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Perspectives of Early Mathematics Implementation among Malaysian Public Preschool Teachers: Issues, Challenges, and Way Forward

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Abstract

This study explored the perspectives of Malaysian public preschool teachers regarding the implementation of early mathematics curriculum. The purpose of this qualitative research was to identify and analyse the issues, challenges, and potential recommendations to enhance early mathematics teaching practices in Malaysian preschools. In order to support data collected from open-ended questionnaires from 398 public preschool teachers, semi-structured interviews and observations on seven preschool teachers were conducted to gather triangulated insights on their early mathematics implementation practices. Findings highlight the importance of addressing issues, challenges, and suggestions on four key themes upon data analysis, including early mathematics curriculum, its implementation, the need for appropriate and digital teaching aids, as well as necessity for continuous professional development. Recommendations for fostering effective teaching practices in early mathematics classrooms in line with learners' needs in the 21st century for Malaysian preschoolers were proposed to further improve the scenario of early mathematics implementation in Malaysian preschools.

Keywords: Early Mathematics, Malaysia, Preschool, Early Childhood Education, Implementation

Introduction

Malaysia has placed great emphasis on improving the quality of early childhood care and education services through the enhancement of the professionalism of its workforce in its global transformation plan (Kong, 2022). Early mathematics education forms an integral component of effective early childhood curriculum, as it plays a fundamental role in laying young children's foundation of cognitive development, determining their prospective academic success. Similar to many other countries, early mathematics curriculum in Malaysia is crucial to ensure young children gain sufficient solid exposure and experiences to fundamental mathematical concepts.

Nevertheless, results from international students' assessment tests on math, science, and reading including PISA and TIMSS revealed that Malaysia scored international average in mathematics (International Association for the Evaluation of Educational Achievement, 2020; Organisation for Economic Co-operation and Development, 2023). In comparison with data from 2012, there was a seven-percentage-point increase in the proportion of students who scored below a baseline level of proficiency in mathematics (Organisation for Economic Co-operation and Development, 2023). Comparison of TIMSS data similarly revealed that Malaysia's ranking has dwindled from 16th to 26th place for mathematics. Data presents clear evidence that indicates poor mathematical proficiency among Malaysian students.

The effectiveness of the education system depends not only on the curriculum and resources but also on the knowledge, attitudes, and practices of teachers, with its impact beginning as early as early childhood education. Hence, the reason behind the low attainment of mathematics among Malaysian students could be traced as far back to the effectiveness of preschool early mathematics instruction. In line with Malaysia's aspirations to become a developed country driven by STEM industries, it is crucial for the nation to carefully look into the ways to nurture a mathematically competent workforce from a young age.

Research has long shown that early exposure to mathematical concepts and problem-solving skills can lead to better academic outcomes and increased mathematical proficiency in later years (Clements & Sarama, 2008). Therefore, understanding how early mathematics is taught and experienced in preschool settings is essential for promoting effective teaching practices and optimizing learning opportunities for young children.

Early Mathematics in Malaysia

In the Malaysian context, preschool education is guided by the National Preschool Standard-based Curriculum (NPSC), which outlines the objectives, content, and pedagogical approaches for early childhood education, including early mathematics instruction. The curriculum also established that teaching and learning of early mathematics should foster preschoolers' enthusiasm for mathematics through diverse activities and experiences, attain foundational mathematical concepts, and improve critical thinking and problem-solving abilities (Ministry of Education, 2017). As outlined by the NPSC Ministry of Education (2017), early mathematics introduces preschool students to fundamental concepts including pre-number concept, number concepts, arithmetic operations, money, time, shapes and space concepts.

However, the translation of curriculum goals into classroom practices may vary depending on factors such as teacher training, resources, and cultural influences. Traditional rote learning techniques are believed to remain in many preschool early mathematics classes. While efforts have been made to enhance the quality of preschool education in Malaysia, challenges persist in ensuring equitable access to high-quality early mathematics instruction across diverse socio-economic backgrounds and geographical locations.

Based on a research study by Mamat et al (2023) on 2889 Malaysian preschool children, only 58% of children were able to solve basic mathematical operations, compared to 78.5% in their reading skills attainment. This indicates that preschoolers' mastery of arithmetic skills is lower in comparison with literacy skills. Hence, this calls for an urgent need to explore the factors behind the low percentage of mathematical attainment among Malaysian preschoolers.

Roles of Malaysian Preschool Teachers in Early Mathematics Teaching and Learning

Preschool teachers, as key facilitators in early childhood education, play essential roles in fostering mathematical learning experiences for young learners. In the Malaysian preschool

context, self-reported questionnaires on beliefs and practices of curriculum implementation indicated the inclination towards child-centred approaches among 580 private preschool teachers in two predominantly urban Malaysian states (Leng et al., 2021). Moreover, public preschool teachers were found to positively acknowledge and implement developmentally appropriate practice in the teaching and learning process (Seman et al., 2022).

Specifically on early mathematics instruction, Seman et al (2020) identified that preschool teachers involved in their qualitative study possessed good mathematical understanding and pedagogical content knowledge. Parallel to Seman et al (2020); Ghazali et al (2022) also revealed positive findings about preschool teachers' knowledge, readiness, attitudes, and understanding of early mathematical learning. Ironically, Leng et al (2023) identified a lack of expertise and the need for professional development as the key issues and challenges faced by in-service preschool teachers in implementing STREAM education, which include early mathematics.

In light of these contradictions as indicated in the available literature, implementation of early mathematics education in Malaysian public preschools should be thoroughly explored. Despite its known importance to preschoolers' prospective mastery of the STEM areas, the gap between the ideal and reality of early mathematics instruction in preschools should be appropriately addressed.

Against this backdrop, this journal article aims to explore the perspectives of Malaysian public preschool teachers regarding the implementation of early mathematics education. Through exploring teachers' experiences and perceptions, this study seeks to uncover current implementation of early mathematics instruction in Malaysian public preschools, hence identify concrete areas for further improvement. Findings from this article represent an earnest attempt to help policymakers and stakeholders to formulate accurate, concrete support mechanisms in improving the current practice of teaching and learning of early mathematics in Malaysian public preschools. Insights from this article will concurrently benefit early childhood educators, enabling refinement of pedagogical practice in Malaysian preschools to better cater to preschoolers' diverse needs.

Methodology

Research Methods and Participants

To explore Malaysian public preschool teachers' implementation of early mathematics teaching and learning, a set of open-ended questionnaire which consists of 8 questions were developed to specifically elicit teachers' perspectives on issues, challenges, and suggestions to improve preschool early mathematics instruction. The initial questionnaire was developed upon a thorough review of relevant literature to identify relevant key themes about early mathematics teaching practices. Subsequently, it was reviewed by three panel experts in early childhood education and mathematics instruction to ensure its clarify and relevance to the research objectives. Feedback from the expert panel was used to refine the questionnaire, resulting in the final version that was distributed to 1,049 public preschool teachers in Malaysia through random sampling via Google Forms. A total of 398 open-ended questionnaires were returned. Table 1 shows a brief background of respondents' demographics background.

Table 1
Demographics background of respondents (*N*= 389)

Aspect	*N*	Percentage (%)
Highest Qualification		
Diploma	32	8.22
Bachelor's Degree	357	91.77
State		
Perlis	10	2.57
Kedah	4	1.00
Pulau Pinang	15	3.85
Kelantan	26	6.68
Terengganu	28	7.19
Pahang	58	14.91
Perak	32	8.22
Selangor	38	9.76
WP KL	17	4.37
WP Putrajaya	3	0.77
Melaka	9	2.31
N. Sembilan	11	2.82
Johor	36	9.25
Sabah	42	10.79
Sarawak	59	15.16
WP Labuan	1	0.25
Location		
Urban	241	61.95
Rural	148	38.05
TOTAL	**389**	**100**

Out of the questionnaire respondents, seven public preschool teachers were selected for semi-structured interview sessions in order to collect more in-depth data, in addition to data collected from the open-ended questionnaires on preschool teachers' implementation of early mathematics. Face-to-face interviews were conducted based on an interview protocol developed in line with the research context of this study. The interview protocol was validated by ensuring its alignment with the research objectives and by seeking feedback from three early childhood education experts in the field.

Participation of these participants were voluntary based on purposive sampling. Participants' consent were adequately obtained upon informing them about ethical concerns including the right to withdraw from participation at any stage of the interview process, and anonymity of their identities. Table 2 outlines the participants' background information.

Table 2
Participants' Background Information

Participant	Preschool Location	Preschool Type	Highest Academic Qualification	Experience (in Years)
T15	Rural	National	Diploma	13
T16	Rural	Vernacular	Diploma	16
T33	Urban	National	Bachelor's Degree	4
T69	Urban	National	Bachelor's Degree	15
T112	Rural	National	Bachelor's Degree	6
T116	Urban	National	Bachelor's Degree	7
T204	Urban	Vernacular	Bachelor's Degree	11

Observations on preschool early mathematics classes of all seven teachers who were interviewed were also carried out as an additional method of triangulation to collect sufficient data to explore the scenario of early mathematics implementation in Malaysian preschool classrooms. Fieldnotes on teachers' preparation and implementation process during early mathematics classes were recorded throughout the observation sessions.

Data Analysis

Data collected from open-ended questionnaires, semi-structured interviews and observations were analysed concurrently through thematic analysis process. The process began with data familiarization, wherein researchers immersed themselves in the collected data through repeated readings. This stage enables researchers to gain a comprehensive understanding of the dataset and identify potential themes or patterns on early mathematics implementation in Malaysian public preschools.

Subsequently, data was further analysed through the coding process. Segments of data were systematically categorised based on their relevance to the research topic. Based on the coded segments, overarching themes were developed in accordance with the identified recurring patterns.

Results

Four different themes have been identified based on data analysis regarding preschool teachers' perspectives on early mathematics teaching and learning. These encompass four categorized aspects, including curriculum, implementation, instructional support materials, and continuous professional development. The themes will be outlined as follows along with their respective subthemes, with support of data from the open-ended questionnaire, interviews, and observations.

Curriculum

Data analysis regarding preschool teachers' perceptions reveals diverse views concerning the present early mathematics curriculum in the National Preschool Standard-based Curriculum (Ministry of Education, 2017). This is evident through several subthemes, including its content, suitability, and continuity.

a) Content

Based on data collected, some topics under the national curriculum's content standard and learning standard have been identified as less suitable for early mathematics teaching and learning. Among the raised topics are concepts of consistency, time, money, shapes and space, particularly on "producing various structures based on creativity" including building "closure" and "link", as well as 3D shapes that are perceived as abstract and challenging to comprehend or implement among preschoolers. Respondents' feedback is as follows

Please reconsider the concept of consistency. Also, MA 5.1.6 (correlate time with past, present and future events) is suitable as a learning activity, not a learning standard. Reduce the burden on preschoolers in the concept of shapes and space, introduce only 2D shapes. (T15_IL30-32)

Many learning standards are too difficult to understand and challenging to explain to preschoolers. (T38)

Remove the content standard MA1.5 (understanding the concept of consistency), as it is not suitable for the mastery level of preschoolers. (T99)

Difficulty in teaching the part about comparing numbers 12 and 13 (13 is 1 more than 12) to children (MA 2.3.2). (T130)

MA 4.1.3 (use money in various activities) is challenging for preschoolers to understand because subtraction taught is only within 18. For example, the value of an item is RM1.50, and the money given is RM2.00; students are not able to subtract smoothly. It might be better to only introduce the value of money and to arrange money according to its value. (T204_IL18-22)

On the other hand, analysis of data indicates a divergence of opinions among preschool teachers regarding the appropriate scope of numbers to be introduced to preschoolers in early mathematics. While some teachers believe that the scope should be increased, others argue that it should be reduced to align with preschoolers' level. This is evident through the quotes as follows:

For addition and subtraction operations, students need exposure to larger numbers, i.e., beyond 18. (T34)

The basics of addition and subtraction should only cover the range within 1-10. (T30)

Understanding of number concept can be extended up to 100. (T53)

It is sufficient for children to be familiar with numbers; addition and subtraction activities should only go up to number 10. For anything beyond that, students have not reached that level and can continue in Year 1. (T69_IL54-57)

Teachers need a better understanding of concepts, similar to primary school teachers, especially in adding and subtracting large numbers, not only within but beyond 18. Improvement is needed towards larger numbers. (T102)

Respondents also emphasize that the focus on fundamental concepts of early mathematics should be strengthened among preschoolers before introducing more complex content and learning standards.

Content standards need to emphasize on pre-number concepts and number operations. (T12)

Restructure the Mathematics content standards for shapes and space, especially 3-dimensional shapes, allowing children to better grasp basic numbers first. Foundation for operation of addition needs to be strengthened before subtraction, as introducing subtraction topics can confuse and make it difficult for children to master both operations. (T16_IL53-58)

Focus on basic mathematical concepts first, namely recognizing numbers before introducing too many topics that need to be learned. (T85)

Focus on the most basic aspects appropriate for preschooler's level. Too many learning or content standards cause teachers to sometimes not cover them comprehensively. (T87)

Additionally, some respondents believe that the quantity and quality of early mathematics curriculum content standards to be taught in preschool should be improved.

Too many skills are introduced, for example, money and time. (T3)

Refine the curriculum with more objective statements about the level for teaching preschoolers based on age. (T9)

Too many learning standards for early mathematics! (T47)

To allow preschool students more time for enjoyable activities and to prevent teachers from rushing through the curriculum, I suggest removing the concepts of consistency and 3D shapes. This is because conducting enjoyable activities or projects for preschoolers requires a lot of time from beginning to completion. If the curriculum is challenging and heavy, teachers need to repeat it, leaving insufficient time to plan enjoyable activities for them. (T33_IL9-14)

To streamline and enhance the curriculum, reduce less important content and learning standards and prioritize more challenging ones. (T52)

Narrow the scope of shape and space to basic concepts only. (T121)

b) Suitability

The analysis also indicates that the suitability of the early mathematics curriculum needs to be reassessed based on the context and abilities of preschoolers. Feedback from study respondents highlights the importance of considering the diversity of contexts among preschool students in Malaysia in early mathematical teaching and learning. Hence, flexibility in the delivery of early mathematical instruction in various local contexts according to the needs of students is required based on the following excerpts:

Assessment levels for student mastery need to be lowered, especially for integrated pre-schools [for children with learning difficulties]. (T12)

Benchmarking of mathematics content should take into account rural schools and students who did not attend nursery before entering kindergarten. (T41)

My suggestion is to have a special program with different learning standards for schools with indigenous students that is less heavy and gradual based on stages. (T66)

Consider the levels of preschoolers in rural or remote areas. (T110)

If possible, the content standards for early mathematics should focus more on number recognition and number operations and nothing beyond that. For students in remote areas, they are not exposed to situations like those in urban areas, so consideration should also be given to content that is suitable for each area. (T112_IL24-28)

Development and mastery levels of preschoolers differ between rural and urban schools. My proposal is to create a special curriculum for rural preschool students. (T99)

In addition to the diversity of localities and types of preschools in the Malaysian context, age, needs, and level of student abilities are also among the key factors that need to be considered in refining the early mathematics curriculum based on respondents' feedback.

Improving the early mathematics curriculum requires adjustments to the content standards, learning standards, and performance standards that are more aligned with students' abilities. (T32)

Skill levels need to be lower to match the preschoolers' age level. (T23)

Levels need to be appropriate for the age and readiness levels of children, which vary. (T29)

The format of solving situation-based number operations should be removed because pre-school students are not mature enough in their visualisation skills in converting sentences into number forms. (T108)

Review early mathematics content. Lower the learning levels for preschoolers. Problem-solving skills in early mathematics may demoralize students who are slow to understand certain mathematical concepts, and these students will lag behind. Personally, let students

recognize numbers and play with numbers first. Do not burden students with various content standards that are not intended for pre-school students. (T116_IL59-65)

The content of learning standards in the curriculum can be improved, such as MA 3.1.6, which is number operations, addition and subtraction. Here, the success criteria for this learning standard are that students can read and understand statements of the mathematical problem. For weaker students (a very small minority), it is difficult for them to read the statements unless the teacher guides them by reading the statements first. (T69_IL42-47)

In the excerpt below, the level of student mastery is linked to parental involvement and the pre-existing knowledge that children have before entering preschool. This highlights the crucial role that parents should play to ensure continuity from home to preschool.

The content in KSPK is appropriate, but it relies too much on teachers. Half of the students come to preschool with no basic mathematical education from home beforehand. Moreover, many of them enter preschool at the age of 6, making it difficult for them to master all the learning standards within 1 year without assistance from their family members. Discussions with family members are highly irrelevant because their attitude is 'it's okay not to be good at it, as long as they have enough to eat.' (T33_IL11-16)

c) Continuity

Furthermore, continuity between the preschool early mathematics and Year 1 curriculum in primary school is also one of the issues that arises from the data analysis.

For preschool students, early mathematics curriculum available is suitable. However, upon entering Year 1, the curriculum gap is very wide and high. I hope curriculum modifications can be done to ensure seamless continuity and not burden students with such heavy learning. (T15_IL30-33)

Taking into account the subject syllabus in Year 1, the early mathematics standards for preschool needs to be enhanced, for example, identifying numbers 1-100, counting by hundreds. (T76)

Skills in content standards should be refined accordingly based on the learning level in Year 1. (T23)

Implementation

Response from preschool teachers also indicates several key issues in the implementation of early mathematics teaching and learning in preschool, which include pedagogy, time allocation, and language of instruction.

a) Pedagogy

Respondents emphasize the importance of implementing pedagogy that is appropriate for teaching and learning early mathematics in preschool in the 21st century. The methods, techniques, and approaches proposed by preschool teachers based on data collected are identified to be in line with developmentally appropriate practices, including playful learning, contextual approaches, diverse delivery methods, and delivery of interactive activities.

The curriculum should emphasise on the pedagogy and innovations that preschool teachers can use when teaching early mathematics. (T64)

The use of conceptual approaches and mastery learning in teaching should be used wisely and balanced to encourage preschoolers' critical thinking skills and problem-solving. (T65)

Can increase and suggest a variety of interactive activities and learning through play involving early mathematics learning in preschool. (T16)

Teachers should use differentiated approach in early mathematics teaching. (T23)

Should increase exposure to teaching and learning activities using 21st century approaches. (T81)

Some respondents also suggest freedom and flexibility in the implementation of pedagogy in the teaching and learning process of early mathematics in preschools. This is in line with the diverse types and contexts of preschools in Malaysia so that the specific needs of different preschoolers can be met. Excerpts supporting this subtheme are as follows:

Examples of suitable activities conducted based on learning standards should be provided in the curriculum. This is because teachers will find it easy to look for ideas to conduct teaching and learning. The examples provided will be modified and adapted according to the developmental level of each student. The examples provided may not necessarily be used directly but will be modified according to the teacher's abilities and resources available. Indirectly, this will provide opportunities for teachers to apply new innovations in delivering mathematics teaching and learning. (T16_IL64-70)

Teachers need to be given more detailed schemes or guidelines in implementing teaching based on each learning standard and performance standard. From there, teachers are given the flexibility to apply these guidelines according to their creativity. (T4)

Nevertheless, findings from observation indicated that the activity conducted during one of the observed early mathematics classes were found to be less effective for preschoolers' mastery of the concept of addition. Based on the observed session, preschoolers were asked obtain questions for addition operation by rolling a ball to knock down a small bottle. The teacher read the questions and asked them to stick number and operational symbol cards on the whiteboard. Finally, the students were asked to solve the mathematical operation.

b) Time Allocation

Respondents also express the importance of ensuring adequate time allocation to implement the prescribed early mathematics curriculum. Based on respondents' feedback, preschool teachers generally agree that the allocated time for early mathematics learning for preschool children which is set at 40 minutes per week is insufficient and does not align with the quantity of learning standards in the curriculum.

Early mathematics needs to be given more allocated time, similar to Communication Strand. Students need to learn Early Mathematics every day to ensure continuity in teaching and learning. (T73)

Rethink the allocation of time for early mathematics teaching because 40 minutes per week is not enough because preschool students need a lot of practice to understand the concepts. (T1)

Increase the time for mathematics in teaching and learning to provide space for students to learn mathematics joyfully. (T84)

Reduce the number of learning standards since the time for Early Mathematics is only 40 minutes per week so that students can master numeracy skills better. (T26)

Moreover, data from observations indicated that preschoolers were not given sufficient time and opportunities to discuss, interact through Q&A sessions, and explore using teaching materials during early mathematics learning sessions.

c) Medium of instruction

Several respondents also raise the issue of language used in the teaching and learning process of early mathematics in preschool. Some states in Malaysia implement a Dual Language Program (DLP) for the implementation of early mathematics. The following excerpts indicate that the use of bilingualism has led to two divergent perceptions on its efficacy for both teachers and preschoolers:

Dual language became one of the constraints for preschool students to adapt to daily learning. (T1)

Teaching early mathematics in English makes it more difficult for students to master. Teachers need to use terms and explanations in English. Students require more time to master the content. (T7)

Abolish the use of bilingualism (DLP) in early mathematics teaching and learning because students experience confusion and difficulty in understanding multiple languages (Malay and English) at once, making it difficult to achieve effective implementation. (T112_IL41-44)

Early mathematics can be taught in bilingualism for better student understanding. (T20)

Implemented in English to facilitate students entering first grade classes that learn math in English (DLP). (T11)

Teaching mathematics in English at this initial stage is quite challenging for me as a teacher in Sarawak. Teachers sometimes have to introduce students in two languages at once. It is a very good effort for students to learn Mathematics in English. It just requires more effort. It is quite challenging for teachers and students. (T116_IL7-11)

Teaching Aids

Teachers' responses also highlight the need for appropriate teaching aids to be used in the teaching and learning process of early mathematics, especially in rural pre-schools. Based on data analysis, two main issues emerged including suitability as well as digitalisation of early mathematics teaching aids.

a) Suitability of Teaching Aids

Based on observations conducted on preschool early mathematics implementation, preschool teachers were found to have planned and prepared teaching aids to be applied in the teaching and learning process. However, the early mathematics teaching aids used were identified to be closed-ended and limited in quantity or options. This could jeopardise preschoolers' opportunities for personal exploration and development of critical and creative thinking.

Feedback from respondents also reiterates the need for provision of teaching aids that are concrete and hands-on. This is in line with the pedagogical practices recommended in the Malaysian national preschool curriculum.

Activities involving tangible materials in counting numbers should be added to enhance understanding for addition and subtraction operations within the concept of play. (T13)

By using concrete and visual materials, children find it easier to understand mathematical concepts. Concrete and visual materials help children think logically and strategically towards solving mathematical operation problems. (T28)

Preparation of creative and innovative teaching materials and aids for early mathematics and logical thinking activities. (T8)

However, data analysis indicates that several respondents still believe that conventional learning materials such as exercise books, worksheets, textbooks, or similar materials are necessary to reinforce preschoolers' mastery of early mathematics in addition to other learning activities. This suggests that preschool teachers still rely on traditional learning approaches in the context of early mathematics teaching and learning.

Mathematics needs to be taught through drill and practice. Exercise books and activity books need to be allowed for use. The Ministry of Education must issue a circular allowing the use of activity books. The Ministry of Education should issue readily printed modules for preschool mathematics. Year 1 mathematics is very difficult. Therefore, the teaching methods in preschool must be aligned with the Year 1 level. (T204_IL66-69)

Request for the provision of books oriented towards early mathematics learning in the form of "big books" with attractive illustrations so that preschool students are more interested in learning mathematics appropriate for their level. (T215)

Creating special preschool exercise/activity books equipped with appropriate content standards and learning standards to facilitate the work of teachers and preschool students in mastering the subject of mathematics better since Early Mathematics learning helps in the

continuity of preschool students to Year 1 later. In addition, schools in each district provides suitable teaching aids for Mathematics, such as number boxes containing number cards, and so on. (T33_IL76-80)

Observations conducted by the researchers echo similar findings, where preschoolers were given minimal opportunity for exploration because early mathematics activities implemented were more inclined towards teacher-centred activities. Teachers were observed to use worksheets as part of teaching and learning activities during all observed early mathematics sessions. This further revealed teachers' overreliance on paper and pencil worksheets that are solitary in nature, reducing preschoolers' opportunities for meaningful learning and interactions.

Several respondents also raised the issue of standardisation of teaching materials. This can be supported through the following excerpts:
It would be better if the Ministry of Education provides standardized exercise books used by all preschool classes in Malaysia. These exercise books should also be provided for all other subject areas as a guide for teachers. They will serve as guidelines for teachers in teaching. It will indirectly reduce the expenses of teachers buying exercise books if provided by the Ministry of Education. These exercise books are crucial for drilling and practice to improve preschoolers' mastery and not just rely on learning through play alone. This is because the Year 1 curriculum is very difficult for them if their foundation in preschool is weak. (T15_IL26-32)

Worksheets or workbooks that are suitable (standardized for all preschools) should be used for preschool students because Mathematics requires drill and practice, not just theory and teacher-led learning in class alone. (T81)

Please provide standardised learning aids for students such as worksheets, counting tools, number cards that use consistent number forms, and so on. (T212)

b) Digitalisation of teaching aids

In addition, feedback from study respondents indicates teachers' awareness of 21st century learning through an emphasis on the need for digitalised teaching aids that can assist preschool students in mastering early mathematics.

My suggestion is that the Ministry of Education should provide tangible and digital teaching aids to rural preschools because rural schools lack tangible learning materials for play-based learning for five to six-year-old children. (T112_IL34-37)

Multimedia / interactive learning should be applied more in early mathematics to attract students' attention during learning. (T37)

Teaching in digital form using ICT is more enjoyable, and students understand concepts faster. (T43)

Maximise the application of ICT materials or applications that can be used for student reinforcement at school and at home. (T47)

Digital aids using technology such as creating interesting videos will help students to understand mathematical concepts easier. (T32)

Audio or video materials that require students to observe and try for themselves should be added into the teaching and learning process. (T50)

Should provide more videos for each content standard for early mathematics and make them easily accessible to teachers. (T74)

Continuous Professional Development

Preschool teachers also emphasize the need for continuous professional development in early mathematics teaching and learning through workshops or relevant courses. Among the proposed course or workshop contents include digital early mathematics curriculum, effective pedagogy, and detailed guidelines for specific content standards.

Provide exposure or courses for teachers on suitable teaching and learning methods to be practiced in preschool classes. Throughout my service, there have not been courses related to early mathematics exposure for pre-school teachers. (T69_IL13-16)

Hands-on courses should be organised so that teachers can learn effective ways to teach preschoolers in mastering early mathematics, similar to the exposure provided to Mathematics option teachers. (T54)

Workshops & teaching manuals for teaching early mathematics using play-based learning methods should be provided. (T68)

More focus should be given to conduct digital learning courses. (T17)

Provide more exposure (courses/workshops/webinars) on creative teaching pedagogies in early mathematics to preschool teachers. (T22)

Courses on preparing creative and innovative teaching materials and aids for early mathematics activities and logical thinking should be carried out. (T10)

Organising training courses on effective pedagogy and early mathematics assessment methods for all preschool teachers. (T6)

Detailed explanations are needed regarding the topic of time, and space. (T92)

This is further supported by data collected via observation sessions that teachers were less competent in terms of pedagogical knowledge regarding early mathematics concepts. Activities and assessment methods applied were found to be less effective in reinforcing preschoolers' mastery of mathematical concepts. For instance, a subtraction worksheet used in an early mathematics session was not specifically helpful in strengthening preschoolers' understanding of the concept (Figure 1).

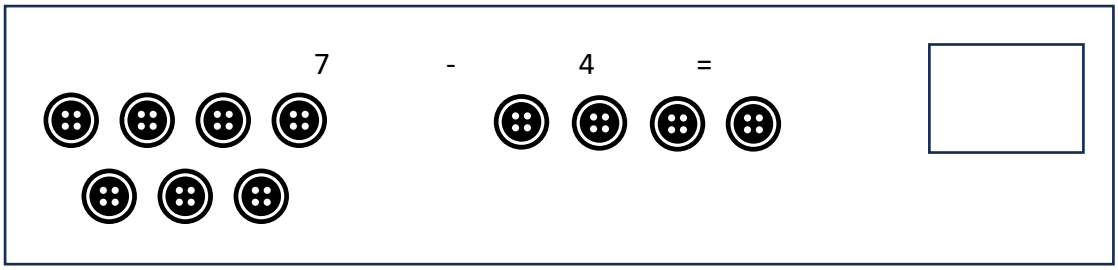

Figure 1. Sample subtraction question in a worksheet used by a preschool teacher.

Moreover, feedback from respondents indicates interesting results. Both senior and junior preschool teachers express the need for more training in the aspect of teaching early mathematics in preschools.

A workshop to enhance teaching and learning of early mathematics can be organized with the aim of providing recap for veteran teachers. (T7)

Conducting a refresher course on early mathematics pedagogy is necessary as it has been too long since I have received exposure from the time when I started to teach in preschool. (T16_L46-48)

Providing additional training, courses, and exposure to new teachers in terms of pedagogy, especially for educating students in rural areas. (T21)

There is a need for more workshops or courses on early mathematics for teachers, especially new teachers, so that teachers have broad knowledge to teach students with varying levels of mastery. (T90)

In terms of the content of professional development, despite some preschool teachers emphasise the need for flexibility in pedagogical practice, there are respondents who suggest the necessity of detailed and specific teaching pedagogical guidance to improve their competencies in the process of early mathematics teaching and learning as illustrated by excerpts below:

The Ministry of Education should provide one teaching guidebook according to levels (complete with full lesson plans so that teachers easily understand the correct teaching methods) and more detailed, standardised assessment. (T98)

Detailed explanations for each learning content should be provided in the curriculum. (T117)

Supply reference materials from the Ministry of Education as a syllabus for preschool teachers' reference to facilitate teachers in planning and teaching based on these reference books. (T79)

A standardized assessment module in Malaysia should be created. It should indicate validated information on the maximum or minimum skills that need to be achieved by the child before progressing to Year 1. (T8)

Conclusion and Discussion

Overall findings established that Malaysian public preschool teachers had raised several issues on the early mathematics curriculum and its implementation. Respondents also highlighted the need for appropriate teaching aids and provision of continuous professional development to improve in their quality of early mathematics teaching and learning.

Teachers generally demonstrated positive attitudes in terms of their awareness of their need for continuous improvement in early mathematics pedagogical content knowledge. They also raised up the necessity for digitalisation of teaching aids, flexibility in curriculum implementation, as well as the development of 21st century skills such as creative and innovative thinking through early mathematical teaching and learning, in line with the Malaysian national preschool curriculum.

On the other hand, data also indicated ironic findings that contradict with previous research studies done in the context of Malaysian preschools. Although research such as Ghazali et al. (2022) indicated that Malaysian preschool teachers were generally proficient in their knowledge, readiness, understanding, attitudes towards teaching early mathematics, on site observations of preschool teachers' implementation of early mathematics teaching and learning implied minimal opportunities for preschoolers' exploration and interactions. Moreover, some teachers also applied play activities that were less effective for children's mastery of basic mathematical concepts.

Respondents' feedback indicated their acknowledgement of early mathematics teaching approaches suggested in the national preschool curriculum such as interactive activities and mastery learning. However, data similarly revealed conflicting findings. In practice, teachers were observed to be highly dependent on worksheets, which is a form of teacher-centred practice in contrast with teachers' beliefs. This is in line with Sheridan et al. (2020) who similarly highlighted the lack of quality in early mathematics teaching and learning demonstrated by the emphasis on rote learning.

In line with Hu et al (2021) whose research was conducted with Chinese preschool teachers, Malaysian public preschool teachers were also found to be lacking in their interactions with children to foster preschoolers' critical thinking skills. Open-ended questions were rarely used as prompts to help promote children's thinking skills.

These practices could possibly be justified based on one of the pressing issues highlighted by the respondents, namely limited time allocated for preschoolers' mathematical experiences. This is in alignment with Sheridan et al (2020) who posited that preschool teachers spend lesser time on early mathematics compared to other content areas.

In a nutshell, data from the study has consistently amplified the need for effective professional development courses on the teaching and learning of early mathematics for preschool teachers (Leng et al., 2023; Li, 2021; Ompok et al., 2021; Sheridan et al., 2020). As asserted by Kenayathulla et al (2023), suitable training and courses should be conducted to improve preschool teachers' skills in applying appropriate pedagogical approaches in line with the needs of young learners in the 21st century.

Furthermore, several content and learning standards of early mathematics curriculum should be reviewed by considering the opinions of study respondents so that the curriculum content is more suitable for preschool children. For instance, topics such as the concept of money and 3D shapes were found to be abstract and challenging to understand and implement. Development of appropriate teaching aids and innovations in teaching and learning (PdP) of early mathematics in preschools that are relevant and aligned with current needs also needs to be worked on. Early mathematics teaching practices that are still teacher-directed and rely

heavily on rote learning such as drill exercises, workbook usage, and worksheets need to be adapted to reflect current trends and developmentally appropriate practices in curriculum implementation and assessment. The effective use of digital, multimedia, and interactive support materials should be expanded nationwide, including in rural, remote, integrated, and other areas, so that all preschoolers have equal access to quality and effective early mathematics learning experiences.

Since 2020, although the Malaysian government has consistently established that all preschool teachers should at least possess a minimum requirement of Diploma in Early Childhood Education, data shows that 73% of Malaysian preschool teachers from the private sector remain unqualified (World Bank, 2023). As this study only included public Malaysian preschool teachers as participants, future research directions should include exploring private preschool teachers' experiences and implementation practices in early mathematics. It is anticipated that a collaborative effort among stakeholders, including policymakers, governmental and non-governmental organizations, preschool administrators, and teachers, will further enhance the quality of early mathematics teaching and learning in Malaysia, hence contribute to the cultivation of Malaysia's skilled workforce in line with the demands of the coming era.

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