

# Preschool Teachers' Competency in Stem Education Implementation

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## Abstract

Teachers play a very important role in educating students since preschool. Competent teachers are those who have high pedagogical practice, high self-efficacy and in-depth knowledge in the subjects taught to produce creative and innovative students, especially in the field of STEM. The low competence preschool teachers can have a significant impact on the implementation of STEM Education in the classroom. Thus, this study was conducted to identify the relationship of the preschool teachers' competency and the implementation of STEM education in kindergartens. The survey method was selected by randomly distributing a questionnaire to a total of 72 private preschool teachers with different academic backgrounds and teaching experiences. The findings show that there is a high positive linear relationship between the mean of competence and the mean of STEM education implementation. Therefore, strong support should be given by the Ministry of Education Malaysia (MOE) in providing special modules or professionalism training in STEM education to private teachers to improve teacher competencies. In conclusion, high teacher competence will facilitate the implementation of STEM education in teaching and learning

**Keyword:** Teacher Competency, STEM Education, Preschool Teacher

## Introduction

Science, Technology, Engineering and Mathematics (STEM) Education is a group of all areas of STEM knowledge and implemented in the teaching and learning process (Ministry of Education Malaysia, 2015). STEM education is applied from the school level to cultivate interest and increase understanding in the field of STEM which is able to affect creativity in problem solving (Wirnani et al., 2016). The effectiveness of STEM education can help students in their daily lives, communicate, facilitate employment and master various media and technologies (Wirnani et al., 2016).

In 2017, the Ministry of Education Malaysia (MOE) introduced STEM across the subjects of Early Mathematics, Early Science and Integrated Learning in the National Preschool Standard Curriculum (KSPK). The existence of STEM can strengthen curiosity towards the surrounding and make children more innovative and creative (KPM, 2016). When STEM is introduced in preschool education and brought into kindergarten, various challenges are faced by teachers in implementing STEM. Based on writing by Khusnidar (2019), most science teachers have low understanding and knowledge of technology and engineering. This has an impact on the implementation of STEM education.

## **Background**

Based on a study conducted by Sahin & Dostoglu (2014), early childhood education in kindergarten is very important for every individual because early education is fundamental to individual social development. Kindergarten is an institution that provides a variety of education including spiritual activities, academics and managing self from a young age. Early education exposed in kindergarten can have a significant impact on children's cognitive and behaviourism (David, 1998). Thus, the selection of the right kindergarten greatly influences the behaviour and way of thinking of children as they age. Kindergarten criteria that are often emphasized by parents include the learning syllabus, teacher competencies, atmosphere and learning environment.

When teaching and learning (T&L) sessions begin, competency of teachers plays a key role in ensuring the smooth running of T&L sessions. Competencies include teachers' knowledge, pedagogy and self-efficacy while completing their responsibility. According to Mitrani et al (1992), competence can be defined as an ability -based ability that affects job performance (Mitrani et al., 1992). According to Lefrancois (2011), competence is the ability to do something that is produced through the learning process. Thus, the competency of teachers in implementing education is highly emphasized because it is able to have an impact on the performance of students

The main problem in this study is the lack of qualified educators in private kindergartens. A study by Abdul Sani & Yunus (2018) stated that only 35.6% of private kindergarten teachers have service experience of between 1-3 years and 8.2% have teaching experience of 3-5 years. 52% of private kindergarten teachers do not have any teaching experience. The question is, do experienced teachers have a significant impact on the implementation of STEM education in private kindergartens?

The low level of competence of private kindergarten teachers is able to influence the implementation of STEM education especially during experiments with students (Leticia et. al., 2009). The Ministry of Education Malaysia (MOE) also does not provide any courses or training for private kindergarten teachers. Low pedagogical knowledge and lack of experience in the education of children at an early age can lead to deficiencies in the delivery of knowledge especially in STEM Education (Leticia et. Al, 2009). Thus, with the implementation of this study, it can be a benchmark that competence is a precise aspect in delivering T&L. This will open opportunities for kindergarten teachers to get professionalism training from the MOE or school administrators.

## **Purpose of Study**

This study was conducted to identify the relationship between the competencies of private kindergarten teachers on the implementation of STEM education in kindergartens. The domains of teacher competence which is knowledge, pedagogy and teacher self-efficacy are seen to have a great influence on the implementation of STEM education in kindergartens.

## **Research Objective**

The objectives of study are

1. Identify the relationship of teacher competence to the implementation of STEM education in kindergarten.
2. To study the relationship between teacher education background and pedagogical practice on the understanding and delivery of STEM education

### Research Hypothesis

Based on objective of study stated above, three hypotheses can be made as below:

Ho1: There is no significant relationship between the competence of private kindergarten teachers with the implementation of STEM education.

Ho2: There is no significant relationship between academic background, teaching experience with the competence of private kindergarten teachers.

### Literature Review

STEM is often considered a complex field, full of procedures and rules and requires a high level of knowledge to understand the STEM context. This response is able to influence the implementation and interest in STEM education since preschool. The domain of teacher competence, namely knowledge, self-efficacy and teacher practice are taken into account to study the implementation of STEM education for kindergarten students.

#### *STEM Knowledge*

Knowledge is the domain of competent kindergarten teachers that has a strong influence on the implementation of STEM education in private kindergartens. Most preschool teachers think that science and STEM are a difficult subject to implement and understand. This is supported by Ismail and Yunus (2004), almost 40% of preschool teachers face difficulties in understanding the concept of science and have a perception that science subjects take a long time. In addition, 7.4% of preschool teachers felt that science was a less interesting subject. This can have a negative impact when T&L takes place because teachers play a very important role in the introduction of science concepts to preschool students. A study by Ramli et al (2017) also stated that only three out of ten teachers have the ability and willingness to implement STEM education on preschool students. Seven out of ten other teachers are less confident and lack understanding of the STEM concepts they want to convey. The results of a study by Daud (2019) also emphasize that the limited knowledge of teachers can have an impact on the T&L STEM process in preschool. This is because teachers who do not follow the specialization of Physics or Biology subjects may have difficulty understanding the concept and they need to do additional research to implement T&L with students.

#### *Teacher Practice*

The second domain emphasized in this study is teacher practice in STEM education in kindergarten. Education in Malaysia places great emphasis on the pedagogical practice of teachers regardless of their level of education. Pedagogical practice is no exception to its importance at the kindergarten or preschool level. This is supported by the National Key Result Areas (NKRA) which emphasizes the importance of pedagogical practice in the Ministry of Education Malaysia (MOE, 2010a). The NKRA emphasizes that preschool teachers play a very important role in delivering education in order to spark interest in students to continue their studies at a higher level (MOE, 2010b).

Based on a study by Abdul Rahim et al (2010), the level of development of preschool students is different for each individual where teachers need to master pedagogical practices to achieve the effectiveness of T&L with students. The level of development of students in kindergarten is different even though the age of students is basically the same. In addition, national educational aspirations should also be met by preschool teachers where teachers should learn to manage pedagogical practices (Souto-Manning & Dice, 2007).

However, the level of pedagogical practice of kindergarten teachers is not at an encouraging level. This statement is supported by a case study conducted by Lord & McFarland (2010), in which three teachers stated that they should improve pedagogical practices in the teaching process of preschool students. Theories related to early childhood education should also be taken into account by kindergarten teachers to form effective pedagogical practices. Based on a case study by Chee et al (2016), kindergarten teachers strongly understand and deepen the importance of different techniques or approaches based on the level of development of students. However, based on the case studies conducted, most teachers do not practice the proposed approach. Chee et al (2016) also stated that teachers who participated in the case study could not control the class well and did not have good time management in delivering T&L to students. This is very disturbing because it is able to give a high impact on student learning even if only at the early education level.

### *Teacher Self-Efficacy*

As a teacher, a high level of self-efficacy plays a very important role before stepping into the classroom. A high level of effectiveness means that a person can highlight their potential and display a positive attitude towards the things they do (Rustika, 2012). Bandura (1997) states that if the level of effectiveness is low, an individual will refrain from activities that can affect their self-confidence. Going back to the situation of teachers, if the level of effectiveness is low, then they will implement simple teaching activities or not implement teaching activities according to standards. This will have an impact on the effectiveness of teaching in the classroom.

Based on research by Tyler (2005), teacher's efficacy level of T&L is influenced by: (a) positive learning environment (b) incorporating challenges for high thinking skills and adaptation of daily life events in T&L (c) positive and motivational students towards their learning environment (d) lessons that affect daily life and activities. All four elements able to influence teacher's efficacy during classroom T&L.

In addition, the level of effectiveness can also be influenced by the teacher's background, experience, vision, or views as well as the learning curriculum provided (Goodson, 2001). The level of teacher effectiveness also considers the background factors of teacher learning. A study by Habsah et al (2012) proved that there are significant differences based on the professional qualifications of teachers' academic background. Teachers with a bachelor's degree have a higher level of effectiveness compared to individuals who only have a Diploma or Certificate of Teaching (Habsah et. al., 2012).

### **Research Methodology**

This study was conducted in Hulu Langat district in Selangor. The respondents of this study consisted of private kindergarten teachers in the Hulu Langat. A total of 72 teachers were selected as respondents. This study was conducted by random sampling to examine the influence of teacher competence in the implementation of STEM education.

### **Research Instruments**

A set of research instruments was constructed and contained 16 items and was divided into five subscales. The questionnaire was on a five-point scale from "strongly disagree" to "strongly agree". The questionnaire contains three parts, part A related to teacher demographics, part B contains three aspects of kindergarten teacher competence (teacher's practice, STEM knowledge and teacher self-efficacy) and part C contains STEM

Implementation in T&L. The items resulted from the researcher's efforts to examine the highlights of writing related to teacher competence and STEM education.

### Data Analysis

The data were analysed with Statistical Package for the Social Sciences (SPSS) version 22. The analysis process involved descriptive analysis and inferential analysis. Descriptive analysis was used to describe information about respondents' profiles such as gender, academic background and teaching experience. In addition, the inferential analysis used was a correlation test. The Spearman correlation test was used in this study to test the null hypothesis about the relationship between teacher competence in teaching with the implementation of STEM Education in T&L. For the tests conducted, the significance level was set at the 0.05 level.

### Research Findings

#### *Demographic background*

Table 1 shows that 11% (7) of the teachers are male teachers and 89% (65) are female teachers. In terms of academic background, a total of 23.28% (16) teachers has SPM, 16.44% (12) have a diploma, 43.84% (32) have a bachelor degree, and 16.44% (12) teachers have a master degree. In terms of kindergarten teaching experience, a total of 12.32% (8) have less than 6 months of experience, 27.40% (20) have teaching experience for 7 months-12 months, 32.88% (24) have experience for 1-3 years, while a total of 21.92% (16) have experience between 3-5 years and only 5.48% (4) have experience of 7 years and above in teaching in kindergarten.

Table 1

#### *Gender background*

Gender	Frequency	Percentage (%)
Male	7	11
Female	65	89

Table 2

#### *Academic background*

Academic	Frequency	Percentage (%)
SPM	17	23.28
Diploma	12	16.44
Bachelor Degree	32	43.84
Master Degree	12	16.44

Table 3

#### *Kindergarten Teaching Experience*

Experience	Frequency	Percentage (%)
Less than 6 months	8	12.32
7 month -12 months	20	27.40
1-3 years	24	32.88
3-5 years	16	21.92
7 years and above	4	5.48

*The relationship between the competencies of private kindergarten teachers with the implementation of STEM education*

Research question 1: Is there a significant relationship between the competence of private kindergarten teachers with the implementation of STEM education?

Based on Table 4, the results of the study have reported that the value of Spearman correlation efficiency between the mean of competence [ $r = 0.70$ ,  $p = 0.00$ ] to the mean of STEM education implementation is significant. Thus, there is a high positive linear relationship between the mean of competence and the mean of STEM education implementation. The analysis of this data proves that if the competence of private kindergarten teachers is very high, then the implementation of STEM education in kindergartens is also very excellent.

Table 4

*Mean correlation of kindergarten teacher competence with the implementation of STEM education*

		Implementation of STEM education	
Kindergarten	Teacher	Spearman	Correlation
Competence		Coefficient	0.76**
		Last Significant	0.001
		N	72

\*\*Significant figures are 0.01 (2 Significant)

Research question 2: Is there a significant relationship between academic background, teaching experience with the competence of private kindergarten teachers?

Based on table 5, the results of the study have reported that the value of Spearman correlation efficiency between the mean of teaching experience [ $r = 0.193$ ,  $p = 0.104$ ] to the mean of kindergarten teacher competence is not significant. Thus, the correlation between teaching experience and teacher competence is weak. Insignificant correlation values were also indicated by the mean of academic background ( $r = 0.204$ ,  $p = 0.08$ ) with teacher competence. It can be concluded that no significant relationship was shown between academic background, teaching experience and the competence of private kindergarten teachers.

Table 5

*Mean correlation between academic background, teaching experience and competence of private kindergarten teachers*

		Teaching experience		Academic Background	
Competence	Spearman	Correlation	0.193		0.204
Kindergarten Teacher	Coefficient				
	Last Significant		0.104		0.085
	N		72		72

**Discussion**

Based on results of the study that has been conducted, it is proved that competent teachers play a very high role in the implementation of STEM education in private kindergartens. One

of the domains of competence that teachers need to possess is pedagogical practice that includes preparation before, during and after T&L is conducted. Based on writing by Akmal (2008), teaching and learning preparation requires high practice to provide a conducive teaching environment to children. Furthermore, the domain of STEM knowledge is also emphasized in influencing the implementation of STEM education. Although a study by Wahono & Chang (2017) showed that 137 science teachers have limited STEM knowledge that requires increased knowledge, however, the findings of this study show that 72 private kindergarten teachers have good STEM knowledge that is under the teacher competency variable. This can be concluded with the passage of the increasingly rapid age of technology, private kindergarten teachers are able to become independent teachers in deepening the field of STEM. As supported by Amirah et.al (2018), facilities in terms of technology play a high role towards the application of STEM fields in T&L. This is no stranger because most private kindergartens in the Hulu Langat district are in urban areas and have high internet access. Therefore, it is not surprising that private kindergarten teachers in Hulu Langat have good STEM knowledge that can influence the implementation of STEM education in kindergartens.

However, the findings of the study showed no significant relationship between educational background, teaching experience and teacher competence. The results of a study by Goliong et al (2016) also support that teaching strategies and methods that are appropriate to the level of students is a very important aspect compared to the academic background or professionalism of teachers. This means that even if the teacher is a novice teacher, however, if this teacher has the appropriate teaching techniques, then, the effectiveness of T&L can be enjoyed by students. Ahmad & Jingga (2015) also emphasize that the competence of teachers' skills in teaching techniques greatly affects students' academic achievement. Next, the variables of teachers teaching experience were tested and found to have no correlation with teacher competencies which did not affect the implementation of STEM education in kindergartens. The results of this study are supported by Zamri, Nik & Juliawati (2009) who stated that there is no significant difference in expert teaching style ( $p$  value = 0.25, greater than 0.05) between teachers with more than 10 years' experience and teachers with less than 10 years' experience. This means, the same teaching style is shown even if the teachers have different experiences.

### **Implications, Limitations and Recommendations**

The implication arises from the influence of the competence of private kindergarten teachers in the implementation of STEM education should be more comprehensive and expanded to aspects of personality or personal qualities that are seen to be mastered in determining the competence of a kindergarten teacher. Emphasis and evaluation on aspects of teacher competence in comprehensive teaching and learning will be able to provide a high impact on STEM education in T&L in private kindergartens.

The limitation of the study faced by the researchers was the COVID-19 pandemic outbreak which limited the researchers to go down to the field and conduct observations as a method of support to the distributed surveys. Since the school was instructed to close, then, the researcher only distributed the questionnaire online to obtain the results of this study.

### Conclusion

The studies on the influence of kindergarten teachers' competencies with the implementation of STEM education can help administrators in training teachers while students can learn STEM efficiently. The conclusions that can be made in this study are (1) High teacher competency will give huge impacts towards the implementation of STEM education in T&L, (2) Bring awareness that STEM field is a very important field in current technological development, and (3) diversity of teacher teaching techniques should be well supported by all parties to increase the effectiveness of T&L to students. This study is hope to give more awareness about the importance of kindergarten teachers in initiating STEM especially during the young ages.

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