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Beyond Grades: Investigating the Influence of Personality on STEM Pathways in Malaysia

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Abstract
The influence of personality on STEM (Science, Technology, Engineering, and Mathematics) education interest and job choices among Malaysian secondary school students is a developing concern in the educational sector. The purpose of this study is to look at the relationship between personality traits and STEM education desire in Malaysia. The study discovered significant relationships between personality qualities such as openness to experience, agreeableness, and extraversion with student interest in STEM education. These findings shed light on how personality factors influence STEM education enthusiasm among Malaysian secondary school students, where enrolment is now falling. The implications of these findings for educators, policymakers, and stakeholders interested in encouraging secondary school students' interest in STEM education and career options are examined. More research is needed to better understand the complex relationship between personality and STEM education interest, as well as to inform strategies for increasing secondary school students' interest and involvement in STEM fields in Malaysia and elsewhere.
Keywords: Personality, STEM Education, Career Interest, Student Enrolment

Introduction

Science, Technology, Engineering, and Mathematics (STEM) education has been identified as a significant focus area in modern education systems around the world, including Malaysia (Ministry of Education Malaysia, 2017). Despite the efforts to promote STEM education, there are challenges in fostering strong interest and engagement in STEM fields among secondary school students. One factor that has been found to influence students' interest in STEM education and career choices is their personality traits of enrolling in a STEM major (Chen & Simpson, 2015).

Personality traits are intrinsic characteristics that define an individual's ideas, feelings, and behaviour. They have been discovered to have an important impact in many facets of human life, including education and career choice making. self-efficacy (Wu et al., 2020). STEM education is important for developing discipline knowledge as well as a diverse set of abilities,

competencies, and characteristics that are compatible with the demands of young individuals performing effectively and ethically in shifting, complex, and difficult jobs in the future, community, and political settings (Fallon et al., 2020).

Certain personality qualities have been linked to increased interest and participation in STEM disciplines, according to research. The openness personality trait, for example, found more prominent in female STEM majors compared to non-STEM majors. This study has significance for discovering female STEM majors with math anxiety, alleviating math anxiety in those students, and promoting girls interested in a STEM career (McKinney et al., 2021).

Furthermore, conscientiousness, which displays a proclivity to be organised, responsible, and persistent, has been demonstrated to link positively with method delivery in STEM disciplines (Idrizi et al., 2023). Additionally, understanding the significance of personality factors in moulding students' interest and involvement in STEM subjects has significant implications for STEM education promotion in Malaysia. Research by Aziz et al. (2020) show the implications of personality toward job performance and satisfaction behaviour among Malaysian student.

Outstanding pedagogues' opinions about personalities are still important today. The modern educator must strive for self-improvement in the context of humanization of education ideas, know and be able to utilise scientific advances, develop innovative methods of educating children, pupils, and students, and interact successfully with parents and the public (Hevko & Savchenko, 2022).

By considering the influence of personality traits, educators and policymakers can develop targeted strategies to empower students' STEM interest and motivation, and ultimately enhance their engagement and performance in STEM-related fields. According to Adams and Muthiah (2020), education in the 21st century is about more than only alleviating misery and poverty; the contemporary environment in this fast-paced world is heavily reliant on education that helps students acquire jobs.

As a result, the purpose of this study is to evaluate relevant literature on the relationship between personality traits and STEM education interest, as well as to analyse the probable processes through which personality traits may influence STEM interest among Malaysian secondary school students. This study aims to contribute to a deeper knowledge of the characteristics that can promote STEM education among secondary school students in Malaysia, as well as to guide evidence-based methods to increase STEM interest and motivation in the country, by exploring the role of personality in STEM education.

Personality and STEM Education

Personality is one of the significant factors or elements that contribute to the academic excellence of students in schools or universities. The relationship between academic success and openness, extraversion, and agreeableness was substantially stronger in elementary/middle school than in subsequent levels (Mamadov, 2021). Personality also influences students' behaviour in various aspects of their lives, such as their relationships, interests in particular subjects or courses at school and determines academic success (Vedel, 2016; Wild & Alvarez, 2020).

Several studies have examined the connection between personality and STEM education in schools. Baruth and Cohen (2023) found that personality variables play a significant role in STEM education empowerment and learning satisfaction. Meyer et al (2023) demonstrated that the combination of topic domain and achievement measures is crucial in exploring the saturation of student achievement in STEM education.

Nieben et al (2020) discovered an incremental association between the Big Five personality traits, socio-demographic variables, and cognitive capacity and transition success in STEM education. Coenen et al (2021) discovered that personality factors have a major impact on an individual's interest, motivation, and performance in STEM education, and that underrepresented groups, such as female students, continue to provide substantial challenges to educators and policymakers. Conscientiousness and flow, openness and agreeableness, and extraversion and neuroticism were discovered to be significantly related to creativity in STEM education (Roth et al., 2022). Personality also has an impact on an individual's approach to learning, attitudes towards learning, and overall degree of engagement and motivation, all of which can affect learning satisfaction (Patitsa et al., 2021).

Personality qualities were also found to impact flipped learning styles in pupils (Arslan et al., 2023). The study by Asselmann and Specht (2021) examined differences in personality qualities between people at the beginning and end of their working lives. According to Al-Qirim et al (2018), the most important methods utilised by CIT students were agreeableness, extraversion, openness, and conscientiousness.

Andersen et al (2020) discovered that academic success was equally correlated with conscientiousness at all grade levels, although agreeableness and emotional stability were largely related to their association with conscientiousness. Personality characteristics, according to Avram et al (2020), have an important impact in an individual's ability to cope with changing work circumstances and demands. Lastly, Gatzka (2021) found that openness has two distinct aspects, intellectual and senso-aesthetic, and that both aspects have a positive correlation with academic achievement in undergraduate students.

Finally, including personality traits such as creativity, critical thinking, and perseverance can significantly improve STEM education in Malaysia. If these characteristics are reinforced alongside technical knowledge, students will be better prepared to face the difficulties of a rapidly changing labour market and make significant contributions to society. As a result, educators and policymakers must recognise the significance of personality traits and aggressively push their incorporation into STEM programmes.

As conclusion, personality variables become an important factor that can help empower children interest in STEM education at school. Previous research has shown that personality traits can be used as variables to help develop and understand the inclinations of students involved in STEM education. At the same time, this study can assist researchers and government organisations in discovering psychological characteristics that can be employed as variables in STEM education.

Table 1
Personality Traits and Their Impact on STEM Education

Reseacher	Results
Mamadov (2021)	Personality traits (openness, extraversion and agreeableness) have a stronger relationship with academic success in elementary/middle school.
Vedel (2016); Wild & Alvarez (2020)	Personality influences students' behavior, relationships, interests, and academic success.
Baruth & Cohen (2023)	Personality variables play a significant role in STEM education empowerment and learning satisfaction.
Meyer et al (2023)	Combination of topic domain and achievement measures is crucial in exploring student achievement saturation in STEM education.
Nieben et al (2020)	Big Five personality traits, socio-demographic variables, and cognitive capacity are associated with transition success in STEM education.
Coenen et al (2021)	Personality factors have a major impact on interest, motivation, and performance in STEM education, especially for underrepresented groups.
Roth et al (2022)	Different personality traits are significantly related to creativity in STEM education.
Patitsa et al (2021)	Personality influences learning approach, attitudes, engagement, and motivation in STEM education.
Arslan et al (2023)	Personality traits affect flipped learning styles in students.
Asselmann & Specht (2021)	Personality traits differ between individuals at the beginning and end of their working lives.
Al-Qirim et al (2018)	Agreeableness, extraversion, openness, and conscientiousness are important traits for CIT students.
Andersen et al (2020)	Conscientiousness is consistently correlated with academic success at all grade levels.
Avram et al (2020)	Personality characteristics impact an individual's ability to cope with changing work circumstances.
Gatzka (2021)	Openness (intellectual and senso-aesthetic) correlates positively with academic achievement in undergraduate students.

STEM Education in Malaysia

STEM (Science, Technology, Engineering, and Mathematics) education is essential in today's world, particularly for individuals who want to succeed in the face of high technology and new information. However, achieving the desired outcomes of STEM education is fraught with

difficulties. According to Lavi et al (2021), Science, Technology, Engineering, and Mathematics abilities are especially difficult for students in schools and universities in the twenty-first century. Despite improvements in education spending and the proportion of higher education graduates in the overall population, the proportion of STEM programme graduates has fallen across Europe over the previous two decades (Bacovic et al., 2022).

Malaysia's government announced the Malaysia Education Blueprint (MEB) in 2013 through the Ministry of Education Malaysia (MOE), with the goal of enhancing STEM education in schools across the country to prepare for the workforce requirements of the Fourth Industrial Revolution (2013) (Ministry of Education). In 2017, the Integrated Secondary School Curriculum (KBSM) was progressively substituted by the Standard Secondary School Curriculum (KSSM), which proposed and implemented a STEM education get closer which includes STEM (Science, Technology, Engineering, and Mathematics) subjects across the country through KSSM (Xian et al., 2017). STEM education should be incorporated for student success and social productivity, as technology changes society and becomes more extensively used. Technology will assist students in adjusting and improving their learning habits (Ali et al., 2023).

To meet the needs of the industry, which is increasingly prioritizing STEM fields in future employment opportunities, various steps and initiatives have been implemented, including establishing a target of a 60:40 ratio of students studying Science and Arts in Malaysian schools (Ong et al., 2021). STEM jobs frequently require qualifications in programs such as statistical analysis, biomedical engineering, software development, web design, and pure science fields (Camasso et al., 2019).

The Malaysia Education Blueprint's implementation is divided into three phases. The first phase, which ran from 2013 to 2015, aimed to improve STEM education quality by emphasizing curriculum consolidation, teacher training, and the use of multi-modal learning models (Ministry of Education Malaysia, 2013). The second phase, which spans the years 2016 to 2020, includes a number of targets, such as campaigns and collaborations with relevant agencies, particularly to generate interest and awareness among individuals, families, and the community in this country about the importance and need for STEM for the future of the country (Ministry of Science, Technology and Innovation, 2022).

Malaysia is now entering its third wave of STEM implementation, which will run from 2021 to 2025. This is also the third phase of the Malaysia Education Blueprint, with one of its objectives being to achieve considerable advancement in STEM through improved operational flexibility. This phase also aims to strengthen STEM teachers' pedagogy, which focuses on training in an inquiry-based approach, encouraging upper secondary students to pursue STEM education, and increasing the assessment of STEM enculturation among students (Ministry of Education, 2021).

Wave	Focus
Wave 1 (2013–2015): Strengthening the foundations	• Raising students' interest through new learning approaches and an enhanced curriculum emphasizing higher order thinking Sharpening skills and abilities of teachers • Building public and student awareness • Enabling high performing teachers and school leaders
Wave 2 (2016–2020): Building on the foundations of Wave 1	• Rolling out the new primary and secondary schools curriculum (KSSM and Revised KSSR curriculum) • Encourage development of inter-school learning communities • Upgrade existing science equipment and facilities in schools to ensure that they are optimal for effective teaching and learning of STEM • Extension of STEM awareness programmes, to primary school students and parents • 50% reduction in the urban-rural students' achievement gap, 25% reduction in the socio-economic and gender students' achievement gap
Wave 3 (2021–2025): Innovating to the next level	• Introduce fresh initiatives and programmes based on the success of the first two Waves and develop a roadmap for the future • Maintain or improve on 50% reduction in the urban-rural, socio-economic and gender students' achievement gap.

Figure 1. Malaysia Education Blueprint 2013-2025

Current Situation STEM Education and Enrolment in Malaysia

STEM education in Malaysia is facing multiple challenges and obstacles that need to be addressed to achieve its goals (Idris et al., 2023). Despite the Malaysia Education Blueprint (2013-2025)'s excellent efforts to overhaul the education system, issues remain in areas such as early childhood education, Technical and Vocational Education and Training (TVET), and tackling educational outcomes inequity. Furthermore, the decline in the percentage of students enrolled in science is concerning, and failure to meet the expected standards of 270,000 students per year, or 60% of the annual national cohort in STEM courses, could result in a severe talent a lack in the STEM field (Fadzil et al., 2019).

The implementation of STEM education in Malaysia faces several challenges and obstacles that need to be addressed, including teacher quality (Hoon et al., 2018; Mahmud et al., 2018; Khalik et al., 2019), limited infrastructure resources in schools (Chin et al., 2019; Markus et al., 2021), lack of interest (Ramli & Awang, 2020), curriculum alignment (Mustafa et al., 2022), and a gender gap among male and female students regarding STEM course enrolment (Goy et al., 2018; Rahman & Halim, 2022). This problem of science-based subject under-absorption is particularly prominent in industrialised countries such as the United States of America, where the proportion of high school graduates following a STEM-related field has been progressively declining over time (Ong et al., 2017).

The major obstacles in qualified STEM teachers and limited resources for teaching STEM subjects are identified by various studies (Mahmud et al., 2018). To overcome this issue, the quality of STEM teachers must be improved through the implementation of training and professional development programs (Nasri et al., 2020). Integrating STEM teaching across

multiple topic areas is a huge difficulty in Malaysian schools, and the lack of clarity and consistency in how STEM is integrated across different subjects contributes to uncertainty among instructors and students about what constitutes STEM education (Rauf et al., 2019).

A lack of student-centered, inquiry-based teaching approaches, traditional lecture-based teaching approaches, and a lack of support from school administrators and policymakers were identified as issues limiting the extent to which STEM education was prioritized and integrated into school curricula (Jamal et al., 2017; Ismail et al., 2019). Cultural and societal factors may also obstruct the implementation of STEM education in Malaysia, as some students and parents perceive STEM disciplines to be difficult and unimportant for future jobs, discouraging students from pursuing STEM education (Abdul Ghani et al., 2020; Halim et al., 2017).

This issue has an impact on STEM education implementation through student involvement or enrolment in STEM at school. According to the Malaysian Ministry of Education (2021), the trajectory of student involvement in STEM is quite alarming, with the maximum level of student involvement at 47.82% in 2016 and the lowest level at 40.95% in 2021, with only 152,568 pupils in secondary school enrolled in STEM courses. Figure 1 represents the trend in Malaysian STEM education participation from 2016 to 2021.

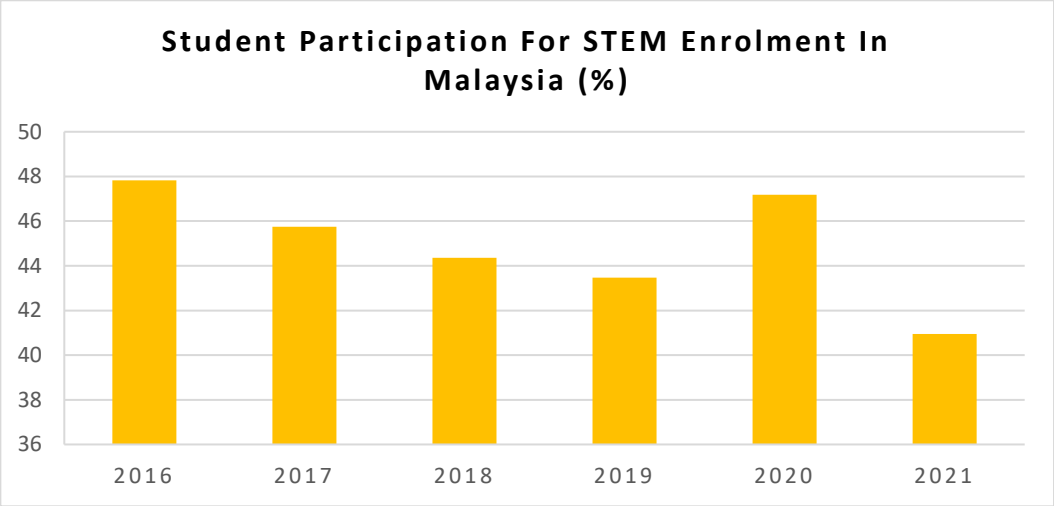

Figure 2. STEM Enrolment for Secondary School Student in Malaysia

Recent research suggests that certain personality factors can significantly influence student enrolment in STEM education in the classroom In fact, a recent research in a leading educational psychology provides evidence to support this argument. Personality variables such as openness, extraversion, and agreeableness have a greater impact on academic performance (Roth et al., 2022; Meyer et al., 2023; Avram et al., 2020) at the elementary or middle school level (Mamadov, 2021), affect student behaviour, relationships, and interests, and determine academic success (Wild & Alvarez, 2020; Coenen et al., 2021).

Conclusion and Future Agenda

The importance of personality factors in STEM education, particularly in relation to career interest in Malaysia, cannot be overstated. As evident from the literature reviewed, various personality traits and characteristics have been found to play a significant role in shaping students' interest and engagement in STEM fields.

To begin with, the data show that kids who have high levels of curiosity, tenacity, and self-efficacy are more interested and motivated in STEM topics and careers. These personality traits are associated with a positive attitude towards challenges, a willingness to explore and experiment, and a belief in one's ability to succeed in STEM-related activities. Therefore, educators and policymakers need to focus on cultivating and nurturing these personality traits among students through targeted interventions and strategies in STEM education.

Secondly, research also highlights the influence of gender stereotypes on students' interest in STEM fields. female students, in particular, are often subject to societal biases and stereotypes that portray STEM as male-dominated fields, leading to lower interest and confidence in pursuing STEM careers. Addressing and challenging these gender stereotypes is crucial in promoting gender equity and diversity in STEM education and careers. Encouraging female students to develop a growth mindset, resilience, and self-confidence can help them overcome these stereotypes and pursue STEM fields with enthusiasm.
Thirdly, the socio-economic background of students can also impact their interest and career aspirations in STEM. Students from low-income families may encounter extra challenges, such as a lack of resources, exposure, and opportunity, which might impact their interest and motivation in STEM professions. Promoting inclusivity and diversity in STEM education and careers requires assuring equitable access to quality STEM education, mentorship, and career help for students from all socioeconomic backgrounds.

Finally, personality variables are important in influencing students' interest and involvement in STEM areas, and addressing these factors can have a substantial impact on boosting STEM career interest and ambitions among students, particularly in Malaysia. Cultivating curiosity, perseverance, self-efficacy, challenging gender stereotypes, and addressing socio-economic disparities are key considerations in designing effective STEM education programs and interventions that foster students' interest and engagement in STEM fields, and ultimately contribute to a skilled STEM workforce for Malaysia's future. Further research and collaboration among stakeholders, including educators, policymakers, and industry partners, are warranted to continue advancing STEM education and promoting STEM career interest among Malaysian students.

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