INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

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To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v13-i4/16676 DOI:10.6007/IJARBSS/v13-i4/16676

Received: *07* February 2023*, **Revised:*** *10* March 2023*, **Accepted:*** *29* March 2023

Published Online: *15* April 2023

In-Text Citation: (Idris et al., 2023)

To Cite this Article: Idris, R., Govindasamy, P., & Nachiappan, S. (2023). Challenge and Obstacles of STEM Education in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, *13*(4), 820 – 828.

Vol. 13, No. 4, 2023, Pg. 820 – 828

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

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Challenge and Obstacles of STEM Education in Malaysia

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Abstract
STEM education is a very important element of education for the development and progress of a developing country like Malaysia. For this reason, the government has introduced the Malaysia Education Blueprint (2013-2025) to ensure that the country keeps pace with the development of science and technology. At the same time, it does not exclude the strengthening of technical and vocational fields in the current national education system. The purpose of this study is to examine the challenges and obstacles of STEM education in Malaysia, especially as the implementation is now entering the final phase of the wave for the year 2021-2025. This study also discusses the declining trend of student participation in high school toward STEM education as of the current year. The goal of 60:40 percent student participation in Science and Arts policy is still far from being achieved. By shedding light on the challenges and obstacles facing STEM education in Malaysia, this research is motivated by the need to enhance the quality and accessibility of STEM education in the country, and its findings will provide valuable insights and recommendations for policymakers, educators, and stakeholders in the academic community, thereby contributing to the ongoing discourse on the development of STEM education in Malaysia and beyond.
Keywords: Challenge, Obstacles, School, STEM Education, Malaysia Education Blueprint

Introduction

STEM education is an acronym for 'Science, Technology, Engineering and Mathematics' (STEM). Subjects found in STEM include subjects such as science, mathematics, design and technology, basic computer science, biology, physics, and chemistry (Amelia & Lilia, 2019). Before the acronym STEM was used, it was known as SMET, and the National Sciences Foundation in the United States chose to use the acronym STEM (Saunder, 2009). While. Bryan et al (2015) defined STEM as the teaching and learning of science content and practices that include elements of science and mathematics with the integration of engineering practices and engineering design through appropriate technology.

STEM Education is an exploration that takes place in the teaching and learning process and includes every component of STEM or more (Becker & Park, 2011). In Malaysia, the introduction of core science and technology policy in the development of the country begin the early 1967 to meet the demand for science-oriented graduastes (Ong et al., 2021), a ratio of 60:40 for Science and Arts was introduced as a core for the development of science and technology (Academy of Science Malaysia, 2017). This policy is strengthened by the government's policy to be achieved through the Science, Technology and Innovation Policy and Vision 2020.

Therefore, in 2013, the government, through the Ministry of Education (MOE), introduced the Malaysia Education Blueprint, which has three stages of implementation waves that began in 2013 and will last until 2025. The targeted development plans include strengthening science, technology, engineering and mathematics (STEM) in the country's schools. This is to meet the future workforce needs that the country has in light of the Industrial Revolution 4.0 (MOE, 2013). Previously, the secondary integrated curriculum (KBSM) was gradually replaced by the secondary standard curriculum (KSSM), which proposes an educational approach STEM in the Malaysia Education Blueprint (2013-2025) that integrates the subjects of science, technology, engineering, and mathematics through the KSSM nationwide (Yusof et al., 2021).

The basic implementation of this educational development plan is divided into three phases, which include different goals and objectives. This phase includes the first wave, which refers to the implementation model from 2013 to 2015, which in the first wave aims to improve the quality of education of STEM by focusing on strengthening the curriculum, training teachers, and using a multimodal learning model (MOE, 2013). The second wave of implementation of STEM, which covers 2016 to 2020, has identified several goals to be achieved during this phase.

The objectives include conducting campaigns and collaborating with relevant agencies, particularly to raise interest and awareness among individuals, families, and community members in this country about the importance and need of STEM for the future of the country (MOE, 2013). The years 2021 to 2025 will be the third wave of STEM implementation in Malaysia. The third phase is also the last in the Malaysia Education Blueprint, and among the goals in this phase is to transition STEM to an excellent level through increased operational flexibility (Amelia & Lilia, 2019).

This phase also focuses on new initiatives and programs based on the successes achieved in the first and second waves to develop action plans for the future, as well as maintaining or improving the 50 percent gap for urban and rural students from a socioeconomic perspective and for student gender (Amirah et al., 2019).

Challenges of STEM Education

Given the 21st century, students' skills in science, technology, engineering, and mathematics are a major challenge, especially for high school and university students (Lavi et al., 2021). In the study by Black et al (2021), it is argued that in the last four decades, science, technology, engineering, and mathematics (STEM) has become the most important choice for job opportunities in today's world.

In general, most countries promote STEM because of the importance of this field to a country's development so as not to fall behind developing countries, although it may be difficult for parents to understand the different educational and curricular requirements, as well as for companies that need to invest to plan the field of jobs for the future in order to be more competitive. The outcome of these efforts, of course, rests with the students themselves (Breiner et al., 2012).

The Ministry of Science, Technology and Innovation (MOSTI, 2022) is one of the agencies responsible for improving the mastery of science and technology. In addition, there is the introduction of several government policies and measures such as the National Science, Technology and Innovation Policy (2021-2030), the National Space Policy (2030), the National Robotics Roadmap (2021-2030), the National Biotechnology Policy 2.0 (2022-2030), the National Blockchain Roadmap (2021-2030), the Electrical & Electronics Roadmap: technology development (2021-2030), Advanced Materials Roadmap (2021-2030), National Technology and Nanoproducts Roadmap (2021-2025), Artificial Intelligence Roadmap (2021-2025), Roadmap for Malaysia's Startup Ecosystem (2021-2030), and the National Fourth Industrial Revolution (4IR) Policy under the Shared Prosperity Vision (2030). The following Table 1 provides more details on the policies and measures and their implementation period in Malaysia.

Table 1
Policies that Support STEM in Malaysia

National Policy	**Implementation Period (Year)**
National Science, Technology, and Innovation Policy	2021-2030
National Space Policy	2030
National Robotics Roadmap	2021-2030
National Biotechnology Policy 2.0	2022-2030
National Blockchain Roadmap	2021-2030
Electrical & Electronics Roadmap: Technology Development	2021-2030
Advanced Technology Materials Roadmap	2021-2030
National Nano Technology and Product Roadmap	2021-2025
Artificial Intelligence Roadmap	2021-2025
Malaysian Startup Ecosystem Roadmap	2021-2030
Fourth Industrial Revolution (4IR) National Policy	2030
Shared Prosperity Vision 2030 (SPV2030)	2030

(Sources: *Ministry of Science, Technology, and Innovation*, 2022)

However, in the implementation of STEM in schools, there have been various polemics and challenges in achieving the goals. Previous studies have shown that there are problems, such as the weakness of the applications of STEM in rural areas (Amirah et al., 2018), the discrepancy in teachers' competency in STEM, which is not balanced between urban and rural areas (Khairani, 2017), teachers' lack of understanding of STEM (Nur Farhana & Othman, 2017), inadequate equipment (Belalang & Abd Rahman, 2016), lack of sufficient equipment in school laboratories (Clyton & Moses, 2017), teachers' attitudes towards STEM (Thibaut et al., 2018), the low and weak basic knowledge and skills of teachers (Thomas & Walters, 2015).

In addition, there are several challenges and barriers in targeting primarily graduates with expertise in STEM. Previous studies have also revealed several factors that serve as catalysts for student engagement and interest in the field STEM in school. The study found that students are more interested in STEM that is oriented to an object-oriented approach rather than theory alone (McIntrye et al., 2021), that exposure to STEM career fields is so limited and lacking (Vela et al., 2020), and that motivational learning does not help to influence the development of students' interest in STEM in school (Razali et al., 2020).

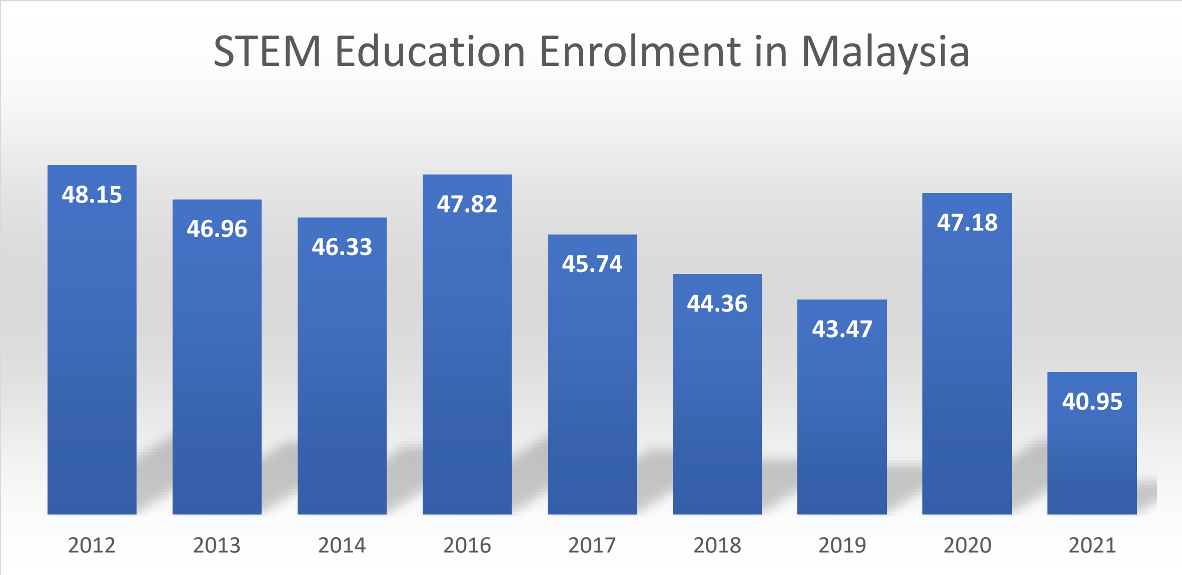
Table 2
The Challenge of STEM Implementation in Schools

Researcher	Results of Research
Abdul Rahman and Surat (2019)	Disadvantages of STEM applications for rural areas include teaching methods and classroom programming.
Khairani (2017)	The competency gap between STEM teachers is not balanced in urban and rural areas.
Ramli and Talib (2017)	Inadequate understanding of STEM teachers in delivering learning and teaching sessions to students.
Belalang and Abd Rahman (2016)	Inadequate school facilities for STEM learning and teaching sessions in the classroom.
Clyton and Moses (2017)	Lack of facilities such as equipment and laboratory rooms for STEM learning.
Thibaut et al (2018)	Teachers' attitudes towards the implementation of STEM learning and teaching in the classroom.
Thomas and Walters (2015)	Basic skills and knowledge in learning and teaching for STEM teachers.
McIntyre et al (2021)	Students are more interested in STEM learning based on objects rather than theory alone.
Vela et al (2020)	Exposure to career fields in STEM is so limited to students.
Razali et al (2020)	Learning motivation does not influence the development of career interest in the STEM field in national secondary schools.

Obstacles of STEM Education Application in School

The Ministry of Education (2020) reported that only 47.18 percent of students in school were engaged in STEM activities. In fact, only 20.51 percent chose pure science subjects, while the remaining 26.67 percent took technical education and vocational training (TVET) subjects. Long before, the Academy of Sciences Malaysia (2017) had reported that the acceptance and participation of students in STEM is so worrying.

In fact, the period from 2016 to 2021 shows that the trend of student participation in STEM is not consistent and does not meet the target. According to the Academy of Sciences Malaysia (2017), student participation in STEM was highest in 2012 at 48.15 percent. However, the Ministry of Education (2022) found that student participation in 2021 was the lowest at only 40.95 percent, meaning that only 152,568 students were involved in STEM. Figure 1 show the details student participation in STEM in Malaysia.



** Data for 2015 is not available

Figure 1. Student Enrolment in STEM Fields in Malaysia

If this trend of participation continues, many policies and strategies introduced by the government through MOSTI will face various challenges in their implementation. Experts in the field STEM can support the country's economic development in line with the Industrial Revolution 4.0 (Ministry of Science, Innovation and Technology, 2022). Previous studies have also shown that the trend of interest in the STEM field in Malaysia is very different from countries such as America, where 87 percent show interest in the STEM field, while European countries record 78 percent (Zhongming et al., 2016).

In fact, in the Asian ranking, Malaysia is also one of the countries that have a very low number of experts in the field STEM. This can be seen from the fact that Malaysia has only 25 percent highly qualified people compared to China, Korea and Singapore. This is also the foundation that is the main obstacle to economic and business growth, especially for small and medium enterprises (Abdullah, 2019).

The Academy of Sciences Malaysia (2020) reports that the country of Malaysia needs 1,000,000 million workers who have skills and expertise in STEM, especially in science, technology, and industry. By 2050, 60 percent of current jobs will no longer exist. Thus, 500,000 thousand university graduates who have diplomas and degrees will be needed for the science, technology, and industry sectors. Meanwhile, the remainder will be filled by skilled workers in technical and vocational fields. The Ministry of Education (2016) reported that the country has only 57 researchers for every 10,000 thousand workers, compared to developed countries that have more than 78.

(Source: Minister of Education, 2022)
Figure 2. Percentage of Students in Vocational Education in 2016-2021

Figure 2 shows the percentage of secondary school students in Malaysia enrolled in vocational education between 2016 and 2021. The year 2019 recorded the lowest percentage, only 4.60% of secondary students participating in vocational education. In 2017, the highest participation of students was recorded at 7.19%. In 2021, only 6.30% was recorded, and this figure is still far from meeting the needs of the industry.

Conclusion and Future Agenda

It is important to study and identify the challenges and obstacles in the implementation of STEM education in Malaysia because student participation or enrollment in STEM has never achieved its goal. This study is important to assess and identify the factors that pose challenge to the implementation of STEM at school level by considering the challenges faced by teachers and students. This study is also relevant to all policies and approaches directly related to student participation at STEM. Policies and measures introduced by the government mainly depend on skilled workforce in STEM in schools. Therefore, this study can help researchers and scholars to identify challenges and issues that need to be addressed to increase student participation in STEM in Malaysia. This research provides significant insights into the challenges confronting STEM education in Malaysia and emphasizes the importance for educators and scholars to remain informed and up-to-date with these issues. By examining the obstacles highlighted in this study, policymakers and stakeholders can take effective steps to create a flourishing STEM environment in Malaysia.

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