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Application of Fuzzy Delphi Method in Teachers' Preparations of Planning the Early Science Teaching in Preschools

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Abstract

The aim of this study is to explore the preparations of preschool teachers in applying the Early Science teaching method effectively in planning the teaching and learning process (TnL) of Early Science in preschools. This study obtained the experts' agreement on the construction of teachers' teaching preparations elements before TnL sessions. This study also used the *Fuzzy Delphi* method by distributing a questionnaire to 15 experts consisting of lecturers, preschool teachers and professionals in the field of Early Childhood Education and science curriculum based on the set criteria. There were 6 items related to teachers' preparations before the teaching sessions of Early Science activities began. The dangerous percentage values indicated that teachers need thorough preparations before starting the Early Science teaching sessions in preschools. All experts agreed that all the items were teachers' preparations elements because the proposed elements had met the triangular fuzzy number condition of the threshold value (d) ≤ 0.2 and the experts' agreement percentage of ≥ 75%. As the conclusion, teachers' preparations before the teaching and learning sessions are the most important factor that determines the quality of teaching. The implication of this study suggests that preschool teachers can make these teaching preparations as a continuous practice to improve the teaching professionalism.

Keywords: Fuzzy Delphi Method, Teachers' Teaching Preparations, Preschools

Introduction

Planning the teaching sessions is a way to ensure that teaching objectives are achieved. Planning begins with teachers always thinking of ways to make sure students understand what they teach based on their understanding of the teaching and learning (TnL) sessions. Teachers' planning begin when teaching objectives are determined based on students' understanding about activities to be implemented. Therefore, teachers need to ensure that each activity planned needs to consider the suitability and students' abilities so teachers can make effective evaluations for the planned activities.

There are four levels that can be used by teachers in planning the TnL process and each level can be used as a guide when planning the implementation of activities. Every teacher should always be prepared with good planning according to students' levels of abilities. This plan can be used as the best guide for teachers to implement creative teaching to preschool

students. In planning lessons, teachers should always be prepared based on students' abilities levels. The first level consists of teaching goals and objectives, teaching contents, classroom management, and appropriate teaching approaches or methods and assessments. Next, the second stage focuses on lessons content, and perfect and thorough teaching management. Then, at the third level, teachers need to be prepared with teaching materials, demonstration of teaching sessions, how to use the whole classroom and set inductions. Finally, the last level is related to preparations of teachers and students, conducive classroom environment and selection of appropriate teaching methods and strategies (Meador, 2019).

Teachers who excel in teaching sessions are teachers who have high teaching confidence during the TnL sessions. Teachers should always be ready to plan teaching methods that support students' creativity by preparing interesting materials and different teaching techniques so that the learning process can be well implemented (Dere, 2019). Therefore, teachers have a choice other than teaching in the classroom, they have the options of conducting experimental activities outside the classroom so that students have more fun and experience more meaningful learning.

Preschool Curriculum Transformation

The Ministry of Education Malaysia has implemented the transformation of the preschool education curriculum since 2010. The transformation process of the preschool education curriculum involves restructuring and improving the design, organization, pedagogy, re-emphasis of the curriculum, time allocation and curriculum management. Next, it was reviewed in 2017 by the Curriculum Development Division (BPK), Ministry of Education Malaysia. The transformation curriculum provides students with knowledge, skills and values relevant to current and future needs. Scientific skills in the science process require teachers and students to constantly explore and investigate information and solve problems. Therefore, this makes the transformation process as a platform for teachers to always be prepared with various teaching strategies that can challenge students' mind (Rohani et al., 2019)

National Preschool Standard Curriculum for Early Science

The Science and Technology pillars found in the revised National Preschool Standard Curriculum 2017 (KSPK, 2017) outline that Early Science is a compulsory subject to be taught in any approach either as core or integrated in preschools. The main objective of Early Science activities emphasizes the formation of attitudes and mastery of science process skills through investigation of the living, materials and physical realms. Process skills are the skills needed to find an answer to a problem or make a systematic decision. It is a process that encourages creative, analytical and systematic thinking. The identified science process skills need to be developed are observing, classifying, measuring, making inferences, predicting and communicating (KSPK, 2017).

The main purpose of Early Science education that focuses on scientific skills, inquiry, exploration, hands on activities and experiments clearly can help students to develop their interests in learning science. This is important and in line with the goals of the Malaysia Education Blueprint (MEB) 2013-2025 to make Science and Technology as an important medium to develop 21st century learning skills. In this journey of exploration, teachers need to be open to students' explorations in the teaching of Early Science where students have

scientific attitudes such as curiosity, skills of observing, measuring, comparing and classifying (Rohani et al., 2019).

Preschool Teachers Preparations

Effective teachings are greatly influenced by the knowledge, skills and competence of teachers in managing teaching and learning strategies. Teachers' competencies and skills in planning before, during and after teaching are the core for the TnL process to produce effective teaching process in classrooms. The National Association for the Education of Young Children (NAEYC) has always emphasized that TnL activities in preschools should be appropriate to the development of students according to their needs and appropriate to their development.

The report by the Malaysia Education Blueprint 2013-2025 states that good quality teaching comes from quality teachers who provide effective teaching of science to students. This statement is supported by Lilia (2013) who stated that creative and innovative teachers affect economic development. In addition, before teachers start teaching, they need to be prepared in terms of knowledge and understanding towards teaching in advance so that students can understand and learn well (Abdul Halim et al., 2019). This statement clearly shows the importance of teachers' teaching preparations in the teaching of Early Science as it has benefits to the educational context or development of society as a whole.

Lilia (2013) also stated that teachers have a role to develop interesting teaching because students are attracted to fun and meaningful teaching. This will change students' perceptions of learning science because they experience so much fun in learning Early Science and they can explore something more interesting and new. The importance of this early experience will have an impact on preschool students where it can affect students' interests in learning science in the future (Curriculum Development Division, 2017). Therefore, teachers need to be prepared with teaching objectives that are appropriate to students' level of abilities in which each activity conducted must be on the right track (Friesner, 2021).

Teachers' understanding about the teaching of Early Science differs from the quality of teaching. There are studies that reveal teachers in Malaysia are less able to meet the characteristics of quality teachers, especially in the teaching of Early Science. This problem stems from the weaknesses of teachers who lack the knowledge of conducting activities related to Early Science. Thus, teachers need to have the knowledge and skills to implement activities, knowledge related to the current curriculum to complement teachers' skills in implementing early TnL of science (Romarzila et al., 2020). Ata-Akturk & Sevimli-Celik (2020) also argued that teachers also need creativity in teaching so that teachers always come up with new ideas, use teaching materials that are appropriate, and students can relate the content of Early Science lessons in daily life.

Research Design

This study used the *Fuzzy Delphi* method (FDM) introduced by (Murray et al., 1985) and developed by (Kaufman & Gupta, 1988) in which experts consensus is needed to determine the appropriate elements in developing the teachers preparations elements before the TnL sessions start.

Research Sample

A total of 15 experts were appointed and directly involved in this study. This is in line with the opinion that (Adler & Ziglio, 1996) the number of appropriate experts in the *Delphi* method is between 10 to 15 people if there is a high uniformity among the selected experts.

Research Instrument

The research instrument used in this study was a questionnaire adapted from Azli (2018) to collect the quantitative data related to the teaching preparations elements of teachers. The research instrument had obtained the language validity and content validity from experts in public universities and the teacher education institute.

Data Collection and Analysis Procedures

There are several steps need to be followed in conducting a study using the *Fuzzy Delphi* method as follows:

Step 1

Determining and selecting of experts must be appropriate to the context of the study. This is important to ensure the selected experts can provide appropriate views to the context of the study. A total of 15 sample were selected as experts. The selected experts are illustrated in table 1:

TABLE 1
Demographic Details of The Samples

EXPERT	EDUCATION LEVEL	FIELD OF EXPERTISE
1	DOCTOR OF PHILOSOPHY	PRESCHOOL EDUCATION
2	DOCTOR OF PHILOSOPHY	PRESCHOOL EDUCATION
3	DOCTOR OF PHILOSOPHY	PRESCHOOL EDUCATION
4	DOCTOR OF PHILOSOPHY	PRESCHOOL EDUCATION
5	DOCTOR OF PHILOSOPHY	PRESCHOOL EDUCATION
6	DOCTOR OF PHILOSOPHY	PRESCHOOL CURRICULUM
7	MASTER'S DEGREE	PRESCHOOL CURRICULUM
8	MASTER'S DEGREE	PRESCHOOL CURRICULUM
9	MASTER'S DEGREE	PRESCHOOL CURRICULUM
10	MASTER'S DEGREE	PRESCHOOL CURRICULUM
11	MASTER'S DEGREE	PRESCHOOL CURRICULUM
12	MASTER'S DEGREE	PRESCHOOL CURRICULUM
13	MASTER'S DEGREE	PRESCHOOL CURRICULUM
14	BACHELOR DEGREE	SCIENCE CURRICULUM
15	BACHELOR DEGREE	SCIENCE CURRICULUM

Step 2

The process of constructing a questionnaire is the same as constructing a regular questionnaire. This questionnaire used seven likert scales because the likert scale used in the questionnaire was based on the requirements of the research questions. The construction of this *fuzzy delphi* questionnaire was conducted through the literature review method and expert interviews. This indicates that this method is very flexible to obtain agreement among the experts.

Step 3

Dissemination and data collection were conducted via email and whatsapp application. The questionnaire was translated in a google form along with uniform recourse locator (URL).

Step 4

Convert all linguistic variables into *fuzzy* triangular number. Assume that the fuzzy number of rij is a variable for each criterion for expert K for i = 1,…m, j = 1,….n, k=1,…..,k dan rij = 1/K (r1ij ± r2ij ± rKij).

Step 5

The analysis of triangular *fuzzy* number data is intended to obtain the threshold value, (d). The condition that must be met is the threshold value, (d) obtained must be less than or equal to the value of 0.2 (Cheng & Lin, 2002). This is based on the use of the vertex method to calculate the distance between the rij average. The distances of two *fuzzy* numbers m = (m1, m2, m3) and n = (m1, m2, m3) are calculated using the following formula:

$$d(m,n) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}$$

Step 6

The data analysis of the expert consensus results is based on recommendations by (Chu & Hwang, 2008) in which they affirmed that the percentage value of experts consensus must be equal to or greater than 75%. If the opposite percentage is obtained, a second round using the *fuzzy delphi* method needs to be performed.

Figure 1 shows the flow chart summary of the procedures in conducting this study adapted from (Ridhuan et al., 2014).

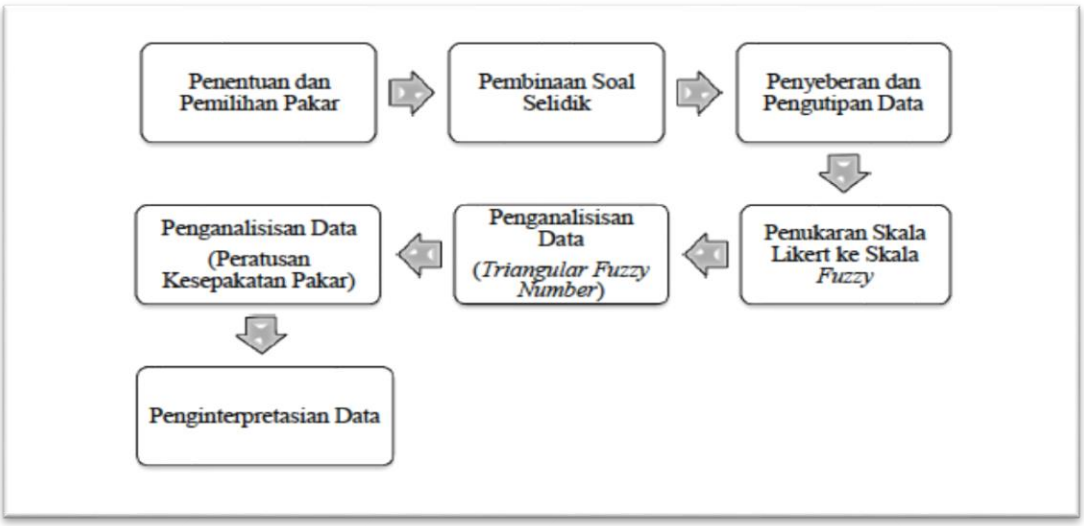

Figure 1. Procedure flow chart of conducting the *fuzzy delphi* method

Research Findings and Discussion

Table 2 illustrates the final findings of teachers' preparations elements in the TnL process of Early Science in preschools. Overall, the panel of experts accepted all the elements proposed

in this study. The elements of teachers determined the themes related to the inquiry and obtained the percentage of experts' agreement and threshold value (d) of 86.67% (0.177) and the teachers planned the implementation of the Early Science TnL based on (KSPK) and the latest threshold value (d) of 93.3% (0.105). In addition, the elements of teachers determined the activities related to the science process skills in the teaching of Early Science with the percentage for the experts' agreement value threshold (d) of 100 % (0.111), the elements of teachers determined measurable teaching objectives and science process skills activities with the percentage of experts' agreement value threshold (d) of 93.3 % (0.158). In addition, the elements of teachers determined the appropriate assessment methods while conducting the Early Science teaching activities with the percentage for experts' agreement threshold value (d) of 93.3 % (0.157) and the teachers submitted new ideas in teaching so that students can relate the learning content of the Early Science to their daily life with the percentage of experts' agreement threshold value (d) of 93.3 % (0.174). Due to this, all components are accepted for passing the threshold value requirement (d) ≤ 0.2 and the percentage of experts' panel agreement is ≥ 75.0%.

Table 2
Final findings for teachers' preparation elements in the TnL process of Early Science in preschools

No	Item / Element	*Triangular Fuzzy Numbers* Terms		*Fuzzy Evaluation Process* Terms				Experts Agreement
		Threshold, d Value	Group Expert Agreement Percentage, %	m1	m2	m3	*Fuzzy* Score *(A)*	
1	Teachers determine the themes relevant to the inquiry.	0.177	86.67%	0.687	0.860	0.947	0.831	ACCEPT
2	Teachers plan the implementation of TnL of Early Science based on the latest (KSPK).	0.105	93.3%	0.833	0.953	0.980	0.922	ACCEPT
3	Teachers determine activities related to the science process skills in the teaching of Early Science.	0.111	100.0%	0.780	0.927	0.987	0.898	ACCEPT
4	Teachers determine measurable teaching objectives and science process skills activities in the teaching of Early Science.	0.158	93.3%	0.767	0.907	0.967	0.880	ACCEPT
5	Teachers determine the appropriate assessment	0.157	93.3%	0.700	0.867	0.960	0.842	ACCEPT

	methods while conducting the Early Science teaching activities.							
6	Teachers present new ideas in teaching so that students can relate the content of the lesson to their daily life during the teaching of Early Science.	0.174	93.3%	0.713	0.873	0.953	0.847	ACCEPT

Terms:

Triangular Fuzzy Number

1. Threshold Value (d) ≤ 0.2
2. Experts Agreement Percentage ≥ 75.0%

Defuzzification Process

1. *Fuzzy* Score (A) ≥ value α – cut = 0.5

The findings and discussion of the study revealed that the preparation of teachers in planning the implementation of TnL process, determining teaching activities and objectives as well as assessment methods by preschool teachers in the context of implementation are very much emphasized for the purpose of teaching Early Science. Strong mastery of teachers' teaching preparations requirements and teaching knowledge influence the effectiveness of applying the science process skills in the teaching of Early Science. A strong mastery of basic concepts of science process skills as well as a high level of knowledge of the Early Science curriculum can make the TnL process of Early Science meaningful in mastering the science process skills. Teaching preparations that includes planning, objectives, activities, submitting new ideas, determining themes and performance standards in assessments are effective factors in the teaching of Early Science to achieve the level of mastery of science process skills. In conclusion, all teachers have a role to play by having sufficient knowledge and need to constantly add new knowledge to strengthen their TnL process. Therefore, teachers need to diversify teaching methods in mastering the science process in order to stimulate and attract the attention of students and to improve their performances.

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