PROCEEDINGS of
INDONESIAFOCUS
ISSN: 2475-4005

# Introducing and Incorporating STEM Education for Young Children in Preschool: How do we start it?

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ABSTRACT

This paper aims to determine some aspects which are needed to be considered to start introducing and incorporating the concept of STEM education for young children in preschools. McClure et al (2018) stated that giving young children high-quality early STEM experiences can support children's growth across the STEM areas as diverse as executive function and literacy development. However, there will be the first step to introduce and incorporate STEM education for preschoolers. The purposive sampling technique was used in which 30 (thirty) preschool teachers in Indonesia were selected for this study. With the semi-constructed interview, the preschool teachers were asked about their perspectives toward STEM education, their implementations, and the aspects which they need in terms of implementing STEM education in their classrooms. Theresult showed that the preschool teachers did not understand enough about STEM education and its implementation in the classroom. In this study, the preschool teachers also mentioned some challenges which they have faced to implement STEM education in their classroom. Finally, teachers' professional development and teacher training are needed for preschool teachers so that STEM education can be applied well at early educational levels.

*Keywords: STEM Education, Preschool Teachers, Indonesia, Young Children*

## 1. Introduction

STEM, as the abbreviation for Science, Technology, Engineering, and Mathematics, in educational practices and concepts is becoming more powerful and prominent from elementary to higher education level. Scholars within this study attempted to find out the use of STEM education and its implementation for teachers in their practices with an emphasis on the integration between STEM disciplines (National Academy of Engineering and National Research Council, 2014). Interestingly, the implementation of STEMeducation is claimed to be started in early childhood too as the young children are natural-born scientists and engineers (Chesloff, 2013).

Implementation of STEM education is often argued as an advantage for young children, as the main concepts in STEM, such as curiosity, creativity, collaboration, and critical thinking. They are the basic nature which young children own. These qualities can help them in the future where it is predicted that they will grow up with the abilities and skills that are needed in their eras, where Science, Technology, Engineering, and Mathematics become the fields that are in high demand. As a result, the best way to shore up the workforce pipeline is to start investing in it early by implementing STEM education in early childhood or preschool starting from now, as early as it could be.

Implementing STEM education is not an easy job to dofor teachers, educational practices, school principals, and management. There are not many practices and guidelines to integrate subjects of Mathematics and Science at a global level (Asghar et all, 2018). It is also going to be a complex process for integrating Science and Technology, and even for all the four fields together in authentic contexts and materials in the teaching and learning process.

On the other hand, the integration of STEM education is not well-implemented in many developing countries since it demands extensive training and expertise on the part of teachers and needs availability of required teaching-learning resources. With no doubt, teachers and school principals are often confused and clueless about the case they want to implement, even they notice the importance of STEM education in their schools and classrooms.

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In Indonesia itself, there is no fixed rules and standard to implement STEM education at the K-12 level and especially in preschool. STEM practices are quite mature in western countries like the UK, USA, and Australia (Gonzalez & Kuenzi, 2012). There were some findings conducted regarding STEM education and implementation in Indonesia. Syukri et all (2019) have conducted their research in implementing STEM education in the elementary setting. There were two other initiated projects in STEM education for educational classrooms focusing on high schools which were successfully implemented for high school students (Sampurno, et all, 20015; Columbia Global, 2014). This also led to the need for educational sectors to establish STEM study centers. However, the implementation of STEM education itself in educational settings are not being standardized in the national curriculum settings, which is used for all compulsory educational levels and school in Indonesia (Murray, 2019).

Furthermore, for the preschool setting itself, the implementation of STEM education is crucial for the kids and their future. It is because by applying this integrated learning in the four fields, kids could find the connection between what they learn with the practice and implementation of the lessons in their real lives. In contrast, the implementation of STEM education is not being emphasized in the early childhood context in Indonesia which is mainly focused only on the calculation and learning how to read in playgroup and kindergarten. Kids are indeed playing and learning at the same time, however, the integration of learning from one field or subject to others is missing and kids are just playing.

The purposes of this study are to find out preschool teachers' perspectives toward STEM education and its implementation; to discover possible challenges that they will face or have faced in implementing STEM education; and to find out some possible help and solution for preschool teachers in implementing STEM education in their practices and classrooms. As a result, this research will also examine the definition of STEM education and how it is implemented in the context of preschool teachers in Indonesia. To achieve these purposes, this study has some research questions, more specifically, the constructed questions are:

- How do preschool teachers define STEM education?
- How do preschool teachers implement STEM education in their classrooms?
- What are some challenges for preschool teachers to implement STEM education in their classrooms?
- What are the suggested solution and recommendations for preschool teachers for implementing STEM education in their classrooms?

## 2. Method

### *2.1 Research design*

In this study, to collect data through interviews, a case study approach, one of the most prevalent and important methods in qualitative data collection, was employed (Myers & Newman, 2007). By using this research design, it provides the researcher with the great opportunity to deeply comprehend the participants' views through talking and listening to their conversations.

### *2.2 Participants*

In qualitative studies, purposeful sampling is used for the identification and selection of information related to the phenomenon of interest (Palinkas et all., 2015). For this purpose, the preschool teachers were selected to participate from 3 (three) different preschools. 2 (two) preschools were public preschool, and 1 (one) preschool was private preschool (national plus curriculum). A total of thirty preschool teachers (n = 30) were chosen for this research and they are asked some questions about STEM education in the interview sessions.

### *2.3 Data Collection Tool*

For the data collection in this study, semi-structured interviews were conducted with open-ended questions which are related to STEM education and its implementation for teachers in their classrooms. The interview form included the following questions:

- How would you best describe STEM education in one term?
- What does it look like if you were directed or asked to implement STEM Education?
- What materials would you like to see added to your classroom to assist you in implementing STEM education?
- What are the challenges in implementing STEM education in preschool for young children?
- Do you think you are ready to implement STEM education in your practice and class?
- Do you think young children are ready for STEM education in preschool or early childhood? Why/Why not?
- What do you think is needed for improvement in terms of the implementation of STEM education?
- What else do you want to tell me about STEM education in this interview? Do you have any other comments?

### *2.4 Data Collection Analysis*

The interview of each participant was approximately 30 minutes. The interviews were recorded by voice recorder and transcribed for analysis. The answers from the participants answering the questions were examined by

using thematic analysis. Thematic analysis is a method for identifying, analyzing, and reporting patterns or themes within data. It minimally organized and described the data set in rich details (Braun and Clarke, 2006)

## 3. Findings

The findings of this study are divided into three themes. Firstly, it is about preschool teachers' perspectives and understanding of STEM education. The answers from participants are related to the first and second questions in the interviews. Secondly, teachers' challenges in implementing STEM education are presented in the findings with the supports or suggestions from preschool teachers in terms of implementing STEM education. Last, it is about preschool teachers' and young children's readiness in implementing STEM education in the classroom.

### *3.1 Preschool Teachers' Perspectives and Understanding toward STEM Education*

The first and second questions from the interview questions were determined to give teachers' perspectives and understanding toward STEM education. Three main themes were being mentioned by preschool teachers; Real-World Problem and Problem-Solving Skills; Integrated Learning; and the abbreviation of STEM education itself which is Science, Technology, Engineering, and Mathematics.

### *3.2 Challenges in Implementing STEM*

With the most theme answered by preschool teachers, the absence of guidelines in implementing STEM education becomes the main challenge that they faced in their practices. Infrastructure and teachers' readiness becomes the second challenge in applying the STEM concept, followed by time management and teachers' knowledge itself about teaching and learning in STEM education.

### *3.3 Preschool Teachers and Young Children Readiness in Implementing STEM Education in Preschool*

Regarding teachers' readiness which also becomes one of preschool teachers' challenges to apply STEM education in their classes, the thirty preschool teachers gave the responses which indicated that most teachers were not ready yet to implement STEM education in their classroom teaching and practices.

## 4. Result and Discussion

### *4.1 Preschool Teachers Perspectives and Understanding toward STEM Education*

Looking at the majority of responses about teachers' understanding and perspectives on STEM education, it was clear that the fields of STEM itself (Science,Technology, Engineering, and Mathematics) are mentioned by preschool teachers when they were asked about their definitions of STEM education. With the further explanation of teachers' perspectives toward STEM education, mostly preschool teachers were still confused as to how it would be applied in their preschool classrooms.The other ten preschool teachers who answered integrated and real-world problem-solving skills in defining STEM education, interestingly are from the same school – the private national preschool. The five preschool teachers agree that STEM education is just a term, which can be changed as it develops such as STEAM (by including Art), or STREAM (by including Reading or Language). However, the concept of integrated teaching and learning is applicable in education. The emphasis on real-world problem-solving skills is also being mentioned by the rest of the five private preschool teachers, as it becomes necessary in education to be implemented at young and early ages. One teacher added that:

*"With STEM education, the children can relate to what they are learning in the classroom in a fun and creative ways,at the same time, they also find the lessons are applicable for their daily lives and will be useful for their future so that they can solve the problems in their real world." (Teacher 1-A)*

### *4.2* Challenges in Implementing STEM Education in Preschool

STEM requires space for activities and storage, infrastructure, and various materials and resources such as computers, tablets, multimedia, robotic kits, woods, glues, and other instruments such screws, calculators, and hammers. Such materials are necessary for implementing integrated STEM education successfully. Teachers also found that they were not ready to implement STEM education, if the media, properties, materials are not available. With the limited knowledge of STEM education, preschool teachers also found it is challenging to modify what they have known previously and to learn the recent knowledge. Teachers' readiness and knowledge, time management, and infrastructure here clearly become one main challenge faced by preschool teachers in implementing STEM education.

The fact that there is no guideline for implementing STEM education in preschool is noted as the main challenge for preschool teachers. Since Indonesian Curriculum in preschool does not include any mention about the implementation of the STEM curriculum, preschool teachers need guidelines of where to start and how to implement it. One teacher in public preschool said:

*"It's true that there are many resources out there about STEM education. However, they are from different countries, different schools, not here in Indonesia. There are a few best practices that I could find but reading those will take time too. It will be so much helpful if the*

*government or Ministry of Education in Indonesia gives the guideline for us." (Teacher 26-B)*

### *4.3 Preschool Teachers and Young Children's Readiness in Implementing STEM Education in Preschool*

Interestingly, private preschool teachers in this research are ready to implement STEM education – their students are too. In contrast, all preschool teachers in the other two private preschools stated that they were not readyyet to implement STEM education in their classes and schools. One private preschool teacher mentioned that:

*"Since our school is a private school, we can add additional materials or subjects in the classroom, and we have decided to implement STEM education ourselves." (Teacher 9-A)*

The other teachers also said that:

*"Our school is a public preschool. We usually implement the national curriculum that is given to us in our school. The books, the subjects, the time schedules. If in the future, our government add STEM education in the preschool educational system, I believe, we will be ready and we will follow it and we also need to learn about it too." (Teacher 29-B)*

*"Our school before has given us the training and seminar about STEM education in a preschool classroom setting contexts. So that is why perhaps, it is not really like walking in the jungle with no compass and guidelines. However, I do agree that we still need teachers' training and professional development about STEM education and national guidelines, it will be so much helpful." (Teacher 6-A)*

From teachers' responses, the role of teachers' educational programs regarding STEM education was also stated by the preschool teachers. When preschool teachers were still in their undergraduate programs, they didn't get any knowledge and skills about the implementation of STEM education at all for the preschool settings.

*"We did learn about Mathematics, Phonics, languages, storytelling, and other common subjects which are needed to be taught for kids. Again, we have never known about STEM education, including how to prepare, how to implement, and how to assess it in a practical way for our teaching practices." (Teacher 24-B)*

Interestingly, this answer from Teacher 24-B who graduated from her undergraduate program in preschool teacher education in 2008 and is having more than 10 years of experience, was also similar with Teacher 18-B who has just graduated in 20016, in the same program and university.

*"I wish I have got more skills about STEM education back in my university time before I became a preschool teacher. Unfortunately, my program has not given any topic related to STEM education. We did learn about Montessori, integrated learning, which at some point, could be similar to STEM education too. However, it is a new thing for me now and I need to learn it from zero." (Teacher 18-B)*

## *5.* Conclusion

Introducing and incorporating STEM education in preschool might be challenging in preschool in Indonesia, oranywhere, if there are no fixed guidelines and standards locally, nationally, or globally. In addition, the roles of infrastructures, teachers and students' readiness, teachers' knowledge, and time management are still the main challenges. Finally, as Anggriawan (2020) stated, teachers' professional development and training are needed for teachers, especially in uncertain times like the Covid-19 pandemic and because of other changes in curriculum and instruction impacted by the development of education itself. Furthermore, it becomes more important if they want to start implementing STEM education in their classrooms and schools. With all of these considerations in implementing STEM education in preschool, the concept of STEM education itself such as curiosity, creativity, collaboration, and critical thinking which are young children's natures and attitudes, can be the first and continual steps for preschool teachers to start their STEM education practices and experience in their real classrooms and schools.

## Acknowledgments

The author of this research thanks to the School of Teaching and Learning at Illinois State University professors and committees, all the participated preschool teachers, and school principals.

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