., (2019) views that social and academic integration contribute to persistence and reinforce one another. Academic achievement in terms of grades that students receive also signalling students' intention to persist in STEM education.

However, things get serious if they receive better grades for non–STEM subjects which will create a potential gap for them to decide such as leaving STEM education (Witteveen & Attewell, 2020). Besides, a study by Starr *et al*., (2020) stated that students' performance in the classroom can increase STEM persistence as long as they are exposed to real learning experiences in their learning context. After all, it was stated that self–efficacy brings about the correlation between students' persistence and their academic performance (Cooper & Berry, 2020; Alhadabi & Karpinski, 2020).

5. Conclusion

STEM education has implemented in many countries, including Malaysia. This study has analyzed three factors that may correlate with students' persistence in STEM education. The factors associated with this study are self-efficacy, socioeconomic status (SES), and student's academic achievement in STEM subjects. A daily secondary school located in a suburban area was chosen, and questionnaires have been given to all respondents through Google Forms. The findings have shown that there is a positive correlation between every factor and students' persistence in STEM education.

It is critical to address these concerns and offer students the tools, support, and opportunities they require to excel in STEM education. These can include academic assistance and mentorship programs, the creation of inclusive and supportive learning environments, and promoting of STEM jobs and possibilities through internships and other experiential learning opportunities. Efforts to boost diversity and fairness in STEM education can also assist to address the underrepresentation of groups in these disciplines and improve overall student persistence.

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Author Contribution

Author1 and Author2 wrote the conceptualization and produced the original draft. Author3 and Author 4 reviewed and check the statistical analysis and interpreted the results. Author5 oversaw the article writing. All authors provided critical feedback and contributed to shaping the whole research, analysis, and manuscript.

Conflict of Interest

The authors have no conflicts of interest to declare.

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