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The Development of Project-Based STEM Teaching Model by Implementing Rapport Elements for Mathematics Primary School: A Needs Analysis

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ABSTRACT

Pelan Pembangunan Pendidikan Malaysia (PPPM) involves three main waves since 2013 to 2025 which focused on the element of Science, Technology, Engineering and Mathematics (STEM). The main purpose of this research was to identify the needs to develop the project-based STEM teaching model with the implementation of rapport elements for mathematics primary school. This research adopted a survey method where a set of questionnaires was distributed through google form to 400 mathematics teachers of the primary school in Johor. The data were analyzed by using the software of Statistical Package for the Social Science (SPSS) version 26.0. The descriptive analysis, frequency, mean, and standard deviation were used to determine the needs in developing the STEM teaching model. The findings on the descriptive analysis showed that, all the respondents agreed that there is a need to develop the project-based STEM teaching model with the implementation of rapport elements in the process of teaching and learning of Mathematics in primary schools The implementation of rapport elements in the teaching process is necessary so that the basic knowledge and skills of mathematics can be mastered by students and hence can contribute to improve student achievement and motivation in school.

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INTRODUCTION

The gradual changes in the Malaysian educational system through the Pelan Pembangunan Pendidikan Malaysia (PPPM) involves three waves which the first one started in 2013 until 2015, continued with the second wave from the year 2016 until 2020 while the third wave start in the year 2021 until 2025 that design in accordance to the rapid changes in the global development (Kementerian Pendidikan Malaysia (KPM),2016). The structural changes in Malaysia's educational system are caused by the world economic factor which is based on the knowledge and digital revolution that had helped to mitigate the worries at the global stage aligned with the labour force needed in the 21st century (Gopal, Salim & Ayub, 2019; Rosli, 2016; Thien & Ong, 2015).

Research by Mazura, Corrienna, Hassan, Marlina and Mohd Ali (2019) showed that the process of teaching and learning that involves Science, Technology, Engineering, and Mathematics (STEM) cannot be fully implemented due to the lack in knowledge in planning and implementing the session in primary school. Thus, the arising issue here is that whether the mathematics teachers in primary school have the teaching model or any guidance in implementing STEM or not for the students? Based on the findings done by Nur Farhana and Othman (2017) found out that the teachers could not implement STEM in teaching and learning process due to some problems such as time constraint, teachers' preparation in respect to the knowledge in implementation, ways to integrate the four main elements of STEM as well as the environment factor that limits the implementation in the classroom. This clearly shows that there is a need to develop the STEM teaching model by implementing rapport elements in project based as a guidance for the mathematics teachers in primary school.

LITERATURE REVIEW

The findings of the research done by Abdul Rasid and Nurfatin Nabihah (2018) showed that the teachers focused to complete the syllabus during the teaching process to the extent that they ignored the difference between the student's ability during the process of teaching and learning. Most of the students studied mathematics with lack motivation due to no implementation of rapport element before the teaching process is conducted (Gopal et al., 2019; Ahmad Fauzi, Aida Suraya, Rosnaini, Nur Raidah & Tajularipin, 2017; Lee, 2014). This can cause the students' motivations and the 21st century skills to drop and in turn will affect with their mathematics achievement. Therefore, the shortcomings in implementing the rapport element for the teaching and learning process needs to be considered.

Aligned with the changes, the process of teaching and learning of the mathematics subject these days need to evolve along with the global development through the implementation of rapport elements in the aspect of affective, behaviour, and cognitive (Subramainan & Mahmoud, 2020; Fredricks, Filsecker, & Lawson, 2016; Sherno, Kelly, Tonks, Anderson, Cavanagh, Sinha, & Abdi, 2016). Furthermore, in the past two decades, previous research on the rapport elements among the students showed that the rapport elements have become an essential factor in improving students' academic achievement in mathematics subject which subsequently influence the students' emotions (Fredricks et al., 2016; Thien & Darmawan, 2016; Ting & Tarmizi, 2016). The importance of implementing the rapport element cannot be doubted anymore. This is due to the findings on the improvement of the students' performances as a result from the implementation of the rapport element that enhance the students' achievements and motivations in school.

Modul Bahan Sumber STEM (BSTEM) Matematik Sekolah Rendah released by Kementerian Pendidikan Malaysia in 2017 did not focus on the implementation of rapport elements in the teaching and learning process. The lack of implementation of rapport elements in this module which uses 5E Model (Bybee, 2009) that only focus on cognitive aspects will be improved by Gullapyan Model (Gullapyan, 2020) which will be focused on the three main aspects which are cognitive, behavioral and affective aspects.

This clearly showed that there is a need to develop the project-based STEM teaching model by implementing rapport elements as a guidance for the mathematics teachers in primary school during the process of teaching and learning in mathematics subject and also able to act as the solving method to be used in restrain the motivational and performance-related issues among the students.

RESEARCH OBJECTIVES

The objectives of this research are:

1) To identify the need to develop project-based STEM teaching model with the implementation of rapport element for mathematics primary school.
2) To identify level of knowledge and mastery of student in Mathematics
3) To identify level of knowledge and mastery of teacher in Mathematics

METHODOLOGY

A set of questionnaire was used as research instrument through survey method to identify the needs of developing the project-based STEM teaching model with the implementation of rapport elements for mathematics primary school. The survey method is conducted with the purpose to collect information and data from a larger population in making the generalization.

This research is conducted by using the simple random sampling method which involving the population of 1839 Standard Two mathematics teachers in primary school in Johor (Jabatan Pendidikan Negeri Johor, 2020). Based on the table of Krejcie and Morgan (1970), the total of samples required is 317 respondents. A total of 400 respondents consisting of mathematics teachers in the district of Johor Bahru, Pasir Gudang, Kota Tinggi, Kulai, Kluang, Batu Pahat, Pontian, Mersing, Segamat, Muar and Tangkak were involved in this study.

The research instrument that has been adopted is structured questionnaire that varies depending on the instrument on the research conducted by Amani (2014) and Ahmad Sobri (2010). There are three parts in the questionnaire which are the first one from the demographic information and the teachers' backgrounds. The second part consists of questions that come with 5 Likert scales (1) Strongly Disagree, (2) Disagree, (3) Moderately Agree, (4) Agree, (5) Strongly Agree that involve the knowledge and mastery of the students in Mathematics. While the third part involves the knowledge and teacher's mastery aspect in Mathematics.

A set of structured questionnaires adapted and modified from research conducted by Amani (2014) and Ahmad Sobri (2010) was used as the research instrument. This questionnaire consists of three parts, where the first part gives the demographic information and the teachers' backgrounds, the second part consists of 5 Likert scales questions that involves the knowledge and mastery of the students. While the third part involves the knowledge and teacher's mastery aspect.

The collected data has been analysed by using the software of Statistical Package for The Social Science (SPSS) Version 26.0. Descriptive analysis, frequency, mean, and standard deviation were used to determine the needs in developing the project-based STEM teaching model with the implementation rapport elements based on the perceptions of the primary school mathematics teachers in Johor. The mean score's interpretation level is given as in Table 1 (Muhammad Nidzam, 2017).

Table 1: Mean Score's Interpretation Level

Mean Score	Interpretation Level
4.01 until 5.00	High
3.01 until 4.00	Moderate High
2.01 until 3.00	Moderate Low
1.00 until 2.00	Low

Source: Muhammad Nidzam (2017)

Validity and Reliability

The content of the questionnaire instrument was ensured to have gone through an expert validation process before the pilot test was implemented. The validity process involved three experts in mathematics education and two experts in language area. This verification process is a process that can ensure the accuracy of the content of the research questionnaire items. This is to enable respondents to understand and answer the items given and to ensure the accuracy of the items and format of the instrument. This validation process can also ensure the effectiveness of the variables and the consistency of the item content.

After the validity process is conducted, the pilot test will be performed to 30 people as a sample. The purpose is to identify the clarity of the question, item is in accordance to the format, and the measurement scale that will be used in that instrument. Johanson and Brooks (2010) proposed suitable number of samples for pilot test which is 30.

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Table 2 shows the Cronbach's Alpha values obtained as a result of the analysis of the items of the two constructs used in the questionnaire. The findings of the analysis showed that the alpha value (α) collected is more than 0.7. According to Loewenthal (2001), alpha value (α) which is more than 0.80 is considered as high. For the alpha value (α) between 0.70 until 0.80, the reliability value is moderate and still acceptable. The reliability alpha value (α) which is less than 0.60 is considered as weak.

Table 2: Summary of Cronbach Alpha for Pilot Test according to construct and alpha value (α)

No	Variable item	Alpha Value (α).
1	The students' knowledge and mastery	.750
2	The teachers' knowledge and mastery	.853

RESEARCH FINDINGS

i) Findings on the need analysis for develop the model

Table 3: Respondents' Demographics

Item	Categories	Frequency	Percentage (%)
Gender	Men	228	57.0
	Women	172	43.0
Teaching experience	More than 10 years	117	29.3
	More than 15 years	173	43.3
	More than 20 years	110	27.5
Needs to develop the model of teaching	Yes	100	100.0
	No	-	-
	Total	**400**	**100.0**

Based on Table 3, shows that the number of respondents of men are 228 (57.0%) while the women respondents are 172 people (43.0%). In the aspect of teaching experience, the findings showed that the respondents that have experience exceeded 10 years are 117 persons (29.3%), while the respondents that have exceeded 15 years of teaching experience are 173 persons (43.3%), and the respondents that have exceeded 20 years of teaching experience are 110 persons (27.5%).

As for the needs in developing the model of teaching, all the respondents (100.0%), agreed that there is a need to develop the project-based STEM teaching model with the implementation of rapport elements as a guidance to mathematics primary school teachers in their teaching and learning processes in the classroom.

ii) The analysis of students' knowledge and mastery in Mathematics

Table 4: The students' knowledge and mastery in Mathematics

No	Items	Mean	Standard Deviation
1.	The students are unable to understand the mathematics concept to be used in their daily lives.	3.82	0.686
2.	The students are unable to master the communication skills while solving the questions.	3.95	0.876
3.	The students are unable to share the ideas with the other students.	3.83	0.686
4.	The students are unable to build a good rapport with the other teachers and students.	4.50	0.501
5.	The students are not discussing with the other friends to respond their ideas	3.34	0.473
6.	The students are unable to relate the subtopic every time during the teaching and learning process	3.50	0.501
	Average	**3.82**	**0.621**

The findings from this research showed that the fourth item has the highest mean, 4.50 (SD= 0.501) with the statement, the students are unable to build a good rapport with the other students and teachers. As for the fifth item, the students are not discussing with the other friends to respond their ideas placed at the lowest mean 3.34 (SD=0.473). However, based on the mean interpretation showed that it is still higher. The findings clearly showed that the respondents believed that there is a need to implement the rapport elements in the process of teaching and learning of mathematics primary school.

iii) The analysis of teachers' knowledge and mastery in Mathematics.

Table 5: The teachers' knowledge and mastery in Mathematics.

No	Items	Mean	Standard Deviation
1.	I am unable to come out with the teaching plan for STEM by applying project based in the classroom.	3.90	0.701
2.	I am unable to do the implementation in teaching of STEM by applying project based in the classroom.	3.47	0.561
3.	I do not understand the way to integrate the element of STEM through the teaching by applying project-based for mathematics subjects.	4.03	0.178
4.	I am unable to implement the rapport elements in the process of teaching by applying project-based for mathematics subjects.	4.57	0.496
5.	I am unable to choose a suitable strategy for teaching STEM by applying project based for mathematics subjects.	3.80	0.754
6.	I am unable to plan suitable activities for teaching STEM by applying projects based for mathematics subjects.	3.58	0.696
7.	I am unable to respond or reflect on the teaching STEM by applying project based for mathematics subject.	3.46	0.499
8.	I am unable to evaluate the performance of the students for teaching STEM by applying project based for the mathematics subject.	3.53	0.500
9.	I am unable to generate critical thinking among the students to create the project.	4.04	0.825
10.	I am unable to retain the students' interest to study consistently through project-based learning.	3.92	0.810
11.	I am unable to retain the students' motivation to study consistently through project-based learning.	3.80	0.749
	Average	**3.83**	**0.615**

The findings have shown that the 7th item (*I am unable to respond or reflect on the teaching STEM by applying project based for mathematics subject*) is at the lowest level, with a mean value 3.46 (SD=0.499). While the 4th item (*I am unable to implement the rapport elements in the process of teaching by applying project-based for the mathematics subject)* is at the highest level, with a mean value 4.57 (SD=0.596). The research findings showed that the majority of respondents are unable to

implement the rapport elements during the process of teaching and learning. Thus, it requires a solution to these issues by developing the project-based STEM teaching model with the implementation rapport elements so that it can be used as a guidance to mathematics primary school teachers in implementing rapport in the teaching and learning process.

DISCUSSIONS

This study shows strong evidence on the need to develop project-based STEM teaching model with the implementation of rapport element for mathematics primary school. All the respondents, agreed that there is a need to develop the project-based STEM teaching model with the implementation of rapport elements as a guidance to mathematics primary school teachers in their teaching and learning processes in the classroom. Teachers need to play an important role in the implementation of rapport elements in three main aspects which are cognitive, behavioral and affective in the teaching and learning process because teachers play a role in creating a conducive and safe learning environment to attract students to learn and improve their achievement in mathematics (Gopal et al., 2019). The findings of this study are in line with the opinion by Ahmad Fauzi et al., (2017) who also agreed that teachers are responsible for implementing the rapport elements among students for mathematics subjects in primary schools. In addition, teachers should also motivate students to encourage them to be more interested in learning sessions and producing more creative and innovative students (Subramainan & Mahmoud, 2020; Fredricks et al., 2016).

CONCLUSION AND RECOMMENDATION

As a conclusion, the analysis of the findings showed that the respondents agreed that there is a need to develop the project-based STEM teaching model with the implementation of rapport elements in the teaching and learning of mathematics. Therefore, each teacher has a role in implementing the element of rapport during the teaching and learning process of mathematics, in order to ensure a more effective learning process, so that in turn can help to improve students' performance in mathematics and also able to produce skilled students in line with 21st century evolution. This teaching model is expected to be a guidance for mathematics teachers in implementing the element of rapport during the teaching and learning process of mathematics in primary schools.

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