Perception of Primary Mathematics Teachers on STEM-oriented Teaching and Learning

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Abstract. This study aims to examine the perception of primary school mathematics on science, technology, engineering and mathematics STEM-oriented teaching and learning. The main focus of the study was on teachers' perceptions towards STEM teaching and learning from aspects of general perception, training, implementation and STEM teaching information. Secondly, to identify the challenges faced by teachers during the implementation of STEM in the classroom. The sample for this study is 40 primary school math teachers throughout the country who answer random questions the Google form. The data were analysed using descriptive analysis. The findings show that early perception of STEM teachers is positive and teachers are prepared to face STEM teaching and learning process. Despite the challenges faced by the respondents, they are still working to teach in accordance with the curriculum prepared by the Ministry of Education Malaysia.

1. Introduction
To improve the quality of education in Malaysia, the Ministry of Education (MOE) has developed and launched the Malaysian Education Blueprint 2013-2025 (PPPM) which aims to transform the Malaysian education system to compete with the growing international education system. To achieve this goal, the MOE has identified 11 changes that could lead to changes in the Malaysian education system. The first transition in the context of action is to provide Equal Access to Quality Education with an International Standard of Standards. One of its benchmarks in the first transition is to further enhance the quality of Science, Technology, Engineering and Mathematics (STEM) education. The term Learning Science, Engineering, Technology and Mathematics (STEM) has become a culture in education today. STEM-based learning not only allows students to have literacy in science, but also in technology. To produce educated people and meet the needs of 21st century skills, STEM education is an important interdisciplinary subject that meets the needs. Each individual must know and understand the basic concepts of STEM. STEM Education has provided the best opportunity for students to understand the world in a holistic way. According to Hays Blaine Lantz, Jr., in the writing of Science, Technology, Engineering, and Mathematics (STEM) Education What Form? What Function?. STEM education offers students one of the best opportunities to understand the world holistically, rather than bits and pieces. STEM is an important issue in education today [1, 6]. STEM has been applied in various countries such as America and Japan. Purpose of STEM education, in order for pupils to master science
and technology literacy rather than reading, writing, observing, and developing the abilities that have been used to deal with problems in everyday life related to STEM science.

STEM education eliminates the traditional barriers established between four disciplines, by integrating them into a cohesive teaching and learning paradigm. To equip students with the skills required to cope with changing global challenges with STEM implementation, KPM is responsible for ensuring improvement in the ratio of students wishing to pursue science and technical fields. In PPPM 2013-2025, KPM has stated five factors that cause the decline and quality of student outcomes in STEM education, the first factor is lack of awareness in STEM education. Student also think STEM subjects are considered to be difficult and the content of solid curriculum. KPM also noticed the factor is less consistent in teaching and learning quality and also old and inadequate infrastructure of school that involved in STEM education.

This factor or problem must be addressed so that KPM's wishes in PPPM 2013-2025 can be achieved. In 2014, the Centre for Education of the Ministry of Science and Mathematics (SEAMEO RECSAM) Southeast Asia has devised a conceptual framework for the development of STEM education in Malaysia. In this framework, it divides the development of STEM education into six phases, from early childhood to industry or community. In this paper, we focus on the second phase of primary or lower education, the focus is to help students connect or build a foundation in STEM education.

To achieve the objectives set by the government. Participants in the school are teachers who need to be adequately exposed before the STEM implementation is conducted thoroughly. Teachers are main factor either implementing STEM in schools is failing or successfully. Therefore, in order to enhance STEM understanding, a study has been conducted, where the main purpose of this research is to look at how far the teacher's perception of teaching and learning involving STEM.

Malaysia government put a very high interest in education to achieve the goal of becoming a developed nation capable of meeting the challenges and economic demand driven by STEM by 2020. Malaysia Government introduced a 60: 40 Science / Technical: Literature in education since 1967, and began implementing the policy in 1970. This policy refers to the Ministry's target to increase the ratio of pupils with significant STEM education to pupils focusing more on Literature. This policy has not reached its goal due to various factors.

In 2011, only 45% of students who passed the school system were students of the Science stream, including technical and vocational trends. Percentage of high school students who are eligible to follow the Science stream after PMR, but choosing not to follow has increased by almost 15%. This situation raises concerns about the ability of the education system to provide sufficient STEM graduates for the needs of the national economy. According to the National Council for Scientific Research and Development, Malaysia needs 493,830 scientists and engineers by 2020. (Strategy Report reaches 60:40) According to the current trend and development trend, MOSTI estimates that there is a deficit of 236,000 workers. Malaysia's performance in TIMSS suggests that student achievement has declined from 1999 to 2011. PISA 2009 results also show that Malaysia is in the lowest third position of 74 participating countries, and below the international average and OECD. This figure demonstrates the need for an intervention to achieve STEM's number of pupils and increase the success of future students.

Therefore, the readiness of teachers in the STEM Integration Education, Engineering, Technology and Mathematics Education is crucial in meeting the challenges of achieving National goals to produce STEM graduates [7, 8]. The variety of methods and techniques in the teaching and learning process is able to achieve the expected objectives. In addition, teachers need to know using the latest technology to enable teachers to get science materials as additional references besides textbooks. To find the readiness among mathematics teachers, the author review the teachers' perceptions of STEM teaching and learning on the aspects of general perception, training, implementation and STEM teaching resources. And also, Identify challenges faced by teachers during the implementation of STEM in the classroom.
2. Method
This study is based on quantitative method approach. The author examine the perceptions of teachers towards STEM teaching and learning in the aspects of understanding, general perception, training, implementation and STEM teaching resources. Questionnaire forms are distributed using the Google Forms medium to obtain feedback from primary school mathematics teachers. This method is best suited as it is easy and widespread.

The sample for this study is 40 primary school math teachers throughout the country who answer random questions. This is done to ensure that every sample from the population gets the same opportunity to be selected. The primary schools involved are national and national schools. Figure 1 shows the number of years of teaching experience for teachers involved in the study.

![Figure 1. Experience Teaching Respondents](image)

3. Research Findings
3.1. Teacher's Early Perception of STEM
Table 1 shows that 80% of teachers stated that the importance of STEM subject exposure to students. A strong agreement was also shown at 3.95. For student items it is fun to learn STEM and teachers encourage students to choose STEM-related areas to give the approximate percentage of 57.5%. The mean values are 3.60 and 3.58. From the findings it is shown that the teacher almost disagrees with the statement that the students are difficult to pass in STEM subjects. This is because the mean of this item is 2.88. the value among the disagreements is also natural. But for items on mathematics subjects are key to STEM Education, 85% of teachers agree and provide an average score of 4.00. The items on teachers' perceptions on government policies that emphasize STEM in teaching and learning provide mean score of 3.35 and 22 teachers agree and agree, it is the same as the number of teachers who agree on the national curriculum item to prioritize the STEM approach in teaching and learning.

| EARLY PERCEPTION                                                   | STS | TS  | N   | S   | SS  | MEAN |
|------------------------------------------------------------------|-----|-----|-----|-----|-----|------|
| 1. I Feel It Is Important For Students to Disclose Students to Stem Subjects | 3   | 0   | 5   | 19  | 13  | 3.95 |
| 2. Students In My School Have Fun Studying STEM Subjects          | 3   | 0   | 14  | 16  | 7   | 3.60 |
| 3. Students In My School Are Harder To Pass With Excellent In STEM Subjects Than Other Subjects | 3   | 9   | 12  | 12  | 2   | 2.88 |
| 4. I Encourage All My Students To Choose a Field Study Related to STEM | 3   | 1   | 13  | 16  | 7   | 3.58 |
| 5. I Feel Mathematics Education Is The Key to STEM Education      | 1   | 1   | 2   | 19  | 15  | 4.00 |
| 6. Government Policy Often Prioritizes STEM Approach In Teaching and Learning | 4   | 2   | 12  | 20  | 2   | 3.35 |
| 7. National Curriculum Prioritize STEM Approach In Teaching and Learning | 3   | 3   | 12  | 18  | 4   | 3.43 |

Mean 3.54
3.2. Teacher perceptions of STEM implementation at school

Table 2 shows that teachers agree that STEM subject curriculum is filled with so much content with a mean value of 3.48. But for STEM items too difficult for most pupils, 17 teachers have expressed their nature about the statement. The mean value of the mines is 3.15. This shows that teachers agree that STEM subjects are not too difficult to learn. From the data, it was shown that the school did not put emphasis on the implementation of STEM, because the mean value was 2.75, 11 teachers disagree with the item 3 statement. For items involving time ie item 4 and 5, high mean value is shown 3.55 and 3.58. This suggests that teachers agree that they do not have enough time to plan and provide STEM Pdp and the time allocated for STEM subjects is insufficient. Classroom too large also has an impact on the effectiveness of STEM teaching and learning. As many as 65% of teachers agree with the mean score of 3.60. Based on the findings, it is shown that the average mean value of 3.35 for items confident with STEM's teaching ability. This shows that teachers in this study feel confident of teaching STEM subjects. Figure 2 is about the method used by teachers in implementing STEM. 65% of teachers indicated STEM teaching during the teaching and learning process. Among other methods used are practical work (15%), tutorial / tuition classes (12.5%) and fieldwork (7.5%).

| STEM IMPLEMENTATION | STS (1) | TS (2) | N (3) | S (4) | SS (5) | MIN |
|---------------------|---------|--------|-------|-------|--------|-----|
| 1. The Curriculum of STEM Subject Matter With So much Content | 3 | 2 | 10 | 23 | 2 | 3.48 |
| 2. STEM subjects are too difficult for most students | 2 | 7 | 17 | 11 | 3 | 3.15 |
| 3. My School Puts Embargo On STEM Education | 1 | 10 | 15 | 11 | 3 | 2.75 |
| 4. Not Enough To Plan and Provide Stem-Based Teaching And Learning Session | 6 | 6 | 10 | 16 | 6 | 3.55 |
| 5. Time Allotted For STEM Lessons Not Sufficient | 2 | 3 | 11 | 18 | 6 | 3.58 |
| 6 I'm Confident With My Ability to Teach STEM Subjects | 4 | 1 | 14 | 19 | 2 | 3.35 |
| 6. Class Size Too Highly Affects Teaching Effectiveness And Learning | 4 | 3 | 7 | 17 | 9 | 3.60 |

Mean 3.35
3.3. Teachers Perceptions on Stem Teaching Information Resources

Table 3 shows the teachers' perceptions of STEM teaching resources. Item 1 concerns teachers incompatibility of STEM Education approaches in teaching and learning. From the data obtained, 60% of teachers disagreed and strongly disagreed with the statement. The mean value is 2.45, and this indicates that teachers agree on the STEM approach to be used in the teaching and learning process. Items 2 and 3 in relation to teaching aids, more than half of respondents agreed that the teachers did not have adequate teaching materials and the quality of the teaching materials was inadequate. Based on Figure 3, 95% of respondents agree on the need to create a STEM module to be a guide and teacher reference when conducting lesson in the classroom.

Table 3. Teacher Perceptions on STEM Teaching Information Resources

| SOURCE OF TEACHING INFORMATION | STS (1) | TS (2) | N (3) | S (4) | SS (5) | MIN |
|--------------------------------|---------|--------|-------|-------|--------|------|
| 1. In My Opinion, I Do not Think STEM Education Approach Suits In The Teaching And Learning Session | 6       | 18     | 10    | 4     | 2      | 2.45 |
| 2. I do not have Sufficient Materials For Teaching | 3       | 7      | 19    | 8     | 3      | 3.03 |
| 3. Existing Teaching Materials Quality is Inadequate | 3       | 1      | 12    | 19    | 5      | 3.55 |
| Mean                                           |         |        |       |       |        | 3.01 |

Figure 3. Requirements of STEM Module among Respondents
3.4. Course / Training / Seminar Related to STEM

Based on the findings, almost half of teachers agree that they are not exposed to STEM implementation in teaching and learning. A total of 10 teachers were not sure whether they had been exposed to STEM implementation. Min this item is 3.1 as shown in Table 4. Respondents were also asked about the number of courses they attended as shown in Figure 4, 57.5% of the teachers stated they had never attended STEM related courses in the teaching and learning process in the classroom.

Table 4. Seminar on STEM-related training courses

| STEM RELATED TRAININGS                                      | STS | TS  | N  | S  | SS | MEAN |
|-------------------------------------------------------------|-----|-----|----|----|----|------|
| I was not exposed by STEM in teaching and learning          | 3   | 10  | 10 | 14 | 3  | 3.1  |

Figure 4. List of Courses Attended by Respondents

3.5. Challenges Faced by Teachers During Implementation of STEM In Classroom.

Based on the questionnaire given, the researcher lists seven challenges faced by the teacher. Respondents are allowed to choose the two most important challenges. Among the challenges is, Not enough time, unusual with STEM, facilities / resources / resources, student interests, encouragement of parents, insufficient support / initiative from the government and lack of teaching skills / beliefs. The findings as illustrated in Figure 4. As many as 57.5% of respondents say the main challenge faced by them during STEM teaching and learning is inadequate time. Followed by resource materials. A total of 20 teachers stated that the STEM source material was reduced to being a challenge to them. Respondents also stated that it was not uncommon for STEM to challenge them (42.5%). Lack of skills and insufficient support from the school gave a percentage of 30% and 25% respectively. Students' interest in STEM and encouraging parents is the least challenging problem faced by the respondents. Each carrying a 22.5% and 17.5% respectively.

4. Discussion

Teachers play a key role in determining the quality of implementation of any new education policy [9]. Often the changes in education have failed due to lack of attention given to aspects of implementation, particularly the needs of executives. Therefore, the perception of STEM Education is an important thing to know to ensure the smoothness and effectiveness of a program. Based on this study, the teacher's early perception of STEM depicts positive values. Overall min is 3.53. Almost all teachers (80%) agree that student exposure to STEM is important. Teachers also encourage students to continue their studies in STEM related fields. People are less exposed to engineering jobs or STEM. With positive exposure
and encouragement from the side teachers can increase the number of students taking the STEM majors as their major department at higher education [9]. The item on teachers' perceptions on government policy that STEM emphasizes in teaching and learning provides a mean value of 3.35 and a total of 22 teachers agree and strongly agree that the number of teachers who agree on the national curriculum item prioritizes the STEM approach teaching and learning. The teachers also agree that the STEM education curriculum is too much and that teachers do not have enough time to plan and provide effective teaching aids. Min both items are 3.55 and 3.58. However, the teachers are still convinced of their teaching even though they state STEM curriculum is too much (min = 3.35) With the education system in Malaysia that has centralized, curriculum, teaching and learning, and all the assessments need to be pursued to form perfect education at all levels. Changes in the curriculum will affect R & D and assessment in the national examination. Therefore, the Ministry of Education is advised to take into account the needs of schools, teachers, students, parents, members of the community and stakeholders before conducting STEM as a whole [8].

Teaching materials and resources are the main factor for a teacher to carry out the teaching and learning process. Teachers should use a variety of teaching and learning media tools while conducting learning activities. From the findings, there is not enough resources and teaching aids. The mean mean of both items is 3.29. The item is "I Do Not Have Sufficient Teaching Materials" and "Quality of Existing Teaching Materials is Inadequate". A form of STEM teaching modules should be established to facilitate implementers to implement the planned curriculum. The teaching preparations are also indirectly helping teachers to teach them more systematically, fluently and effectively, thus preventing discomfort while in the classroom. Teachers' skills are still inadequate, more than half of which 57.5% of teachers stated they had never attended any STEM-related courses in the teaching and learning process in the classroom. It should be a form of training or a professional development course to be given to these teachers. This is supported by a study [9] expressing the professional development of teachers in STEM should be focused on enhancing the content knowledge that will affect the practice of teachers. Through their research findings, it also shows that by providing training or courses to teachers will be able to change the attitude and perception of the next teacher in the pursuit of innovation especially in teaching. [9] also believes that lack of knowledge can make teachers feel uncertain about their ability, which will affect their confidence in teaching STEM subjects, thereby affecting the overall teaching and learning process.

Challenges to match the diversity of learning and teaching styles also in fact influence teacher's methods and pedagogy in teaching. This is in fact not a big problem if the teacher has a good level of knowledge and readiness to teach the students. Through the findings of this study, the main challenge for teachers to carry STD STEP is the time constraint in providing teaching preparations. A total of 57.5% of respondents experienced the challenge. Teachers should be given enough time to design various teaching methods so that the teaching is fun and impactful. The diversity of teacher teaching and teaching methods are several examples that relate to the influence of teacher teaching. Hence the teacher need to choose the appropriate teaching methods for their students. Meanwhile, 20 teachers mentioned that the STEM resource was reduced to their challenge. Teaching resources are tools that can help teachers achieve teaching objectives. Learning resources are all sources including verbal, non-verbal, singular, material, tools or techniques that can be used by teachers or students alone or in groups to enhance understanding during the learning process. Among the other challenges that influence the teacher is lack of skills and not enough support from the school to give a percentage of 30% and 25% respectively. In addition, less interest in STEM among students is also a lack of support from parents as well as challenges for respondents. These challenges need to be addressed urgently so that the wishes of the education ministry can be achieved. Therefore, the Ministry of Education is advised to consider the needs of schools, teachers, students, parents, members of the community and stakeholders in planning the STEM teaching and learning plan [10].
5. Conclusion
Overall, the results of this study have been successful in achieving the objectives set and providing answers to some of the research questions that have arisen from them. The findings show that the initial perception of STEM teachers is positive and ready to face the teaching and learning process of STEM. Despite the challenges faced by the respondents, they are still working to teach in accordance with the curriculum prepared by the Ministry of Education Malaysia. They still carry the process of teaching and learning as desired in STEM teaching and learning process even though the knowledge is still lacking. These teachers are expected to continue the teaching and learning process with enthusiasm and make these teachers more qualified and able to produce outstanding students in the future.

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