

Achieving Quality Learning Through STEM Education Towards Kindergarten Teachers' Perceptions

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ABSTRACT

STEM Education is one of the elements that need to be applied in 21st Century Education (PAK-21). However, STEM Education is given less attention by many early childhood education (ECE) teachers due to various factors that influence its implementation in kindergartens such as lack of exposure to STEM Education information and many more. This study was conducted to see the perceptions of kindergarten teachers on how they think about the importance of STEM Education itself in order to ensure the quality of children's learning can be achieved through STEM Education at the early schooling level. The objectives of this study are (i) to explore the best practices of teaching STEM Education; (ii) to explore the accessibility of informative knowledge through STEM education; (iii) to explore the integration of STEM disciplines in STEM activities; and (iv) to explore the implementation of STEM activities in teaching and learning sessions. There were 4 participants selected in this study and they were kindergarten teachers with different backgrounds. Besides that, a set of interview protocols was used as an instrument in this study containing 16 questions. Data were analyzed using NVIVO software version 10. The findings of the study found that there are various methods, strategies, techniques, and creative teaching methods that can be used in STEM education because it will provide quality learning to children holistically. In line with the agenda of the Ministry of Education Malaysia in elevating STEM Education, it is hoped that the study will be a reference for ECE teachers.

Keywords: STEM Education, 21st Century Learning, Quality Learning, Best Practice

INTRODUCTION

In everyday practice, interdisciplinary approaches to scientific knowledge and abilities are critical. As a result, distinct educational breakthroughs and STEM education are disclosed. STEM education is built on an interdisciplinary approach, which approaches these four fields as a holistic and undifferentiated whole rather than teaching them separately. STEM education, as an integrated educational system, is a method to learning that is based on natural linkages across STEM courses. (2) increasing student comprehension of STEM fields by exposing them to socially relevant STEM contexts; and (3) making STEM fields and occupations more accessible and appealing to students (Wang, Moore, Roehrig & Park, 2011). STEM education strives to prepare qualified people in the domains of science, mathematics, and engineering. In this scenario, it makes STEM education (Barnett, 2005; Thomas, 2014);

- i. Enables children to develop critical thinking and upper thinking skills.
- ii. Empowers teachers to motivate students to learn mathematics and science by introducing them to current and innovative approaches.
- iii. Teaches science and mathematics, which helps to educate literate individuals.
- iv. Allows youngsters to practice critical thinking and higher-order thinking capabilities.
- v. Encourages pupils to learn mathematics and science by introducing them to cutting-edge techniques.
- vi. Assists in the development of well-equipped persons for the corporate sector.
- vii. Facilitates collaboration between industry and schools.
- viii. Contributes to the people's economic and technological growth.

STEM education and activities are thought to be important in the development of language skills. When children read science books, for example, it can spark new areas of STEM discussion. And what they've read may inspire children to plan and carry out an investigation to test a hypothesis, which is an important aspect of scientific research. Children would then be encouraged to talk to one another about their hypotheses and findings, which would help them build both essential literacy and comprehension abilities. Literacy and STEM subjects clearly complement one another. Minarni et al. (2016) in their study discussed that in STEM education provides opportunities for students to develop their creativity while striving in solving a problem. When STEM education is conducted well, it can help students to master 21st century skills, such as working together, problem solving, communicating, being creative and being able to use various media or technological equipment to facilitate work in daily life.

The competition and jobs of the future are very different from the present. It places more emphasis on 21st century skills, such as working together, problem solving, critical and innovative thinking, communicating, having high creativity and analytical skills. STEM education has been considered as something that needs to be taught and mastered by students especially starting at an early stage to prepare the generation in the face of 21st century competition (McClure et al. 2017). Blueprint 2013-2025 (Ministry of Education, 2013) emphasizes STEM education at the school level through curriculum and co-curricular activities with support from various stakeholders. STEM education was a means of engaging the younger generation. It emphasized the concept of 4C components, namely communication, collaboration, creativity, and critical thinking, as found in 21st century learning (PAK-21), as well as high-level thinking skills (KBAT). The development

of these components is viewed as producing young people with advanced problem-solving abilities. (Lopez & Whittington, 2001).

PROBLEM STATEMENT

STEM education is a discussion in all circles, especially for early childhood education in implementing STEM education. They become more motivated in pursuing STEM education when it is introduced in early childhood (Sobey, 2019). So there is a great need for teachers who master and have high qualifications in teaching STEM education so that the expected goals can be achieved well. Through this way, teachers can create quality learning for children but unfortunately according to Daud (2019), there are some challenges faced by teacher to deliver quality education in implementing STEM education. Briefly, quality learning is not only to ensure that children get good scores in summative or formative examination, but they need to be equipped with critical thinking skills, problem solving skills, decision making skills and other skills as well. This will be a big challenge for teachers on how to ensure both groups of children have equal access to education. Definitely, education is one of the most important benchmark in determining the quality of human life and it is able to move towards the achievement of the desired job (Samianand Awang, 2017).

There are some of problems faced by the teachers and children to empower STEM education at school level. Many types of STEM education approaches are difficult for students to implement due to a lack of knowledge and skills (Khalik et al., 2019). However, if teachers understand the concept of STEM well, then the implementation of activities in school will be easier. According to Nadelson and Seifert (2017), implementing integrated STEM education entails ill-structured problems with multiple solutions, as well as extensive knowledge in all disciplines. Some of the integrated STEM approaches used in schools include problem and project-based learning, as well as inquiry-based learning. Majority of proponents of STEM education emphasize the importance of purposefully integrating many disciplines in scenarios that foster real-world problem solving. To some extent, integration entails combining the four disciplines into a single entity (Breiner, Harkness, Johnson, & Koehler, 2012), yet there has recently been a push by experts outside of these four disciplines to include other domains in the STEM movement (Gervosani et al, 2017).

The implementation of the best STEM Education teaching and learning practices is able to influence the pan of children's education. Otherwise it is vice-versa. Poor quality early childhood education and care (ECEC) can be detrimental to the development of children from all backgrounds, particularly if they fail to equalise some of the disparities and disadvantages that children face in the early developmental stages of their lives. Disparities, for example, may be present in children's cognitive, physical, and social-emotional development (National Institute of Child Health and Human Development Early Child Care Research Network, 2005; Peisner-Feinberg et al., 1999). Without access to high-quality services (e.g., health care and education) that support the child and his/her family in the early years of life, potential negative pathways may lead to poor social, emotional, educational, health, economic and behavioural outcomes (Manning, Homel, & Smith, 2010).

RESEARCH OBJECTIVE

The main purpose of conducting this study is to:

- i. Explore the best practices of teaching STEM Education.
- ii. Explore the accessibility of informative knowledge through STEM education.
- iii. Explore the integration of STEM disciplines in STEM activities.
- iv. Explore the implementation of STEM activities in teaching and learning sessions.

METHODOLOGY

Design of Research

For this study, researcher has used a qualitative research method because the main purpose of the researcher is to see the results of the respondents' response to the instruments formed. According to Crossman (2020), qualitative research is a type of social science research that collects and works with non-numerical data and that seeks to interpret meaning from these data that help understand social life through the study of targeted populations or places. The focus of this study is a case study to generalize over several units. the researcher used a set of interview protocols in this study to answer the research questions that had been formed.

Sample and Population

In this study, researcher used purposive sampling. It is also known as judgement sampling, which is the purposeful selection of a participant based on the participant's characteristics. It's a nonrandom technique that doesn't require any underlying theories or a specific number of participants (Etikan, Musa, and Alkassim, 2016). Shortly, the samples of this study are 4 persons that consist of permanent teachers, pre-service teacher, part time teacher. Researcher did not emphasize the element of teaching experience in this study because researcher only wanted to investigate about their perceptions of STEM Education and not to look at their teaching. It is more flexible by taking a variety of perspectives from a variety of teacher backgrounds. The backgrounds of the sample can be seen as below:

Table 1.0: Sample's Workplace

NO.	SAMPLE'S WORKPLACE	NUMBER OF SAMPLE
1	Prasekolah Alor Pongsu, Perak	1
2	Islamic Kindergarten (Tadika PASTI), Negeri Sembilan	1
3	Potensi SAM Kindergarten, Kelantan	1
4	Kaffah Kindergarten, Perak	1

Research Instrument

Research instruments are simply devices for gathering information relevant to your research project, and there are numerous options available. There is just an instrument used for collecting data and it is just a set of interview protocol. In this study, researcher uses a semi-structured interviews. Basically, definition of structured interviews, it is an interview that has a set of

predefined questions and the questions would be asked in the same order for all respondents. But semi-structured interview is an exploratory interview used most often in the social sciences for qualitative research purposes or to gather data, (Magaldi & Berler, 2018). In the processes of interview sessions, researcher needs to make preparation regarding to the topic research specifically before researcher get the information from respondents. It means, researcher needs to explore more about how early childhood educators think about quality learning would receive by children through STEM Education. There are 4 respondents would be involved in this interview. The items of interview questions were designed by researcher himself with the guidance of his lecturer and then it was finally recertified by two experts. To ensure that researcher answers the research questions precisely, there are 16 items would be focused. The details of the interview sessions can be seen as in the table below:

Table 2.0: Interview Session Timeline

RESPONDENT	LOCATION	DATE/DAY	TIME
1	Online Platform	Sunday / May 23 rd 2021	5.00pm – 6.00pm
2	Online Platform	Sunday / May 23 rd 2021	8.35pm – 9.05pm
3	Online Platform	Tuesday/ May 25 th 2021	8.35pm – 9.05pm
4	Online Platform	Friday / May 28 th 2021	6.30 – 11.10

Procedure of Data Collection

The procedure of data collection in this study is as in the table below:

Table 3.0: Procedure of Data Collection Timetable

NO.	DATE	PROCESS
1	May 2021	Permission Application
2	May 2021	Work Planning
3	May 2021	Research Tools Preparation
4	May 2021	Research Time and Research Data Collection
5	Jun 2020	Research Data Analysis

Procedure of Data Analysis

There are three steps taken by researcher in analyzing the data. The first step is researcher would use the transcription method. Researcher would do the process of transcribing the obtained data from interview session and video recordings. Then, researcher would arrange the data after the transcription process. The data is arranged into several sections that has been reviewed and retrieved. Then, all data would be given particular codes and numbers to represent its contents. The third step taken by researcher is proceeding with coding process and determining category system. After the reading of transcriptions has successfully done, the data would be divided into several meaningful analysis units.

When the meaningful segments of data traced, so it finally would be coded. Data analysis through the three steps above is done by using NVIVO 10. This software would assist researcher to find out text segments, putting category labels on segments and arranging texts that relate to specific categories. The details of data analysis can be seen in the table on the next page.

Table 4.0: The Analysis Method for Collected Items

RESEARCH QUESTION	DATA COLLECTING	DATA ANALYZING
i. What is the best practices in teaching STEM Education in order to produce quality learning in the classroom?	Interviews	Microsoft Words NVIVO VERSION 10
ii. How do children access informative knowledge through learning STEM education in the classrooms?	Interviews	Microsoft Words NVIVO VERSION 10
iii. How do educators integrate Science, Technology, Engineering, and Mathematics in the lessons?	Interviews	NVIVO VERSION 10 Microsoft Words
iv. Explore the implementation of STEM activities in teaching and learning sessions.	Interviews	NVIVO VERSION 10 Microsoft Words

FINDINGS

This chapter focuses on a detailed description of the findings research. Data were obtained through one source which is interviews. A total of 4 participants were involved in this study, namely 4 early childhood education teachers from different backgrounds in their respective services. The data obtained were analyzed using a computer according to the NVIVO 10 software’s procedure.

Objective 1: Explore The Best Practices of Teaching STEM Education

To answer the first research question, there are four questions asked to the interviewee (IV). They are consisted of four sub-constructs which is project approach, learning through play approach, thematic approach, and inquiry approach. In this sub-topic, the research would reveal some particular information from all IVs. For project approach, IV1 stated that:

“I think this approach is effective for children in the context of STEM because it makes teacher’s work easier in teaching children,,,,, it can help students understanding what teacher have taught them”.

Besides that, for learning through play approach, IV2 stated:

“Learning through play is the best approach for children”

“When they are happy, surely, they will get a meaningful learning. When they get the meaningful learning, of course they will keep in the memory box”.

On the other hand, for thematic approach, IV4 stated:

“children will explore various kinds of things one of the benefits if we have specific theme on each week, we have something can be focused, and we can do a lot of activities regarding to those theme.

“it can help children to acquire any knowledge differently”.

Finally, for inquiry approach, IV3 stated,

“Thematic is absolutely needed. Because we teach them according to the theme”.

“It is necessary. If we have inquiry, children urmmmm, are not centered on one individual only. So, they will be centered between 2 persons which is children and teacher”.

“Inquiry approach is important”.

For this findings, the researcher has obtained positive data from all participants. It can be concluded that all the approaches namely project approach, learning through play approach, thematic approach, and inquiry approach are among the best of the best practices in implementing STEM activities to early years.

Objective 2: Explore The Accessibility of Informative Knowledge Through STEM Education

To answer the second research question, researcher had designed four questions to be asked to the interviewee (IV). They are consisted of four sub-constructs which are group-centered strategy, teacher-centered learning, tool-centered learning, and individual-centered learning. In this sub-topic, the research would reveal some particular information from all IVs. For group-centered strategy, all IVs expressed that it is important for children. As a proof, according to IV2:

“the group centered-learning strategy is one of the best strategies”

“it ensures children to acquire information regarding to any activities related to STEM”

“the group activity is needed between each other”

“they will learn together and it supports the learning of children”

On the other hand, for teacher-centered strategy, IV2 stated that:

“teacher needs to give them induction set first. It needs to be centered on teacher’s instructions first because sometimes, the things that we give, they can’t do it instead of our instruction”

“so the decision from teacher is important, they need to be guided one by one and at the end of the day, they know ow to handle it”

Besides, for tool-centered strategy, IV3 mentioned that:

“they need to learn with teaching tools first. If they can complete it well, means they master the teaching tool that I make”

In addition, for individual-centered strategy, IV1 guessed that:

“I think I am the one who loves observing children, when I give them the choices to make decision, so, for me, I like to see what they like to do”

“First child is interested to what. Second child is interested to what. So, I love observing the way they do something”

Summarily, for this findings, researcher had gotten rich information from each participant. Even there are a few opposite views among the IVS, but they shared the same information which is each of strategy is needed in teaching STEM Education for children.

Objective 3: Explore The Integration of STEM Disciplines in STEM Activities

For this part, researcher had to analysis different kinds of data from all of the interviewees (IVs). There are four sub-construct based on this objective which are combination integration (all of STEM disciplines are combined in one time learning), separation integration (there is only a disciplines focused by the teacher), couple integration (Mathematics and Science discipline are integration in one time learning), and merge integration (Mathematics and Science discipline are only integrated either in Engineering or Technology discipline. Based on the analysis data process on combination integration, IV3 states that:

“this integration is good for what,,, urmmm, children to know knowledge deeper, like you said just now, we explain to them about airplane, and then ask them to build airplane by using legos.

“From this situation, we can see that the collaboration between the subjects happens”

Besides, for separation integration, IV2 states:

“I think it needs to be taught separately. Because children are easy to be blurred”

“Science involves the exploration of nature world, the exploration of thing world. Mathematics involves the number. So, through this separate method, it is systematic to help children to understand and master any topic”

In addition, for couple integration, according to IV4:

“The benefit, is urmmmmm, children will acquire urmmm, such as we just focus on various kinds of knowledge. Maybe from the perspective of Mathematics they can learn it. From the perspective of Science, they can learn it”

“like what I told just now, it is not a must. Means that, if we can relate it, we may relate it. No need to think too much on how can we relate it like searching where is Technology element, where is Science element, and so on”.

Finally, for merge integration, according to IV1:

“the info they get may be less, like I said earlier, in the first question, I agreed to combine the four subjects, so we can explain the whole topic like what I mentioned just now the airplane. Kids will know, airplanes can fly because we have technology”.

Based on the analysis data above, it can be concluded that each of the mentioned integrations, it has its own benefits. But most of the interviewees did agree if these kinds of integrations implemented in STEM learning to ensure that children will acquire quality learning.

Objective 4: Explore The Implementation of Stem Activities in Teaching and Learning Sessions

Same goes to another sub-topic, researcher had designed four sub-constructs to answer the fourth research questions. It consists of paper-based, video-based teaching, teaching tools-based teaching, and outdoor activity-based teaching. Based on what IV3 said about paper-based teaching:

“Regarding to my teaching experience, books and worksheets are absolutely available in school and kindergarten”

“But as a teacher, we need to be more creative to teach children any STEM activity because the whole book, for me it is not really approachable”

“Before we give them any worksheets or guidance books, we need to make STEM activity along with children”

Secondly, for video-based teaching, IV1 pointed out that:

“Urmm my point is I disagree because we only rely on video display alone”

“So I think, teaching through this video display can also be implemented in teaching. We can only insert a few videos”.

Thirdly, for teaching tools-based teaching, IV3 said that:

“For me, STEM activity is great because we can give children to do something that they can see”

“We give them the straw, ask them to arrange it, then we make it. From there, Technology and Science can be seen”

Finally, based on the views of IV3 about the outdoor activity-based learning, she said that:

“children will definitely feel excited to learn any topic that they will learn

it can help children to feel easier or happier and excited to learn something even though they have learned something from their family, or other people, but they will learn again and again and it makes they feel happy and excited”

“it can help children from their learning to learn something mmm”

Based on the objective 4, researcher can conclude that those for learning methods are important to be implemented in kindergarten or preschools. But to those who are teaching children, they need to know to adapt it in particular learning. Sometimes, the misconception from the teacher him/herself makes the teaching and learning become not interesting.

DISCUSSION AND IMPLICATION

Based on finding, the best practices are important for teachers to use in ensuring that their teaching becomes more interesting and creative in order to attract children to learn STEM activities in school. The first best practice that can be applied to children is the method of learning through play or play-based learning. According to Wallerstedt & Pramling, (2012) play-based learning entails learning while having fun. Learning through play can provide a valuable experience for children to learn STEM activities in the classroom. They are not only able to learn all four elements of learning, but they are also able to improve their ability to learn new things. Clearly, learning through play will encourage children to learn in the most enjoyable situations.

Besides that, the best way to ensure that children can access informative knowledge through STEM Education is by using teaching tools-centered strategy. Most schools use the help of teaching aids to ensure that children can obtain information taught by teachers in school. This is because, through the exploration of materials, children are more comfortable adapting themselves to mastering a learning topic. If children are given any materials while they are doing STEM activities, it can enhance their cognitive development to express appropriate answers to a question involving certain activities. According to OLC (2020), the goal and significance of teaching and learning materials is to make lessons engaging, learning simple, and allowing teachers to convey concepts clearly. Learning materials that support learning can significantly increase learners' achievement.

In addition, there are many ways teachers can integrate the disciplines of Science, Technology, Engineering, and Mathematics in their teaching. However, the best way to ensure that children acquire a wide range of information is by integrating each STEM element in one teaching time. Through this integration, children will not only be able to learn about the importance of the STEM activities being learned, but they will also gain useful experiences through free learning. Research indicates that using an interdisciplinary or integrated curriculum provides opportunities for more relevant, less fragmented, and more stimulating experiences for learners (Furner & Kumar,2007). Moreover, through this integration, children can learn 4 learning in one activity. For example, they will not only learn the process of science skills, but they will learn the concepts of Mathematics, Engineering, and Technology. This will give children the opportunity to add to the various information in their brains.

On the other hand, there are many methods and techniques that can be used to engage children to continue learning through their involvement through STEM Education. However, through the findings of the study, it shows that outdoor activities can provide a special value to children to learn and continue to learn happily. In fact, there are many advantages that can be achieved if a person participates in STEM activities conducted outside of which they can show an

attitude of wanting to explore something and a high curiosity about a topic studied. There are many STEM activities that can be carried out outside the school such as planting trees, collecting recycled materials and then making crafts, doing research activities related to green plants, and so on. According to Ilhespy (2009), the students' involvement in the outdoor recreation program is important in order to improve their self-confidence, positive thinking and more perfectness.

Through the findings of this study, it can be used as a reference to the school either at the early school stage especially. Viewed from the point of view of the importance of STEM Education, it provides many benefits to the development of children holistically. However, such development cannot be achieved without the initiative taken by the school behalf, whether it is a government -administered school or a private school. Children are now seen to need more direct skills compared to traditional skills such as reading, writing, and spelling. Therefore, through the techniques, approaches, methods, best practices that have been revealed in this study, perhaps the school can make it a reference to implement interesting STEM activities in schools.

CONCLUSION

In conclusion, the promotion of STEM Education in Malaysian preschools is still at an early stage. Although there are teachers who try to implement STEM teaching at an early stage, but there are some challenges and obstacles that they have to face to ensure that children get meaningful information when they come to school and learn with their peers. School institutions are the mainstay in producing the best future leaders for Malaysia. In addition, the role of the teacher is the most important role in ensuring that children can learn well through engaging STEM activities. With the availability of this study, it will be a basic reference for teachers in preparing themselves to teach in the best way through the introduction of STEM activities in schools. Hopefully, with the efforts taken by the school behalf and the Ministry of Education Malaysia in elevating STEM Education in Malaysia, it will be able to provide a different experience for children in Malaysia in improving their learning at an early stage. In turn, it will have an impact on the progress on the country in the future.

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