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Redefining Horizons: Delving into Personality Trends and Diverse Challenges in STEM Education Across Malaysia

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Abstract

Personality is a characteristic feature of a person that is manifested in outward behavior and is influenced by the factors that make up a person's personality in life. The boom in the development of science and technology combined with the rapid progress of *Industrial Revolution 4.0* (IR4.0) makes STEM education so important as a career element in the future. However, the trend of STEM students' participation in education in schools is very worrying. The purpose of this study is to evaluate the personality characteristics and trends of students' inclination towards STEM education in schools. The conceptual parts consist of an extensive search and analysis of academic articles and government publications related to personality issues and trends of STEM interest in education. A conceptual framework is proposed to identify the relationship between personality and STEM education trends based on the findings and support from previous studies. The significance of this study provides a new dimension of personality factors as a variable for the trend of interest in STEM education among students in school. This study also helps researchers and government agencies explore and evaluate the extent to which personality factors can add value in strengthening STEM education in schools.

Keywords: Industrial Revolution 4.0, Malaysia Education Blueprint, Personality, STEM

Introduction

Science, technology, engineering, and mathematics education (STEM) has become very important in today's world of education, especially for members of society who want to successfully face the changes of high technology and new information (Minister of Science, Technology and Innovation, 2022). The acronym STEM was popularized by (Gonzalez and Kuenzi, 2012). According to Gonzalez and Kuenzi (2012), the acronym *STEM* generally refersto a set of educational and professional fields or areas related to 'science," but the definition of this group is inconsistent. As a result, there is debate about whether particular attention needs to be paid to the four fields as a collective entity. Meanwhile, Breiner et al (2012) explained that STEM education varies greatly depending on the level of education in the previous education system.

STEM education is also an approach that is synonymous with the development and progress of today's world. In the 21st century, students' skills in science, technology, engineering, and mathematics are a major challenge, especially for students in schools and universities (Lavi et al., 2021). In Malaysia, the Ministry of Education Malaysia (MOE) introduced education STEM in 2013 with the Malaysia Education Blueprint, which outlines several goals and implementation strategies. The Malaysia Education Blueprint (2013-2025) has been unveiled with the goal of ensuring that the country's workforce is skilled in the fields of science, technology, technical, and vocational fields (Idris & Nachiappan, 2023). This plan outlines three phases of implementation at the school level in Malaysia. One of the items that support implementation is the curriculum blueprint, which transitions from the High School Integrated Skills Curriculum (KBSM) to the High School Standard Curriculum. Table 1 displays the Malaysia Education Blueprint (2013-2025), which outlines three phases of implementation in Malaysia.

Table 1
Malaysia Education Blueprint (2013-2025)

Wave	**Focus**
Wave 1 (2013-2015) Changing the system by supporting teachers andfocusing on key skills	Improving teaching quality through focused teacherconsultation. Exam questions should be redesigned. Strengthening the quality of education STEM. Implementation of the standard curriculum for elementary school (KSSR) Bahasa Malaysia SJK designed. Language proficiency is being improved. 1BestariNet implementation and IPG modification.
Wave 2 (2016-2020) Drives system upgrades	Implementation of the secondary school standard curriculum (KSSM) and the primary school standard curriculum (KSSR). Raise STEM enthusiasm and awareness in the community.

	Obtain international accreditation and improve the enrollment program's curriculum. Increase vocational education alternatives throughcollaboration with the private sector.
Wave 3 (2021-2025) Move towards excellence through increased operational flexibility	More opportunities for creativity and skill development in Malay, English, and other languages. Implement ICT programs and advances for people withspecial needs. Improving school-based administration. Empowering the ministry and establishing change.

Research Methodology

A quantitative technique is appropriate when the purpose of the research is to quantify data and generalize outcomes from a sample to a population of interest. It allows objective hypotheses to be tested by evaluating the relationships between variables that may be measured and analyzed using statistical processes (Creswell, 2014). A quantitative method allows for the statistical testing of hypotheses about specific variable relationships. This is ideal for this study since we want to look at the relationships between assessed personality traits and STEM interest (Idris et al., 2023e).

The use of approved personality evaluations generates quantitative data that can be analyzed statistically. This enables empirical research into how personality factors correlate with and predict STEM involvement and career choices (Ambriel et al., 2020). To summarize, a quantitative methodology would enable researchers to collect numerical data on personality and STEM interest and statistically evaluate the data to uncover potential correlations and test hypotheses regarding the relationships between personality traits and STEM trends. This corresponds to the overall deductive method portrayed in the conceptual framework.

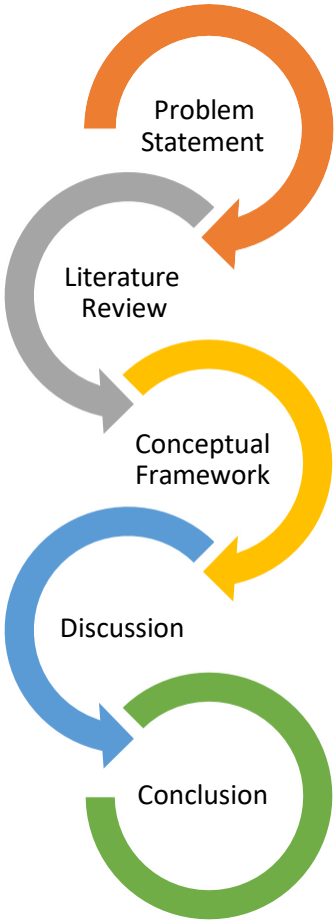

Figure 1. Research Methodology

Current Issues of STEM Education in Malaysia

The STEM wave is now entering its third phase (2021-2025), but the goal of reaching 60 percent of students choosing science majors remains elusive when compared to the literature field, which continues to dominate at more than 40%. According to a study by Zhongming et al. (2016), 87 percent of students in the United States are interested in STEM fields, compared to 78 percent in Europe. These figures still show significant disparities when compared to student participation and engagement in STEM in Malaysia.

According to a report published by the Academy of Sciences of Malaysia (2017), the goal of a 60:40 ratio for science and arts in the Malaysian education curriculum is not new; the policy was implemented in the 1970s to achieve this goal. However, to date, the Ministry of Education's primary goal has been to ensure that this agenda continues. Therefore, the introduction of the Malaysia Education Blueprint (2013-2025) is a step towards achieving the goal in a more detailed and systematic manner (MOSTI, 2022).

As a result, the reality is that the trend of declining student engagement at STEM is becoming increasingly worrisome. A report from the Ministry of Education Malaysia (2022) shows that only 47.18 percent of students in school take the subject STEM. This figure is still far from the target ratio of 60:40 for science and arts. The year 2021 shows the lowest participation compared to the previous years where only 40.95 percent was recorded, with the participation

of students in STEM subjects recording 152,568 students for the year 2021. The trend towards STEM also shows an inconsistent trend pattern, with an increase each year. STEM (science, technology, engineering, and math) education is vital for preparing students for future employment, yet STEM enrollment among Malaysian secondary school students is dropping (Idris et al., 2023a). Compared to previous years, there is a downward trend, as shown in Table 2.

Table 2
Statistics of Student Participation in STEM Course

Year	Student Participation in STEM Course
2012	48.15
2013	46.96
2014	46.33
2016	47.82
2017	45.74
2018	44.36
2019	43.47
2020	47.18
2021	40.95

Although learning in school is important for high school students, student personality is still a priority when identifying trends in STEM career interests among high school students, particularly in Malaysia. Furthermore, the trend of student participation in STEM remains static, with never exceeding 50% participation compared to the targeted 60%. Table 3 provides a brief overview of John and Srivastava's (1999) Big Five personality model.

Table 3
A Brief Description of the Five Main Personality (Big Five)

Big Five Dimension	Explanation
Extraversion	Sociable, assertive, energetic, adventurous, positive emotions, easy to get along with
Agreeableness	Trusting, straightforward, undemanding, altruistic, obedient, simple and sympathetic
Conscientiousness	Efficient, organized, dedicated, trying to achieve success, self-disciplined, earnest
Neuroticism	Anxious, angry, hostile, depressed, self-conscious, impulsive, vulnerable
Openness	Curious, imaginative, artistic, broad, interest, excited, unconventional

(Adapted from the Big Five Trait Taxonomy, John & Srivastava, 1999)

John and Srivastava's (1999) Big Five personality model is widely used to identify personality traits in students (Norhasliza, 2019). Exploring students' personalities in the field of STEM

facilitates the process of identifying personality traits that are associated with the STEM trend in schools. This is supported by a study conducted by Coenen et al. (2021), who investigated STEM educational options and career fields, focusing on cognitive skills and examining the role of students' personality characteristics. The study also looked at how the Big Five personality traits influenced students' preferences for STEM courses and STEM career fields.

According to previous studies, openness, conscientiousness, agreeableness, and extraversion all positively influence STEM interest and performance (Idris et al., 2023e). The study also determined how the personality traits included in the Big Five traits were related tostudents' preferences for STEM courses and STEM career fields. Understanding personality variations allows for the personalization of teaching techniques, learning settings, and interventions in order to improve STEM education outcomes. Empowering students by recognizing their distinct personalities and interests fosters engagement and excitement for STEM professions. This necessitates inclusive, individualized approaches in the classroom (Idris et al., 2023c).

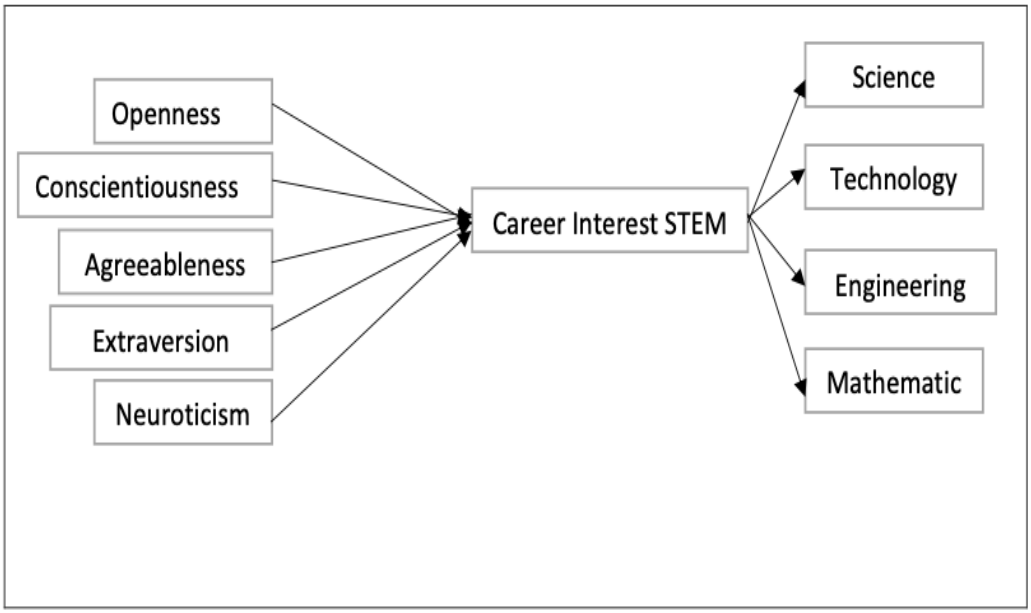

Figure 2: Conceptual Framework of Personality and STEM Interest Career

Based on figure 2, mention about the conceptual framework of personality towards STEM interest career. From this perspective the conceptual framework used for investigating the relationship between the Big Five personality traits and STEM career interest provides a structured lens through which to investigate the nuanced interplay of traits like openness, conscientiousness, extraversion, agreeableness, and neuroticism in shaping individuals' proclivity and motivation to pursue STEM careers. This conceptual framework strongly supported by previous research.

Table 4
Personality Factor towards 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.

(Adapted from Idris et al., 2023e)

Trends of STEM Interest

STEM (science, technology, engineering, and mathematics) education is critical for Malaysia's development, and the government has put policies in place to encourage it. However, in

Malaysian schools, student involvement and enrollment in STEM disciplines is falling and inconsistent, failing to reach state standards (Idris et al., 2023d).

A lack of student-centered, inquiry-based teaching approaches, as well as traditional lecture-based teaching approaches, 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). Some students and parents regard STEM fields to be difficult and insignificant for future professions, deterring kids from pursuing STEM education (Abdul Ghani et al., 2020; Halim et al., 2017).

According to a recent study, certain personality traits can significantly influence student enrolment in STEM education in the classroom. In fact, a recent study published in a prestigious educational psychology journal provides evidence to support this claim. At the elementary or middle school level (Mamadov, 2021), 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), affect student behavior, relationships, and interests, and determine academic success (Wild & Alvarez, 2020; Coenen et al., 2021).

Other than that, Kier et al. (2013) argued that the tendency of interest in the fields of STEM can be formed and cultivated in high school students before they go to university to become professionals in the field of STEM. Thus, personality perspective is also one of the factors that determine students' interest in STEM. In the field of careers and STEM careers are monopolized by men, but the need for female workers is very necessary to overcome the shortage of skilled labor offered in STEM (Black et al., 2021). A study by Chen and Simpson (2015) found that students with personality traits such as openness have a strong tendency to enroll in school for STEM subjects.

The study by Nieben et al (2020) found that students who possess the trait of conscientiousness have a significant ability to succeed in vocational education as they transition to secondary school. The study by Wirthwein et al. (2019) showed that students with the openness trait perform well in school (STEM). The study by Samsilah et al. (2022) found that students who exhibit the traits of openness, conscientiousness, and agreeableness have a significant impact on thinking and problem-solving skills. This is consistent with the complex problems found in STEM education involving problem-solving issues for students.

Discussion

First, the study emphasizes the importance of personality traits like openness, conscientiousness, and agreeableness in shaping students' interest and enrollment in STEM disciplines. Studies by Mamadov (2021); Nieben et al (2020); Samsilah et al (2022) consistently show how these personality traits influence students' STEM decision-making. For example, Mamadov's research emphasizes the impact of openness and agreeableness on academic performance, demonstrating their importance in fostering interest and success in STEM fields (Mamadov, 2021). Similarly, Nieben et al (2020) demonstrate the importance of conscientiousness in predicting students' ability to succeed in vocational education, which is a critical transition point between secondary school and higher education, including STEM disciplines. Furthermore, Samsilah et al (2022) emphasize the importance of openness,

conscientiousness, and agreeableness in developing critical thinking and problem-solving skills, which are required for STEM education and careers.

Second, addressing personality-related factors in STEM education is critical to developing a strong STEM workforce in Malaysia. As stated in the article, Malaysia aims to increase student participation in STEM by 60%, necessitating targeted interventions to effectively engage students. Recognizing the impact of personality traits on STEM interest allows educators and policymakers to create tailored educational programs that foster key characteristics such as curiosity, perseverance, and self-efficacy, as noted by (Roth et al., 2022; Wirthwein et al., 2019).

These characteristics are critical for cultivating a culture of innovation and problem-solving, which is required for success in STEM fields. Furthermore, initiatives to challenge gender stereotypes and address socioeconomic disparities, such as those advocated for by Black et al (2021), are critical for promoting inclusivity and equity in STEM education, ensuring that all students have equal opportunities to pursue STEM careers. These initiatives not only help to address systemic inequalities, additionally they also facilitate the development of diverse talent pools, which are critical for driving innovation and sustaining economic growth in the STEM sector (Idris et al., 2024).

Finally, understanding the complex relationship between personality traits and STEM interest can help shape effective educational policies and interventions. Educators and policymakers can develop evidence-based strategies to improve student engagement and achievement in STEM subjects by combining findings from previous research, such as those by (Coenen et al., 2021; Likhanov et al., 2021; Mammadov, 2021). For example, Coenen et al (2021) highlight the predictive value of openness and agreeableness in STEM career choice, emphasizing the importance of instilling these qualities in students. Similarly, Likhanov et al(2021) highlight the association between personality traits and academic performance in STEM courses, emphasizing the importance of assisting students in developing relevant traits for success in STEM education.

In the final analysis, incorporating personality-based approaches into STEM education is critical for increasing interest, engagement, and success among Malaysian students. Recognizing the impact of personality traits on STEM interest and enrolment allows educators and policymakers to design targeted interventions that foster key characteristics while promoting inclusivity and equity in STEM education. Furthermore, using insights from previous research allows for the development of evidence-based strategies to improve student engagement and achievement in STEM subjects, thereby contributing to the development of a skilled and diverse STEM workforce critical to Malaysia's future prosperity.

Conclusion and Future Agenda

It is important to examine the personality factors that influence students' interest in the areas of STEM, especially to determine the personality-based interests of high school students. Thisis very important because these students need to develop and cultivate their interest in STEM and then make career choices based on STEM. The continuation of this interest in STEM must continue to the university level.

Student participation in STEM needs to be improved to reach the goal of having 60 percent of students in schools engaged in STEM. Therefore, identifying the psychological approach of students at the school level can help teachers and the Ministry of Education (MOE) to identify the tendency of the STEM stream based on the personality of students in the school. Thus, this contributes to the consolidation of the personality theory and its connection with the trend of interest in STEM in schools in Malaysia.

Personality factors influence students' interest and involvement in STEM disciplines, and addressing these aspects can have a substantial impact on enhancing STEM career interest and objectives among Malaysian students. Cultivating curiosity, perseverance, and self-efficacy, as well as challenging gender stereotypes and addressing socioeconomicdisparities, are critical considerations in designing effective STEM education programs and interventions that foster students' interest and engagement in STEM fields, thereby contributing to Malaysia's future STEM workforce.

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