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Teacher's Readiness Implementing STEM Education in Kindergarten from Aspect of Knowledge

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Abstract

This paper highlights the about teacher's readiness implementing STEM education. This study aims to identify the readiness of kindergarten teachers in implementing STEM education in teaching and learning. Although there are many benefits in teaching and learning, the implementation of STEM education is still not widely implemented in preschools or practices by teachers. This study aims to identify the readiness of kindergarten teachers in implementing STEM education in teaching and learning. The survey was administered offline involving 200 teachers as respondents. Respondents were obtained through convenience sampling technique. Therefore, this study is to describe the level of preparedness of a kindergarten teacher from a knowledge aspect on STEM education in Kuantan, Pahang. Based on descriptive statistical method use the interpretation of the mean score used by Alias (1999), a total of 13 items were allocated to the respondents to answer through a knowledge survey. It is intended to know the consent of respondents by using a 5-scale Likert selection. From the findings obtained, it was found that all items mentioned are at a high level of mean 3.67 to 5.00. The Pearson correlation test is used to determine the relationship between the level of teacher readiness from a knowledge aspect and stem education implementation. The results of the analysis showed that there was a very high positive relationship based on the descriptive interpretation of the Davis scale (1971) between the availability of implementation and the independent variable i.e. knowledge ($r = 0.714$). The findings also show that the level of teacher readiness in terms of knowledge is related to the implementation of STEM education. This study emphasizes that high teacher knowledge regarding STEM education will make teachers more willing to carry out STEM education. Courses or trainings should be given continuously to the kindergarten teachers to ensure they are constantly exposed to new knowledge and positive attitudes related to STEM education.

Keywords: STEM Education, Teacher Readiness, Knowledge, Early Childhood Education

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Introduction

In a world that is growing in terms of economic competition, global financial problems that between fast and future evolution of technology, there is a need that comes in education. Education technology is not a continuous circulation of the technology world that is driving this initiative. Hence with this circulation technology, educational technology especially science has been soaked in syllabus with education Science, Technology, Engineering, Mathematics (Campbell et al., 2018). STEM education (Science, Technology, Engineering, and Mathematics) is increasingly important in the school education system today. STEM education is neither a field of study nor a subject but it is also a method of teaching and learning that is project-based, collaborative, and focused on solving real-world problems. STEM education educates children thoroughly by emphasizing innovation, problem solving, critical thinking, and creativity (Jabatan Kemajuan Masyarakat, 2019). STEM education affects our daily lives with the resources and technological advancements that we come to depend on. STEM approaches can be integrated into various strategies such as problem-based learning, which rely primarily on problem solving in real-life contexts, project-based learning that relies on Engineering design, and learning activities based on environmental investigations to encourage higher thinking skills by students with a centered learning and hands-on approach.

The Industrial Revolution Phenomenon 4.0 also had an impact on the Department of Community Development (KEMAS) especially in early childhood education. The careful preparation of early childhood education in KEMAS continues to be relevant and competitive in line with the work of producing digitally skilled human capital to face the challenges of the Industrial Revolution 4.0. The introduction of STEM to the whole kindergarten under it, KEMAS has developed the e-STEM Tabika KEMAS module in collaboration with education experts such as Sultan Idris Education University (UPSI), Academy of Cultural Arts and Heritage (ASWARA) *Competency in Early Childhood Education* (CECD Group – CACHE UK) and Wilderness School Organisation. The module is equipped with interactive practical or simulation training related to industry themes such as astronomy, marine, oil and gas, health, robotics and automotive to attract children to attend schooling sessions. STEM piercing themes in the neat tabikas by state are Sarawak (Oil & Gas), Sabah (*Marine*), Perlis (Agrotechpreneur), Kedah (Eco Education), Penang (Aquatic *Science*), Perak (Aerospace), Kuala Lumpur (Robotic), Selangor (Automotive), Melaka (Aviation), Negeri Sembilan (Safety Army), Johor (Astronomy), Pahang (Medical Science), Terengganu (Oil & Gas (Onshore)) and Kelantan (Geoscience).

Statement of Problem

Based on the higher education development plan 2015-2025, the Malaysian government is working to prepare the younger generation for the Industrial Revolution 4.0. Based on Malaysia's goal of advancing the industry by 2020, the need for science education and learning is increasing(Muhammad Daud, 2019). Therefore they also need to have the ability and efficiency needed to face the issues faced by Malaysia with the Industrial Revolution, but not experts from STEM (Rahaman et al., 2020).

If looking at the requirements of implementation of STEM education should be implemented at the early stage i.e. preschool. Aminah et al. (2016) is of the opinion that STEM education should be started from early childhood because at this stage children are more often asked questions about everything to adults who are in their environment especially parents and teachers. Thus, teachers need to have knowledge and ability in conducting STEM education which is a mix of science, technology, engineering and mathematics knowledge.

When education reform was undertaken, Malaysia experienced problems from the aspect of teacher readiness. The Ministry of Education Malaysia (KPM) has focused specifically on the issue of education preparation in measuring its effectiveness in integrated STEM education (Rahaman et al., 2020). Aziziah et al. (2017) showed teachers' preparation for stem education in teaching is still at a low level. The involvement of ten teachers showed that only three teachers were ready for stem education. Seven more of the 10 teachers found themselves unprepared to carry out STEM education.

Effective implementation of STEM requires high knowledge of science, technology, engineering and mathematics content (Eckman et al., 2016). In addition, teachers' knowledge regarding the implementation of STEM content to students should be known(Thibaut et al., 2018). The need to investigate teachers' readiness in implementing STEM education, especially on their knowledge and skills in the reform of higher-level national education in order to achieve its objectives. As technology evolves rapidly, society is now more focused on technology. However, many preschool teachers do not focus on technology or early childhood engineering, but rather focus on the areas of science and mathematics (Muhammad Daud, 2019). Two of the most important issues for teachers are implementing STEM education for in children's classrooms. First, understanding and knowledge of technology and engineering (Bers, 2013).

Teachers play a key role in the process of conducting the teaching and facilitation process and are responsible to ensure students master the skills required in STEM education (Jurgena et al., 2018). Teachers' method of seeing and implementing STEM education in the classroom will certainly have implications for stem education delivery itself (Bell, 2016). This opinion is supported by Park et. al. (2016), states that STEM education in South Korea has been implemented for many years, but teacher knowledge of how STEM education is conducted in schools is few. Therefore, this study focuses on the willingness of tabika teachers in carrying out STEM education in Kuantan, Pahang.

Research Objective

1. What is the level of readiness of tabika teachers from knowledge aspect of STEM education in Kuantan, Pahang?

Literature Review

Teachers' Readiness

Teachers have a responsibility to achieve students' achievements in the classroom (Maulana et al., 2015). The focus is on teachers' readiness in terms of knowledge and skills as they educate children who will be the determinant of the future generalization of a country. There is no point in talking about the construction of human capital if teachers are not capable of nurturing children's ability in teaching especially Stem education at the preschool level. Teachers should have knowledge of the most effective methods of teaching through a combination of several methods that are thought to suit the child (Snow et al., 2007). It is clear here that knowledge is essential in delivering the essence of teaching content to preschoolers in particular. Preschoolers at the beginning of their age are the times in which the process they learn is through play.

Knowledgeable teachers are able to educate good disciplines in the learning climate of the 21st century(Mohd Nazri & Fadzli Shah, 2018). According to Mohd Nazri and Fadzli Shah (2018), the teachers gained knowledge through indirect experience. Good knowledge is able to launch the teaching process and any activities and programs that occur in preschool or within the school itself. In addition, teachers with basic knowledge in STEM education can identify the teaching methods that should be done.

In assessing the efficiency and readiness of learning, the amount of education and training given to teachers is important. Teachers without expertise at the teaching level are less confident in carrying out the teaching and learning process to students (Clarke & Pittaway, 2014). Quality teachers are consistent and interesting to teach information to students, because teachers have the right teaching approach techniques in STEM. Teachers must continue to improve their knowledge, skills and become qualified STEM leaders in the future (Chang & Park, 2014). Sufficient knowledge for a teacher influences a child's learning.

STEM Education

Science, Technology, Engineering, and Mathematics Education (STEM) is a topic of high interest in 21st century education. STEM education is not only a field of learning, it is also project-based, collaborative and focused on solving real-world problems. STEM education educates and emphasizes children in terms of innovation, problem solving, critical thinking, and creativity (Campbell et al., 2018). The goal of ST EM education is to give children the skills needed to succeed in today's workforce. This camp is defined as problem solving, research, and critical creative thinking in the 21st century (Solis et al., 2017). Society today needs these skills to maintain competitiveness in the global economy. Through STEM Education, children are taught through constructivist methods aimed at building an understanding of content and knowledge authentication (Grover, 2011). Successful STEM education learning relies on curriculum and teaching in science and mathematics, integration approaches, teaching engineering design cycles and problem solving, enhances strategy research in all subjects, promotes collaboration, connects children with communities, promotes perspectival viewpoints to develop ideas between subjects, offers investigation of learning experiences using existing technologies, including science and engineering subjects, and uses project-based learning and problem-based learning (Kennedy & Odell 2014; Storksdieck, 2016). The 21st century generation needs to be critical and creative, collaborative, cooperative and communicative thinkers. In order to achieve these skills, by applying STEM education in learning, it helps teachers implement problem solving, engineering design projects as well as query strategies to children at times (Asunda & Mativo, 2016; Kasza & Slater, 2017).

Methodology

The design of this research is survey design by using convenience sampling. The survey was conducted using a survey form that was formed based on the research question. Research design is also a model for researchers to make descriptive and inference analysis of the variables studied. The design of the study serves as a guide to the reviewer to see in detail the course of the study carried out. This guide helps us collect, analyze and explain the results of the study conducted (Chua, 2006). Among the factors taken into account such as demographic factors include gender, age, race, academic approval, teaching experience and have attended STEM education courses or workshops.

Results

The survey question was to describe the level of preparedness of a kindergarten teacher from a knowledge aspect on STEM education in Kuantan, Pahang. The research question is what is the level of readiness of tabika teachers from knowledge aspect of STEM education in Kuantan, Pahang. Analysis using descriptive statistical methods is shown through the study data in the table below. For this purpose, the reviewer uses the mean score interpretation used by Alias (1999) as follows:

Table 1. Mean Score Interpretation Scale

Mean Score	Interpretation of Mean Score
1.00-1.80	Very Low
1.81-2.60	Low
2.61-3.40	Average
3.41-4.20	High
4.21-5.00	Very High

Source: Alias, B. (1999)

Researchers have adapted a survey form from Norazizah, B. A. R., Noor Ashikin, B. M. Y., Nil Farakh, B. S., Amalina, B. S., Rosmidah, B. H., Ajurun Begum, B. A., Bushra Limuna, B. I., & Aliyas, B. S. (2020). *Validity and reliability of measurement instruments using the rasch model: Preschool teacher readiness for STEM implementation in Malaysia* and Fatahiyah, M. H. N., MahMud, & DiyaNa, S. N. (2020). Teachers' Readiness in Implementing Stem Education from Knowledge, Attitude and Teaching Experience Aspects. Akademika, 90(3), 85–101 by gathering key domains as well as past studies that are often featured and discussed in previous studies. The selection of 5 Likert scales was selected based on studies conducted by James T Croasmun & Lee Ostrom (2011) in the fact that there is a high consistency of Cronbach alpha values when done to large population size groups using statements (SD) Strongly Disagree, (D) Disagree, (U) Uncertain, (A) Agree dan (SA) Strongly Agree.

Table 2 Teacher Knowledge In STEM Education

Items	Level of Consent (Frequency/Percent)					Mean
	1	2	3	4	5	
I know the definition of STEM education.	1 (0.5)	3 (1.5)	68 (34.0)	112 (56.0)	16 (8.0)	3.70
I know the characteristics of STEM education are integrated.		2 (1.0)	48 (24.0)	133 (66.5)	17 (8.5)	3.79
I know the characteristics of STEM education relate to disciplines learned with the real world.		2 (1.0)	48 (24.0)	133(66.5)	17 (8.5)	3.83
I know the characteristics of STEM learning based on curiosity.		3 (1.5)	76 (38.0)	106 (53.0)	15 (7.5)	3.67
I know the characteristics of problem-based STEM learning education.		4 (2.0)	103 (51.5)	78 (39.0)	15 (7.5)	3.52
I know the characteristics of children's STEM education collaborating in small groups.		3 (1.5)	63 (31.5)	118 (59.0)	16 (8.0)	3.74
I know the characteristics of STEM education as a facilitator.		2 (1.0)	51 (25.5)	132 (66.0)	15 (7.5)	3.80
I know the educational characteristics of STEM alternative assessment applications.		2 (1.0)	89 (44.5)	93 (46.5)	16 (8.0)	3.62
I know the importance of implementing STEM education.		5 (2.5)	73 (36.5)	104 (52.0)	18 (9.0)	3.68
I know the advantages of carrying out STEM education.		5 (2.5)	73 (36.5)	106 (53.0)	16 (8.0)	3.67
I know how to implement STEM education teaching and learning.		10 (5.0)	93 (46.5)	87 (43.5)	10 (5.0)	3.49

Table 2 explains teacher knowledge in STEM education. A total of 13 items were allocated to the respondents to answer based on knowledge aspect survey. From the findings obtained, it was found that all items mentioned are at a high level of mean 3.67 to 5.00. In detail, for knowledge items on stem education definitions (M=3.70, SP=0.659) while for knowledge items of stem education characteristics are integrated (M=3.79, SP=0.590). For stem educational characteristics items relate to disciplines learned with the real world (M=3.83, SP=0.580). Meanwhile, for the stem education characteristics of inquiry-based learning (M=3.67, SP=0.636). For problem-based stem learning educational characteristics items (M=3.52, SP=0.665) while children's STEM educational characteristics items collaborate in small groups (M=3.74, SP=0.622). For items of educational characteristics stem teachers as facilitators (M=3.80, SP=0.576), while stem education characteristics items are alternative assessment applications (M=3.62, SP=0.647). For items of importance of implementing STEM education (M=3.68, SP=0.672) while the advantage item implements STEM education (M=3.67, SP=0.660). Further, for the item method of implementing stem education teaching and learning (M=3.49, SP=0.672), while the process item evaluation process for STEM education teaching and learning (M=3.48, SP=0.679) and the role of teachers in implementing STEM education teaching and learning (M=3.64, SP=0.627). Overall, all items displayed to respondents have mean at high level. The Pearson correlation test is used to determine the relationship between the level of teacher readiness from knowledge aspect and the level of readiness of STEM education implementation. Table 3 shows the scale of correlation strength between two variables (Davis,1971).

Table 3 Davis Scale (1971) – Correlation Strength Between Two Variables

Coefficient Value	Descriptive Interpretation
0.70 – 1.00	Very High
0.50 – 0.69	High
0.30 – 0.49	Medium High
0.10 – 0.29	Low
`0.01 – 0.09	Ignored

Next, the discussion on the analysis of Pearson correlation to determine the relationship between readiness of STEM implementation and independent variables as shown in table 4.

Table 4. Pearson correlation analysis of the relationship between teachers' readiness from knowledge aspects to STEM education implementation

		Knowledge	Teacher's Readiness
Knowledge	Pearson Correlation	1	**.714****
	Sig. (2-tailed)		.000
	N	200	200

***correlation is significant at a level of 0.01 (2-tailed)*

Table 4 above shows that statistical tests using the correlation method found that independent variables are significant, i.e., the value of $p < 0.01$. The variable is knowledge (.714**). The results of the analysis showed that there was a very high positive relationship based on the descriptive interpretation of the Davis scale (1971) between the availability of implementation and independent variables i.e., knowledge ($r = 0.714$), this finding also shows that the level of teacher readiness from knowledge aspects is related to the implementation of STEM education.

Discussion

The findings showed that the level of readiness of kindergarten teachers is at a high level based on the aspects of STEM education. This is supported by O'Neill et al. (2012) states that the role of teachers as facilitators in implementing STEM education will provide new knowledge to students. This was also supported by Rahman N., Yassin S. (2016), that teachers have an important role in providing interesting materials and resources by children as facilitators. In addition, teachers' readiness in terms of knowledge should be given attention to educating children who will be the determinant of the future of a country. Teacher readiness plays an important role and element to the exposure of education to pre-teachers (Izham & Noraini, 2007). If the teacher is not ready, then all the goals that will be implemented cannot be done successfully. The Theory of Educational Change by (Fullan, 2001) emphasizes the willingness of teachers to accept and implement change. Changes are treated as mechanisms in place to change a person or circumstances within a certain period of time. The commitment and involvement of teachers should be proactive in the implementation of educational planning. In other words, teacher readiness and commitment is an important aspect in determining success or failure in the implementation of an effective educational plan (Habib & Syed, 2011).

The finding supported by Fatahiyah et al. (2020) states that teachers with knowledge of concepts, characteristics, interests, benefits, methods of evaluation of teaching and learning, and teachers' responsibilities in STEM education. STEM education knowledge level is important to ensure teachers have the preparation to carry out teaching. This shows that teachers' knowledge in STEM education is expanding as the department has been doing the exposure nowadays. Teachers' knowledge of the characteristics of STEM education in the aspect of teachers acting as facilitators is the second highest mean value. The study also found that teacher recommendations on teaching and learning STEM education had a mean value of 3.49, indicating moderate levels. According to Brown et al. (2011), in addition to knowing and understanding the true meaning of STEM education, it is important to know how stem education is implemented in schools. This is in line with the Bryant Education Process Model (1974) which focuses on the aspects of knowledge and implementation skills determining the efficiency of educational practices. Knowledge is an important component in determining effective teaching outcomes.

Conclusion

Teachers’ readiness to carry out STEM education is seen as essential for development in early childhood education. The findings showed a significant positive relationship between teachers' readiness to carry out STEM education from knowledge aspect. This shows that there is an association between teachers' readiness to undertake STEM education and the level of knowledge about STEM education. The higher teachers' knowledge of STEM education will lead to teachers being more willing to carry out STEM education. The findings of this study have important implications for certain parties to work together to improve teacher readiness. The implementation of STEM activities will be easy if the module on stem implementation methods is disclosed to teachers. Training or course needs to be done continuously to the kindergarten teacher to ensure new knowledge exposure to STEM education.

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