

Primary School Mathematics Teachers' Perceptions and Challenges in Implementing Classroom-Based Assessment (CBA) in STEM Mathematics Education

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Abstract

This study aims to determine primary school teacher's perception of STEM integration in mathematics education and the challenges faced in implementing Classroom Assessment for Mathematics learning. The design of this study is quantitative survey research that involved 30 of mathematics teacher in primary school around Kuantan, Pahang. The instrument used in this study was two questionnaires. The main objective of this study was to determine teachers' perception and challenges faced in implementing Classroom-Based Assessment (CBA) for STEM Mathematics learning. The data obtained was analyzed by using the Statistical Package for Social Science (SPSS) version 20.0. The study findings show indicating that teachers strongly agree that implementing STEM in learning requires teachers to possess a higher level of mathematical skills (highest mean score at 4.47, S.D.= 0.51) and pedagogical support may be beneficial in helping teachers integrate STEM more effectively into mathematics instruction. The most dominant challenge faced by teachers is time constraints (highest mean score of 4.27, SD = 0.58).

Keywords: STEM, Classroom-Based Assessment, SPSS, Perception, Challenges

Introduction

In recent years, the STEM has been widely discussed within Malaysian education system. STEM initiatives have been emphasized in Malaysia Education Blueprint (2013-2025) with main objective of equipping students with the skills needed to face challenges in science and technology while ensuring that Malaysia produces a sufficient number of STEM graduates. Under the Malaysia Education Blueprint (2013-2025), efforts to strengthen STEM across the education system were divided into three main phases. Wave 1 (2013-2015) focused on strengthening the foundations of existing programmes and encouraging students to pursue science-related streams. Wave 2 (2016-2020) emphasized capacity building through the involvement and support the broader range of stakeholders, while the third wave (2021-

2025) evaluated the achievements of the previous two waves to develop a roadmap for future innovations. Furthermore, the development of STEM education is regarded as crucial in supporting national policies related to science, technology and innovation, including the National Science, Technology and Innovation Policy (DSTIN) 2021-2030, the National Fourth Industrial Revolution (4IR) Policy, the National Energy Policy 2022-2040, and the National Nanotechnology Policy and Strategy 2021-2030.

In the context of school education, STEM was a philosophy or the way of thinking in which the disciplines of Mathematics, Science, Technology and Engineering were integrated into a relevant and appropriate educational subject implemented in schools (Abdullah et al., 2022). Through this approach, students were provided with broad learning experiences that enable the to apply scientific and mathematical concepts, making learning more engaging and effective while also serving as a platform for solving real-life problems. Choi (2024) stated that STEM is an educational approach that focuses on science, develops critical thinking skills and enhances problem-solving abilities in everyday life. In efforts to integrate STEM education nationwide, teachers play a significant role as agents of change in the implementation of STEM education at school. Teachers must possess a high level of readiness and understanding to adapt educational reforms, particularly those related to STEM education in the teaching and learning process (Abdullah et al., 2022).

Literature Review

The Malaysia Education Blueprint (PPPM) 2013-2025 has brought a new transformative direction for science and mathematics education in Malaysia by promoting educational practices that are aligned with the demands of the 21st century. Student-centred learning approaches encourages learners to actively construct knowledge, express their ideas and engage in problem-solving through appropriate guidance from teachers. In line with this aspiration, the integration of Science, Technology, Engineering and Mathematics (STEM) in teaching and learning process enhances students' creativity, critical thinking, collaboration and innovation, enabling the to develop effective solutions to rea-world problems (Adam et al., 2019). This aspiration is further reinforced in the Malaysia Education Plan (RPM,2026-2035), particularly through Strategy 3, which focuses on nurturing students' talents holistically across various strategic and high-impact fields including STEM, TVET (Technical and Vocational Education and Training) as well as sports and the arts. The strategy aims to develop a generation that is technologically literate, competitive, disciplined and possesses strong character and identity (RPM,2026-2035). Therefore, to successfully realise the implementation of STEM education within the Malaysian education system, teachers' readiness is the one of the most crucial factors. They play a vital role in planning, implementing and facilitating effective STEM-based teaching and learning activities at school. Their pedagogical knowledge, content expertise and positive attitudes towards STEM significantly influence the quality of classroom and students' learning experiences.

Research Contribution

This study contributes to the existing body of knowledge by providing empirical evidence on teachers' perception and identify the challenges faced in implementing classroom assessment within STEM-based mathematics learning. The finding will enhance the understanding of the factors that influence effective assessment practices in STEM education and address the existing gap in research related to classroom assessment in mathematics. Other than that,

from the practical perspective, the findings may assist teachers in identifying areas for professional growth and improving their assessment practices to better support STEM learning in the classroom. The study may also provide valuable insights for school leaders, teacher educators and policymakers in designing targeted professional development programmed and support systems to strengthen teachers' competency and readiness in classroom assessment. Ultimately, the findings are expected to contribute and improving the quality of STEM-based mathematics education and achieving the goals of the Malaysia education system.

Research Gap

Despite the growing emphasis on STEM education in Malaysia, further research is needed to understand how primary school mathematics teachers perceive and experience Classroom-Based Assessment within STEM mathematics education. Even though, the existing research has examined various aspects of STEM implementation, the needs and challenges faced by the teachers' is important because the effective STEM implementation requires not only the integration of mathematical concepts but also appropriate assessment practices. Addressing this gap, the present study examines primary school mathematics teachers' perceptions and challenges in implementation CBA in STEM mathematics education in Malaysia. The findings are expected to provide context-specific insights into teachers' assessment practices and guide targeted professional development to strengthen CBA in STEM.

Objectives of the study

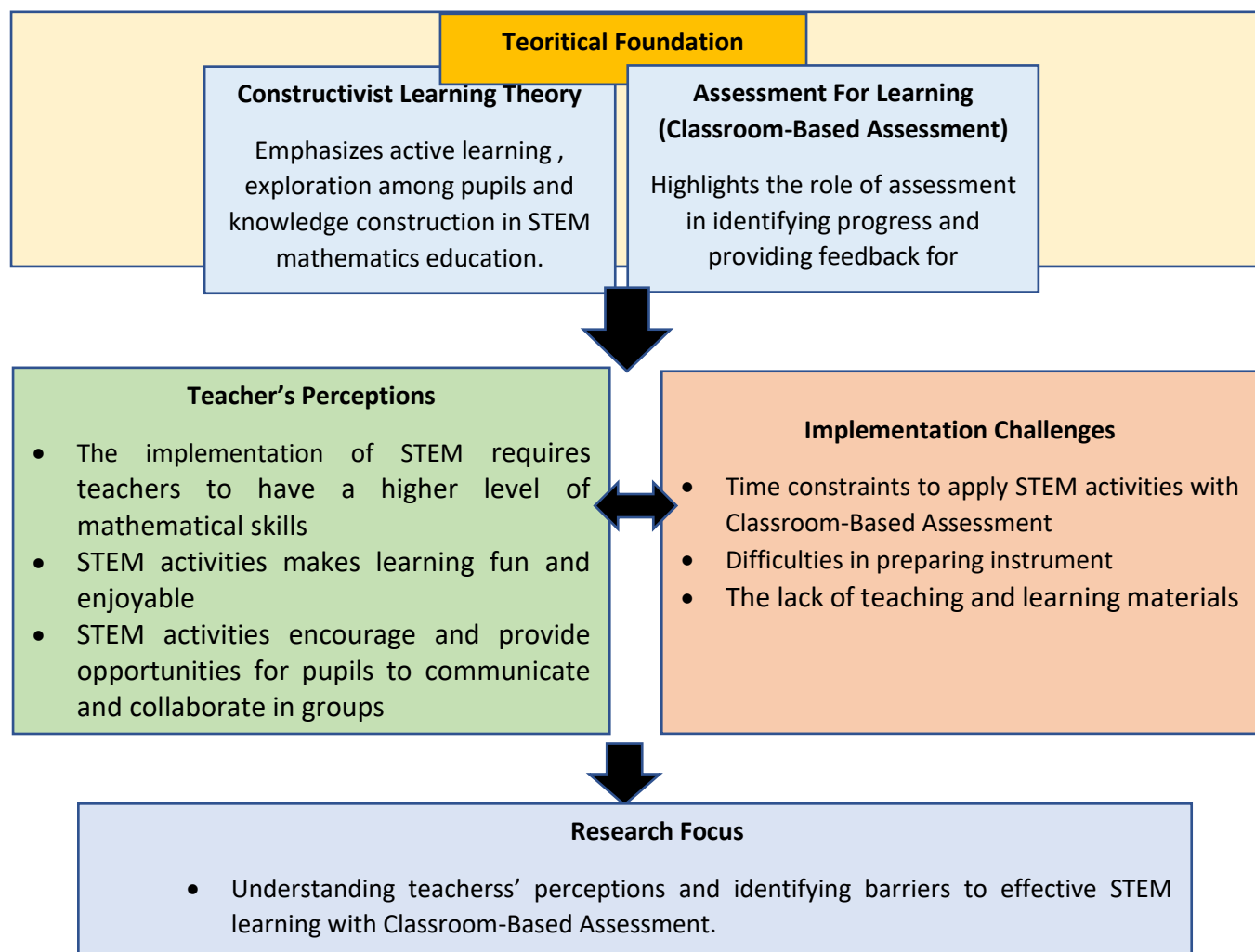
To determine primary school teacher's perception of STEM integration in mathematics education.

To identify the challenges and barriers faced by primary school teachers in implementing Classroom-Based Assessment (CBA) in STEM mathematics education.

Research questions of the study

What are the levels of primary school teachers' perception of STEM integration in mathematics education?

What are the challenges and barriers faced by primary school teachers in implementing Classroom-Based Assessment (CBA) in STEM mathematics education?

Conceptual Framework**Methodology and Results***Research Design*

Research design is formulated to explain the methods used in collecting, testing, analyzing information and data including research hypothesis, research techniques, research instruments and the scope of the study (Fuad Mohamed Berawi, 2024). This study focused on quantitative research approach which refers to the use of objective measurement to generate numerical data and analyzed using statistics (Othman Talib, 2022). Thus, this study adopts a quantitative cross-sectional survey design to investigate the levels of readiness and competency among primary school mathematics teachers in implementing Classroom Assessment for STEM education. Structured questionnaire used to collect data from primary mathematics teachers. The collected data were analysed using descriptive statistics, including frequencies, percentages, means and standard deviation to determine the levels of teachers' perception as well as the challenges for implementing Classroom Assessment for STEM in mathematics education.

Sampling and Population

Sampling is a fundamental technique in research which involves selecting a smaller group or sample from a larger population to represent the whole (Jessica, 2024). Ali Hussain (2025) stated that sampling is a statistical technique for efficiently analysing large datasets by

selecting a representative subset which is sample. This study involved a sample of 30 mathematics teachers, consisting of 14 teachers with fewer than 15 years of teaching experience (46.7%) and 16 teachers with more than 15 years of teaching experience (53.3%).

Instrument

Instrument is a list of equipment,tools,software used in a study (Fuad, 2024). Equipment in research consists of the questionnaires, notebooks,videos,cameras or voice recorders. While, for the software in research consists of SPSS, SAS or Ms Excel. In this study, the researcher used a questionnaire as the research instrument for data collection.

Questionnaire

This study involved two questionnaires, both using a five-point Likert Scale. The first questionnaire examined teachers' views on the implementation of STEM in mathematics education. The second one examined the challenges and barriers faced by primary school teachers in implementing Classroom-Based Assessment (CBA) in STEM mathematics.

Statistical Test Used

The data in this study were analyzed using Statistical Package for Social Science (SPSS) version 20.0. descriptive statistics, including frequency,percentage, mean and standard deviation were used to analyse the data. Frequency and percentage were used to describe the demographic profile of the respondents, while mean and standard deviation were used to determine the level of primary school mathematics teachers' perception (Research Question 1) and challenges in implementing Classroom-Based Assessment (CBA) in STEM mathematics education (Research Question 2). Thus, the findings of this study aimed to address the two research questions concerning teachers' perceptions and the challenges they encountered in implementing CBA in STEM.

Result

Demographic Characteristics of Respondents

A total of 30 primary school mathematics teachers participated in this study. Tables 1 presents the demographic characteristics of the respondents, including gender,teaching level and teaching experience.

Table 1

Demographic Characteristics of Respondents (N=30)

Demographic Characteristic	Category	Frequency	Percentage (%)
Gender	Male	9	30.0
	Female	21	70.0
Teaching Level	Level 1	12	40.0
	Level 2	11	36.7
	Both level 1 and 2	7	23.3
Teaching Experience	1-10years	8	26.7
	11-20 years	6	20.0
	21-30 years	15	50.0
	More than 30 years	1	3.3
Total		30	100.0

The findings indicate that the respondents comprised teachers with varied demographic characteristics and teaching experience. In terms of teaching experience, 8 respondents (26.7%) had between 1 and 10 years of teaching experience, 6 respondents (20.0%) had between 11 and 20 years of teaching experience, 15 respondents (50.0%) had between 21 and 30 years of teaching experience, while only 1 respondents (3.3%) more than 30 years of teaching experience. Regarding teaching level, 12 respondents (40.0%) taught level 1 only, 11 respondents taught level 2 only, while 7 respondents taught both level 1 and 2.

Table 2

Teachers' Perception of STEM in Mathematics Education

No	Item	Mean	Interpretation	Standard Deviation
1	The STEM approach in mathematics helps to increase pupils' interest in learning	4.20	High	0.55
2	STEM activities make learning enjoyable and meaningful	4.33	High	0.55
3	STEM can enhance pupils' mathematical problem-solving skills	3.90	High	0.48
4	STEM-based activities can help pupils become more creative and critical thinkers	4.13	High	0.68
5	I believe that the implementation of STEM in schools can improve pupils' achievement and understanding of mathematical concepts	4.00	High	0.70
6	STEM implementation encourages pupils to relate mathematics learning to real-life situations	4.17	High	0.46
7	The implementation of STEM in learning requires teachers to have a higher level of mathematical skills	4.47	High	0.51
8	STEM-based activities encourage and provide opportunities for pupils to communicate and collaborate in groups	4.33	High	0.48
9	I believe that integrating STEM into mathematics can help pupils develop higher-order thinking skills (HOTS) in mathematics	4.13	High	0.63
10	Overall, I support the implementation of STEM in mathematics learning	4.23	High	0.57

Table 2 presents the mean and standard deviation for the survey findings regarding teachers' perceptions of the implementation of STEM in mathematics education across 10 evaluated items. Overall, all items fall within the high interpretation level. The mean score were interpreted using three levels : low (1.00-2.33), moderate (2.34-3.67), and high (3.68-5.00). the class intervals were calculated based on the range of the five-point Likert Scale (Landell,1977).

Based on the table given, item 7 registered the highest mean score at 4.47 (S.D.= 0.51), indicating that teachers strongly agree that implementing STEM in learning requires teachers to possess a higher level of mathematical skills. This is followed by Item 2 ('STEM

activities make learning enjoyable and meaningful') and Item 8 ('STEM-Based activities encourage and provide opportunities for pupils to communicate and collaborate in groups'), both recording the second-highest mean score at 4.33 (S.D.= 0.55 and 0.48, respectively).

Furthermore, the overall support among teachers for STEM implementation in mathematics learning is highly positive, as demonstrated by Item 10 ("*Overall, I support the implementation of STEM in mathematics learning*") with a mean score of 4.23 (S.D. = 0.57). Regarding higher-order thinking, teachers agreed that STEM integration helps pupils develop higher-order thinking skills (HOTS), as shown in Item 9 (Mean = 4.13, S.D. = 0.63), as well as assisting pupils to become creative and critical thinkers as reflected in Item 4 (Mean = 4.13, S.D. = 0.68). On the other hand, the lowest mean score was observed in Item 3 ("*STEM can enhance pupils' mathematical problem-solving skills*") with a mean value of 3.90 (S.D. = 0.48). Nevertheless, this score remains within the high interpretation range.

Overall, the standard deviation values across all items are relatively small, ranging from **0.46 to 0.70**. This indicates that the respondents' answers are consistent and show minimal variation from one another.

Table 3

The Challenges and Barriers Faced In Implementing Classroom-Based Assessment (CBA) In Stem Mathematics Education

No	Item	Mean	Interpretation	Standard Deviation
1	I find it difficult to plan STEM mathematics activities that are appropriate for the implementation of Classroom-Based Assessment	3.77	High	0.63
2	Time constraints are the one of the factors that make it difficult for me to implement Classroom-Based Assessment during STEM activities in school	4.27	High	0.58
3	I find it difficult to prepare assessment instruments, such as checklists and rubrics, that appropriate for STEM activities	4.07	High	0.74
4	Pupils find it difficult to cooperate during STEM activities	3.27	Moderate	0.78
5	I find it difficult to manage Classroom-Based Assessment records after Stem activity	3.40	Moderate	0.81
6	The lack of teaching and learning materials make make it difficult for me to conduct Classroom-Based Assessment	4.03	High	0.56
7	I find it difficult to assess pupils' creativity and problem solving skills during STEM activities	3.63	Moderate	0.81
8	I find it difficult to provide effective feedback to pupils immediately after STEM activities	3.50	Moderate	0.78
9	I feel that I have insufficient readiness and guidance regarding Classroom-Based Assessment methods in STEM education	3.63	Moderate	0.72
10	There are limited reference materials or STEM modules available for teachers to refer to when conducting Classroom-Based Assessment during STEM activities in mathematics	3.83	High	0.75

Table 3 presents the mean scores, interpretations, and standard deviations regarding the challenges and barriers faced by teachers in implementing Classroom-Based Assessment (CBA) in STEM mathematics education across 10 items. Overall, the findings reveal a combination of high and moderate levels of agreement among respondents regarding these obstacles.

The most dominant challenge faced by teachers is time constraints, as reflected in Item 2 (*"Time constraints are one of the factors that make it difficult for me to implement Classroom-Based Assessment during STEM activities in school"*), which recorded the highest mean score of 4.27 (S.D. = 0.58). This is followed closely by Item 3 (*"I find it difficult to prepare assessment instruments, such as checklists and rubrics, that are appropriate for STEM activities"*) and Item 6 (*"The lack of teaching and learning materials make it difficult for me to conduct Classroom-Based Assessment"*), with mean scores of 4.07 (S.D. = 0.74) and 4.03 (S.D. = 0.56) respectively. Both items fall under the high interpretation level.

Other challenges categorized at a high level include limited reference materials or STEM modules for conducting CBA (Item 10: Mean = 3.83, S.D. = 0.75) and difficulty in planning appropriate STEM mathematics activities for CBA implementation (Item 1: Mean = 3.77, S.D. = 0.63).

Conversely, several items were interpreted at a moderate level. These include teachers' perceived lack of readiness and guidance regarding CBA methods in STEM education (Item 9: Mean = 3.63, S.D. = 0.72) and difficulties in assessing pupils' creativity and problem-solving skills (Item 7: Mean = 3.63, S.D. = 0.81). Additionally, providing immediate effective feedback (Item 8: Mean = 3.50, S.D. = 0.78) and managing CBA records post-activity (Item 5: Mean = 3.40, S.D. = 0.81) were also rated at a moderate level.

The lowest mean score recorded was for Item 4 (*"Pupils find it difficult to cooperate during STEM activities"*), with a mean of 3.27 (S.D. = 0.78), indicating that student cooperation is perceived as a moderate challenge compared to structural and logistical constraints. Overall, the standard deviation values range between 0.56 and 0.81, reflecting a fairly consistent pattern of responses across all respondents.

Conclusion

Overall, the first questionnaire findings provide insights into teachers' perceptions in STEM mathematics education. Based on the descriptive statistical analysis of responses from 30 teachers, the mean and standard deviation values provide an overview of teachers' levels of agreement with the questionnaire items and the variability of their responses. The findings suggest that teachers are receptive to STEM implementation in mathematics learning. However, positive perceptions alone may not guarantee effective classroom implementation. Therefore, appropriate professional development, practical teaching resources, and pedagogical support may be beneficial in helping teachers integrate STEM more effectively into mathematics instruction.

The second questionnaire findings indicate that teachers face several challenges in implementing Classroom-Based Assessment (CBA) in STEM mathematics education, particularly in terms of time constraints, assessment preparation, and the availability of

teaching and learning materials. Time constraints emerged as the most significant challenge, with the highest mean score of 4.27 (SD = 0.58). This was followed by difficulties in preparing suitable assessment instruments and the lack of teaching and learning materials. These findings suggest that effective CBA implementation requires adequate time, appropriate assessment tools, and sufficient instructional resources to support STEM-based mathematics activities.

Other challenges, including limited reference materials, difficulties in planning STEM mathematics activities, and teachers' readiness to implement CBA, further highlight the need for additional guidance and support. Although pupil cooperation was perceived as a relatively less significant challenge, teachers still reported moderate difficulties in providing effective feedback, managing assessment records, and assessing pupils' creativity and problem-solving skills.

In conclusion, the findings suggest that improving CBA implementation in STEM mathematics education requires more than teachers' willingness to adopt STEM approaches. Schools and relevant educational authorities should consider providing practical assessment resources, accessible STEM teaching modules, professional development opportunities, and sufficient time for assessment planning and documentation. Addressing these challenges may help teachers implement CBA more effectively and support meaningful assessment of pupils' learning in STEM mathematics education.

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