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STEM FLEXIBEL MODEL IN KINDERGARTEN

Model Fleksibel STEM di TK

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Abstrak: Tujuan dari penelitian ini adalah untuk mengeksplorasi bagaimana konsep STEM digunakan dan dinegosiasikan oleh guru di taman kanak-kanak. Sains, Teknologi, Teknik, dan Matematika merupakan bagian yang tidak terpisahkan dari kehidupan sehari-hari. Penelitian ini difokuskan pada perspektif guru tentang pembelajaran STEM di tingkat taman kanak-kanak (TK). Pembelajaran STEM dalam artikel ini termasuk kegiatan yang diintegrasikan ke dalam tema-tema yang ada di TK. Pembelajaran STEM melibatkan kreativitas dan stimulasi anak untuk memecahkan masalah, mengetahui solusi, dan berpikir logis, matematis, dan kritis. Dalam implementasinya, pembelajaran STEM tidak lepas dari perspektif guru. Dengan demikian, menganalisis perspektif guru tentang pembelajaran STEM di TK, termasuk kegiatan apa yang dimasukkan, akan berkontribusi pada pengembangan pendidikan anak usia dini. Penelitian ini merupakan penelitian kualitatif dan dilakukan dengan wawancara online. Berdasarkan data dari 50 guru TK di Indonesia sebagai responden, temuan penelitian ini menunjukkan bahwa istilah STEM masih menjadi hal baru bagi guru TK, implementasi dan manfaat STEM di TK juga dilaksanakan dengan model yang lebih fleksibel.

Kata Kunci: STEM, Model, Pembelajaran, TK

Abstract: The purpose of this study is to explore how the concept of STEM were used and negotiated by teachers in kindergarten. Science, Technology, Engineering, and Mathematics are inseparable parts of everyday life. This study was focused on teachers' perspectives on STEM learning in kindergarten level. STEM learning in this article included activities integrated into the existing themes in kindergarten. STEM learning involves children's creativity and stimulation to solve problems, know the solutions, and think logically, mathematically, and critically. In its implementation, STEM learning cannot be separated from the teachers' perspectives. Thus, analysing teachers' perspectives on STEM learning in kindergarten, including what activities were included, will contribute to early childhood education development. This research was a qualitative study and carried out using an online interview. Drawing on data from 50 kindergarten teachers in Indonesia as the respondents, findings of this study indicated that the term STEM was still considered unfamiliar for kindergarten teachers, the implementation and benefits of STEM in kindergarten also implemented with a more flexible model.

Keyword: STEM, Model, Learning, Kindergarten

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INTRODUCTION

In the 21st century era, which develops continuously, many challenges and opportunities mark the development. Many things need to be prepared for globalization's demographic bonus and challenges (Alsubaie, Ayesh, 2016; Jati, 2015). Early childhood education is considered as an alternative to deal with the demographic bonus. Indonesia will face a demographic bonus in 2045 (Munir, 2009). Thus, the focus of early childhood education is positioned as The Starting Well Index, especially early childhood education teachers who have an essential role in preparing generations. Moreover, technology and information-based education, which refers to problem-solving and the ability to think critically, play a significant role in preschool students to prepare future generations and sustainable development in the future

Learning in the kindergarten setting is carried out in holistic and integrative ways. The developmental aspects that should be achieved by children are integrated into the learning material designed by the teacher. This includes learning, which refers to the STEM model (Science, Technology, Engineering, and Mathematics). In general, STEM learning aims to create excellent students in science, technology, engineering, and mathematics that are useful in the future (Shidiq, Permanasari, & Hernani, 2020). The integration of STEM learning in kindergarten is created in many approaches (Tao, 2019). As it is widely believed, the implementation of STEM in kindergartens, which was integrated into learning themes and strategies, can help children solve future problems.

In kindergarten, STEM learning focuses not only on activities that stimulate children's cognitive development but also involves other aspects such as physical motor, language, and moral and social emotions. Integrating these developmental aspects is summarized in an integrated manner in activities designed with project-based learning and problem-solving skills with hands on, mind on activity. The context of STEM learning in kindergartens is also designed to teach children about science, technology, engineering, and mathematics, which are commonly abstract, to become more real in children's daily lives (Mcclure et al., 2017).

STEM learning has been implemented in several studies, such as in primary and secondary school settings, especially in Biology, Mathematics, and Chemistry (Shidiq et al., 2020). However,

studies that discuss STEM learning in kindergartens were still limited, especially in Indonesia. Applying the STEM model in kindergartens in Indonesia was still rare, so it is matter to know how the kindergarten teachers' perspectives on implementing STEM from an early age.

In the Indonesian context, research on STEM in formal settings was conducted by Shidiq et al (2020) who looked at the teacher's perspective on STEM-based learning models in chemistry subjects in high school settings. Research that discusses STEM learning in kindergarten is still limited, especially in Indonesia. However, the application of the STEM model in kindergartens in Indonesia is still rarely done.

Research conducted by Artobatama (2019) is limited to STEM in outdoor and traditional game activities. Then the research conducted by Santika, Mulyana, & Nur (2020) that the implementation of STEM in PAUD is limited to teaching the concept of floating, floating and sinking. So it can be concluded that previous studies are still limited to certain activities or themes. In addition, there are still few who pay attention to the perceptions and views of teachers on the STEM model applied in learning in early childhood education, especially in kindergarten settings, especially in Indonesia. Teachers' perceptions of STEM will affect the application of learning models and strategies in kindergarten. As a facilitator, regardless of the teacher's perception of something, that is what will be given to the child.

METHOD

This study is a qualitative study using an online interviews. Participants in this study were 50 kindergarten teachers. Then, followed by a focus group discussion conducted with 7 teachers as representatives of the respondents. The selection of participants in this study was carried out purposively. The participants were then given a questionnaire about the teacher's views about STEM learning in kindergarten, consisting of 10 questions. Subsequently, researchers conducted in-depth interviews with teachers of kindergarten in South Sumatra and West Java, Indonesia. The results of in-depth interviews obtained from respondents are the main things that need to be considered in concluding Kindergarten teachers' perceptions of the STEM learning model for preschool students.

RESULT AND DISCUSSION

1. Kindergarten Teachers' Perspectives on STEM

Preschool students require unlimited opportunities to explore science, develop scientific skills in formal and non-formal situations (Lestari, 2020b; Widyastuti, 2018), indoor and outdoor (Lestari, 2020a) using unlimited time and their experiences. One of the STEM model characteristics is applying science, technology, engineering, and mathematics problems solving in daily life (Tao, 2019). There are many methods to implement STEM, especially in a kindergarten setting, which are undoubtedly different from the standard practice at the primary and secondary school level (Ioannou & Bratitsis, 2016).

The kindergarten curriculum is holistic and integrative. So the development of a STEM model in kindergarten should be easier to implement. In the curriculum, the teacher as an activity designer and facilitator also considers what things need to achieve the learning objectives. In implementing activities, teachers also play an essential role in accommodating children's curiosity, which is relatively high (Adriany & Warin, 2014). The practice that children do every day in kindergarten is identical to playing activities (Brinkman et al., 2017). The materials in the learning package in the form of play. As well as guidance and strengthening in the teacher's learning process and often done in children's groups or individually. Nevertheless, the integration remains in the form of a game. The content of learning at the kindergarten level includes developmental aspects that need to stimulate according to the children's ages.

This study's findings indicated that 70% of the respondents never applied the STEM model in their class. Further explanation of teachers' perspective on STEM is presented in Table 1.

Based on the data presented in Table 1, teachers' perceptions of the STEM model in early childhood education were varied. The teachers had known that the STEM model should be implemented from an early age. However, they were not familiar because it had not been designed for school activities—also, their inadequate socialization or similar training about Teachers' perceptions in kindergarten will impact children as subjects and objects in the world of education. Children's needs for scientific exploration, with technology and techniques as well as mathematical abilities must be able to be supported by creative and integrated strategies in aspects of child development (moral and religious, language,

cognitive, physical motor, and social-emotional) (Lillard & Heise, 2016). As a facilitator, the teacher also be able to learn new things before teaching them to children. Because teaching early childhood is different from adults. In order to create a child who has a broad curiosity and insight about science, technological developments, various existing techniques as well as concepts in mathematics (Schmitt, Korucu, Napoli, Bryant, & Purpura, 2018). In addition, being a teacher in a kindergarten also means being ready to equip ourself with knowledge that is constantly updated without limits.

Table 1. Teachers' Perspectives on STEM in Kindergarten

No.	Respondent	Teachers' perception on STEM
1.	Ms. Ci	I have not been familiar with STEM. I think there has not been any socialization of this model from school and from educational affair office related to stem model for preschool students.
2.	Ms. Cu	STEM model is excellent to be implemented in early childhood education. This model is an integration of science, technology, engineering, and mathematics like what I have been implemented using project-based learning. Therefore, it can assist students to be more creative in solving problems and think critically.
3.	Ms. Re	I have heard about STEM but I think that no one has implemented it yet in my school, so I do not know how to implement it in kindergarten.
4.	Ms. Li	I have only heard about STEM in training organized by a school but I have not applied it in my class to my students.
5.	Ms. Ve	I have implemented STEM model like sentra learning. The science is in the activities, technology in the equipment used, engineering in the methods, arts also can be seen and mathematics in arranging and matching activities.
6.	Ms. An	STEM is good to be implemented in early childhood education. Teachers in our school have implemented STEM model in all classes especially in kindergarten level.
7.	Ms. El	In my opinion, STEM is the integration of science, mathematics, and other field of study in an instruction so we can find science and mathematics in a subject.

Furthermore, teachers' perceptions of STEM are also influenced by many factors. Based on the findings that the authors obtained from this study, schools as institutions contribute to curriculum planning in kindergartens (Fitri, 2017). Support from other teachers, school principals, and school residents also affects why the STEM model is not familiar with teachers' kindergartens. Even though teachers have received one-time training on the STEM model for early childhood. If there is no support from the school where the teacher teaches, it will still not be implemented, and the teacher's knowledge that is not practiced will also

be useless (Allen, Webb, & Matthews, 2016).

Part from schools, the government and related government agencies should also provide continuous information and training on current issues in children, which are not only local issues but also global issues. Not only seminars and training in parenting, but also in improving cognitive abilities, especially in problem-solving and critical thinking, which need to be a concern and effort to synergize together.

2. STEM Model Implementation in Kindergarten

Referring to the concept of STEM-based learning model in general, STEM-based learning model is defined as a constant learning considering that the knowledge and skills necessary to solve problems (Allen, Webb, & Matthews, 2016). The aspects are integrated in STEM learning model is the science, technology, engineering and math (Mcclure et al., 2017; Ring, Dare, Crotty, and Roehrig, 2017). The goal is to make the learning process more meaningful. Because in the application of this STEM-based learning model, children do not only act as passive recipients of knowledge provided by the teacher. However, children also play an active role in exploring their knowledge. Starting from investigating a concept (science), applying it in creative ways (technology), designing something / creating new things (engineering) and analysis, critical thinking, drawing conclusions, as well as calculating logically and mathematically (math). Search the solution of existing problems. Both problems in daily life today, and in the future.

In kindergarten settings, implementation STEM in kindergarten are made more flexible. STEM-based learning models in kindergarten are provided in the form of fun and safe learning for children (in play activities) (Ioannou & Bratitsis, 2016; Katz, 2010; McClure et al., 2017; Tao, 2019). In practice, aspects of STEM in kindergarten often become STEAM. In this aspect, it is added with art that facilitates play activities and children's freedom to manipulate various materials in different ways according to their imagination and are not structured (Nugraheni, 2019). This allows children to explore and experiment without limits. Therefore, the role of teachers and parents in implementing STEM-based learning models in PAUD is not only as a designer

of children's activities, but also as a facilitator who provides tools, materials, and media that are interesting for children. Included in giving children the opportunity to select and their creative ideas, respond to, provide reinforcement, challenge, and encourage children to play as well as praise for what their children do and the work that has been made.

The findings of this study highlighted the implementation of STEM in kindergartens, where the teacher did not only know about STEM but also applied it during the learning process in school. The summary of the interview with a teacher can be seen in the following transcript.

"We carry out STEM into an integrated activity. For example, in making bakwan jagung activity, science could be seen from mixing flour with water and other ingredients. The technology element could then be seen from plates, spoons, bowls, or other tools used during the activity. In addition, the engineering element was presented by the method used in making bakwan jagung, such as stirring. Further, art element was added by decorating the bakwan jagung on a plate. Finally, the mathematics element was integrated by requiring children to count how many bakwan jagung were made or served on the plate or how many bakwan jagung that the children ate." (Transcript of Ms. Ve's interview)

Moreover, The interview showed that some teachers were able to design learning in kindergartens with a simple STEM-based learning (Allen et al., 2016). This revealed that teachers were ready to implement the STEM model in the kindergarten level. The application of the STEM model for early childhood in practice involves more children as a whole. Through assistance from teachers and parents, children can explore their knowledge through natural objects around them (Susperreguy, Douglas, Xu, Molina-Rojas, & LeFevre, 2018). For example, they learn the concept of numbers from seeds taken from plants in front of the house (D. Lore, Wang, & Buckley, 2016). After counting, then the seeds can also be strung into necklaces.

Especially during the Covid-19 pandemic, learning activities for children emphasize activities that lead to daily practices, such as cooking with family, making chocolate banana ice, or making simple drinks such as milk. This practice has led to the STEM model because it involves scientific practice, with technical steps that are experimental and also involve mathematical concepts in simple forms.

Another simple STEM activity might include pouring water from a large bucket into a glass or bottle. In addition

to teaching children about science concepts, this game can also transform information about the concept of shape and mathematics (Berch, 2005; Kristiyanto, Ashadi, Yamtinah, & Saputro, 2018), train children's physical motor skills and also train children to work together when playing games. Through STEM activities, children will be trained to solve problems with what steps they have to do (Brunold-Conesa, 2010). In other words, children have also been able to carry out integrated activities. Furthermore, this will help to prepare our students for the globalization era in the future (Gupta, 2015).

CONCLUSION

Teachers' perceptions of the STEM model for preschool students have to be put in concern. Moreover, the teachers' unfamiliarity to the STEM model for preschool students, especially in kindergarten setting, illustrated that socialization and training on STEM for early childhood education was still limited. Based on the analysis of 50 kindergarten teachers from various places in Indonesia, all of them were female and varies in background. It was found that there are more teachers who never applied the STEM approach both in their class and in their school than the teachers who already implemented it.

In general, some teachers already had sufficient knowledge to carry out STEM learning model in early childhood education. However, they were not accustomed to use it and the schools where they taught did not support STEM model as part of the weekly, monthly or annual activities in schools. Furthermore, some other teachers were not familiar with STEM model intended for preschool students but there was no socialization of STEM for them. According to teachers, it was important to implement STEM from an early age so that it can improve children's skills in facing the 21st century era. STEM approach can be implemented in holistic and integrated method in all learning themes in early childhood education. In practice, the application of STEM model was also closely related to project-based learning and learning in classroom-centred setting. Lastly, this study was intended to contribute in changing kindergarten teachers' perceptions to apply the STEM model to preschool students, which can be the basis for its implementation in the future.

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