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Teachers' Perception of Integrating Play-Based Learning in Early Science

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Abstract. This study investigates the key challenges faced by preschool teachers in delivering Early Science education and highlights the need for a systematically designed play-based learning (PBL) module. It also evaluates the necessity for structured teaching resources such as guides, activity templates, and training tools. A survey research design with a quantitative approach was employed. A total of 300 preschool teachers from Sabah, Malaysia, were selected through simple random sampling. Data was gathered using a modified version of the Needs Assessment Questionnaire, focusing on the challenges in teaching early science and the teachers' perceptions of the necessity for a PBL module. Descriptive analysis using SPSS version 28.0 revealed that the teachers encountered difficulties mastering the science content, selecting appropriate teaching strategies, managing instructional time, and effectively implementing play-based techniques. The findings highlight a significant demand for organized and play-based teaching materials in line with the National Preschool Standard Curriculum (KSPK) and the Malaysia Education Blueprint 2013–2025, both of which emphasize holistic, child-centered, and inquiry-based learning. The novelty of this study lies in its proposal for a play-based early science module that supports STEM in early childhood education. The study also contributes to future research by recommending the design and pilot implementation of the module to evaluate its impact on teacher effectiveness and student learning. Furthermore, it calls for collaborative efforts among policymakers, teacher educators, and curriculum developers to ensure equitable access to quality early science education for all preschool children.

Keywords: Early science; Play-based learning; Module Development; Preschool

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1. Introduction

Malaysia's education system strongly emphasizes the development of 21st-century skills, with Science, Technology, Engineering, and Mathematics (STEM) positioned as the key drivers of national progress (Ministry of Education Malaysia, 2013). This agenda is reinforced through the KSSR and KSSM curricula, which promotes inquiry-based, hands-on learning. Additionally, national frameworks like the National Policy on Science, Technology, and Innovation (DSTIN) and the Shared Prosperity Vision 2030 further emphasize the need to develop STEM-literate citizens (MOSTI, 2020).

In line with these goals, early science education is recognized as a critical foundation. Play-based learning (PBL), rooted in theories by Piaget, Vygotsky, Froebel, and Montessori, supports children's cognitive, social, and emotional growth by promoting learning through doing, imagination, and exploration (Colliver & Veraksa, 2019). Research shows that children are naturally curious and capable of scientific thinking when given meaningful, real-world learning experiences (Studhalter et al., 2021; Arciniega, 2020). PBL increases motivation and engagement, and helps children build problem-solving and science process skills (Danniels & Pyle, 2018).

The systematic application of science education through play-based learning (PBL) in Malaysian early childhood education (ECE) remains difficult, even with the existence of extensive planning and policy frameworks. Preschoolers are introduced to science but these programs are usually disjointed, conceptually shallow, and out of step with national curriculum standards. Here, 69% of preschool teachers are ill-prepared to teach science in a cohesive manner, according to a National Academies of Sciences, Engineering, and Medicine (2022.) report. They frequently use fragmented, activity-based instruction without an integrated knowledge foundation. Parker and Thomsen (2019) discovered that PBL at the elementary school level prioritizes reading and social skills above methodical science instruction.

This problem is especially noticeable in Sabah, an East Malaysian state, where a large number of preschools are situated in remote or underdeveloped areas. Other difficulties that teachers frequently encounter include restricted training opportunities, a dearth of resources related to science that are age-appropriate, and pressure from parents and administrators to put academic preparation ahead of exploratory learning (Rahim et al., 2021; Hashim et al., 2021). Teachers find it challenging to confidently use play-based science instruction because of these characteristics.

According to a study by Yasmin et al. (2022), 68% of preschool teachers in Malaysia have expressed insecurity about organizing and facilitating play-based science activities. The lack of a framework for implementing PBL in early science contributes to incongruent teaching practices and superficial learning experiences (Parker et al., 2022; Hafsah Taha et al., 2020). Access to quality materials and professional training is heavily constrained in rural and under-resourced settings. This is more so a challenge in these areas (Rahim et al., 2021). If the issue is not

properly mitigated, Malaysia may not be able to achieve its goal of a scientific work force. In response to this demand, well-planned and well-structured teaching modules are required to support preschool teachers in teaching science through play. Modules must clearly state the learning objectives, provide activities appropriate for the age group, and list the targeted outcomes to align with national curriculum standards and STEM policy (Cerbo, 2025; Mondal et al, 2024). Such tools would not only improve teaching practices but also foster scientific curiosity and foundational thinking skills among young learners.

This research study seeks to determine the challenges faced by preschool teachers in imparting early science education. It will also attempt to find out the preschool teachers' perception of the need for a play-based science learning module and the essential need for a structured and curriculum-aligned module. This research supports the development of evidence-based strategies for integrating science into early childhood classrooms by exploring the teachers' views and resource needs. It assists in the long-term vision of activities in Malaysia for a STEM-literate and innovative society.

2. Literature Review

2.1 Challenges Faced by Preschool Teachers in Imparting Early Science Education

Early science refers to the scientific ideas that are taught and learned by children during their early developmental stages. This includes introducing children to scientific knowledge and helping them understand concepts, principles, and scientific problem-solving (Tanjung et al., 2023). The goal is to spark children's curiosity about the natural world while providing them with experiences and understanding of their surroundings (Diah, 2022). Early science education also focuses on enhancing children's cognitive development and creativity (Churiyah & Fitri, 2024). It is not just about teaching science as a subject but also about immersing children in various concepts and behaviors related to nature.

Science education in early childhood provides valuable opportunities for children to explore and learn about the world around them (Moeed & Saha, 2022). It supports the development of essential cognitive and social skills, and enables them to apply technology in everyday life meaningfully. The findings from Andari et al. (2022) show that early engagement with science positively influences long-term academic achievement and fosters early interest in science-related careers. However, implementing science learning in preschools is often challenging. Early science education significantly contributes to the development of cognitive, social, and logical thinking skills, thereby supporting holistic development (Roostin & Swandhina, 2019).

While these benefits are well-documented, the findings from the current study confirm that many preschool teachers struggle with science instruction due to limited training and poor conceptual understanding. This aligns with the previous research and suggests a systemic issue: despite curriculum mandates, teachers often lack the confidence and support needed to implement effective science education. The integration of natural materials and sensory experiences

(Roostin & Swandhina, 2019; Helena & Yaswinda, 2020) may be theoretically recommended but in practice, many teachers are unsure how to apply these strategies meaningfully without structured guidance.

Aligned with the Malaysian National Preschool Curriculum Standard (KSPK), early science education is positioned as a core component in fostering children's investigative and process skills such as observing, classifying, measuring, predicting, and communicating (Ministry of Education Malaysia, 2017). However, the study found that most respondents struggle with these very competencies, indicating that the curriculum intentions are not being effectively translated into teaching practice. Thus, the literature confirms both the value and challenge of early science teaching. This study contributes critical context: teachers in Sabah face unique constraints including a lack of resources, time, and systematic training, reinforcing the urgency of developing a support module tailored to these needs.

2.2 The Need for a Play-Based Science Learning Module

Play-based science creates opportunities for young children to explore using their senses and hands-on materials. Through such exploratory play, children develop a positive disposition toward science, becoming more inquisitive and confident in asking questions (Helena & Yaswinda, 2020; UNICEF, 2018). During these experiences, they acquire essential skills such as observing, measuring, comparing, classifying, and recording (Ministry of Education Malaysia, 2017). These foundational skills contribute to school readiness and a smooth transition into primary education (Bustamante et al., 2017).

Research reveals that play embedded into early science instruction increases understanding, engagement, and motivation (Danniels & Pyle, 2018; Colliver & Veraksa, 2019). However, despite the growing recognition of its benefits, the present study reveals a gap between the support for PBL in principle and its implementation in practice. Many teachers express enthusiasm for play-based strategies but lack the tools, time, and support needed to carry them out effectively.

This supports prior findings by Sung and Jeong (2023) where educators acknowledged the benefits of play-based science but cited difficulties in integration. Similarly, in Malaysia, Hashim et al. (2021) noted that systemic pressures often steer teachers away from exploratory approaches. The current study builds on this by demonstrating that teachers want to use play-based learning but are constrained by practical barriers, including minimal training and scarce teaching aids (Yanti et al., 2024). This underscores the importance of developing a play-based module that is not only grounded in theory but also provides clear, actionable guidance that teachers can easily implement, especially within time-constrained environments.

2.3 The Essential Need for a Structured and Curriculum-Aligned Module

Existing play-integrated science modules demonstrate clear benefits for children's development. Beyond knowledge acquisition, these modules promote problem-solving confidence and prepare children for future academic success (Bustamante

et al., 2017; Rahman et al., 2019). Play-based learning fosters lifelong competencies by strengthening cognitive, social, and emotional development.

A well-executed needs analysis is vital for developing science modules that suit the context of specific learning environments, such as preschools in Sabah. This process helps identify existing gaps in teaching practices and ensures that the newly developed materials align with curriculum objectives and classroom realities. A targeted needs analysis also reveals areas where play-based strategies can enhance the children's development by supporting their scientific thinking.

Furthermore, involving subject matter experts ensures that teachers are equipped with high-quality teaching aids, enabling the delivery of developmentally appropriate, engaging science education. This aligns with the research advocating for expert-driven module design (Cerbo, 2025; Lestari et al., 2025). By anchoring these needs in both the literature and the lived realities of teachers, the study supports the development of a play-based science module that is not only theoretically sound but also practically implementable and contextually responsive, especially for educators in under-resourced areas like Sabah.

3. Methodology

3.1 Research Design

This study used a survey research design with a quantitative approach. This research design was appropriate as it allowed for systematic data collection and analysis from a large sample, identifying gaps and needs in early scientific education that are able to guide the creation of a successful instructional module. This method answers the research concerns regarding the need for module development and the learning objectives of an early science module.

3.2 Research Participants

The study was conducted in Sabah, where the total population of preschool teachers was approximately 1,305 (Ministry of Education Malaysia, 2024). To determine the appropriate sample size, the Bukhari Sample Size Calculator (Bukhari, 2020), an MS Excel-based calculator, was used. Based on this calculator, a total of 297 respondents was determined to be required for the study. However, a total of 300 preschool teachers participated to account for rounding and potential data loss. A simple random sampling technique was used as it ensured that each respondent had an equal chance of being selected.

In this context, the respondents were randomly selected without stratification by their demographic characteristics. The needs assessment identified specific content and structural needs for an early science learning module. According to Wang (2024), needs analysis plays a critical role in aligning instructional strategies with the learners' specific needs, thereby enhancing the learning outcomes and supporting the teachers' continuous professional development.

Table 1: Demographic Analysis

Aspect		Frequency	Percent
Age	< 30 Years	64	21.3%
	31 - 40 Years	118	39.3%
	41 - 50 Years	63	21.0%
	51 - 60 Years	55	18.3%
Education	Degree	240	80.0%
	Master	60	20.0%
Teaching Experience	< 3 Years	111	37.0%
	3 - 5 Years	19	6.3%
	> 5 Years	170	56.7%
Course/ Workshop	No	235	78.3%
	Yes	65	21.7%

Table 1 shows a balanced age distribution, with the highest concentration (39.3%) in the 31–40 age group, while younger professionals (below 30) account for 21.3%, and 18.3% fall within 51–60 years, reflecting a mix of early-career and experienced professionals. In terms of educational attainment, 80.0% of participants hold a bachelor's degree, while 20.0% possess a master's degree, indicating that most have foundational academic qualifications with a smaller yet meaningful segment having advanced education.

Additionally, 56.7% have over five years of teaching experience, demonstrating a strong base of seasoned teachers, whereas 37.0% have less than three years, highlighting a group of newer teachers, while a smaller 6.3% fall within the three to five-year range. However, participation in professional development courses or workshops in early science remains low, with 78.3% not attending any courses, while only 21.7% have, suggesting a need for greater emphasis on professional development in this area.

3.3 Research Instrument

The questionnaire used in this study was the Needs Assessment Questionnaire, adapted from the self-assessment instrument for in-service training needs (LDP) by the Malaysian Ministry of Education (2020). This questionnaire aims to identify the essential requirements for module development prior to the design and development stages. It has been structured and modified by the researcher based on the learning focus in the National Preschool Standard-Based Curriculum and is divided into four main sections. Section A focuses on demographic information and consists of 5 items. Section B examines the challenges faced by preschool teachers in teaching Early Science, comprising 10 items.

Section C explores the importance of developing an Early Science Learning Module, which includes 11 items. Lastly, Section D assesses the necessity of an Early Science Learning Module based on a play-based learning approach, containing 8 items. In total, the questionnaire consists of 34 items. A Likert scale is used in Sections B, C, and D, ranging from (1) Strongly Disagree to (5) Strongly Agree to measure the respondents' level of agreement with the statements provided.

3.4 Data Collection

A systematic quantitative strategy was used to successfully answer the study questions. Because they are actively involved in the implementation of early scientific instruction and are in the best position to reflect on their classroom realities and professional needs, preschool teachers in Sabah, Malaysia, made up the study's target group. The researcher used Google Forms to deliver a structured questionnaire to preschool teachers throughout Sabah in order to gather the data. To guarantee widespread and easy access, the form was distributed via email and WhatsApp. To allow the participants enough time to reply, the survey was available for three months.

The Ministry of Education Malaysia gave its clearance before the start of the data collection. The participants were informed of the study's purpose, their rights, and the voluntary nature of their involvement. Consent was collected digitally through the form. No personal information was requested, and all responses were anonymous. The data was securely stored and used only for research purposes. The study adhered to strict ethical standards, ensuring that the participants' privacy, dignity, and autonomy were respected throughout the process.

3.5 Reliability and Validity

The involvement of experts in this study ensured that the research instrument accurately measured the intended construct (Buuren & Eekhout, 2023). The questionnaire, adapted from the Ministry of Education Malaysia's in-service training (LDP) self-assessment tool, was evaluated for content validity by three experts. Each expert reviewed the items and provided feedback on word choice, sentence structure, language, and construct alignment. Content validity refers to the extent to which a questionnaire accurately measures its intended concept (Tolvanen et al., 2024). The experts, all experienced lecturers in Early Childhood Education, contributed to the refinement of 29 items. Based on their feedback, revisions were made to enhance clarity and consistency. The questionnaire achieved a Cronbach's Alpha of 0.913 and 0.927 based on the standardized items, indicating excellent internal consistency. These results confirm that the instrument is highly reliable and appropriate for assessing the targeted construct.

3.6 Data Analysis

The data analysis for the module design was conducted using the Statistical Package for the Social Sciences (SPSS) version 28.0. To answer the study's research questions, a survey approach was used. The data was analyzed using descriptive statistical methods. In particular, the demographic background of the respondents was described using frequency and percentage analysis. Additionally, based on the opinions of participating preschool teachers, mean and standard deviation analyses were carried out to determine the main subject areas and instructional priorities involved in the creation of the early scientific teaching and learning module.

Given the exploratory nature of this study, which aimed to identify the challenges encountered by instructors, assess the level of need, and examine attitudes towards the development of a play-based science learning module, the application of descriptive statistics was deemed appropriate. Descriptive statistics

were sufficient to capture response patterns and establish a foundational understanding necessary for the subsequent development of the module. This analytical approach offers valuable preliminary insights that can inform and shape more rigorous future investigations employing inferential statistical techniques.

Table 2: Interpretation of mean scores

Mean Score	Interpretation
4.23-5.00	Very High
3.42 – 4.22	High
2.61– 3.41	Moderate
1.81-2.60	Low
1.00 – 1.80	Very Low

Source: Sanjaya & Hidayat (2022)

4. Results

The following section outlines the results of the data collection. The findings identify the main difficulties encountered by preschool teachers related to achieving competency in early science education, identifying the teachers' perceptions on the importance of developing Play-Based Science Module, and assessing the need for an early science learning module that incorporates play-based learning.

Table 3 : Descriptive statistics of the needs analysis for developing a play-based science module

Construct	Mean	Std. Deviation	Interpretation
Challenges Faced by Preschool Teachers in Early Science Teaching Competency	2.8643	.21693	Moderate
Importance of Developing a Play-Based Science Module	4.5612	.07495	Very High
Essential Need for a Play-Based Science Module	4.6492	.02849	Very High

Table 3 reveals that the respondents reported a moderate level of challenges regarding Early Science teaching competency (Mean = 2.8643, SD = .21693). However, there was strong agreement on the importance of developing a play-based science module (M = 4.5612, SD = .07495) and a high perceived need for such a module (M = 4.6492, SD = .02849). These results suggest that although teachers encounter challenges of moderate intensity, there is a consistent and compelling demand for a structured, play-based approach to support early science instruction. The disparity between the level of challenges faced and the high level of need underscores a critical gap: teachers perceive the existing support systems as insufficient and express a clear desire for developmentally appropriate, curriculum-aligned resources. This finding directly supports the

study's objective of advocating for the development of a comprehensive play-based science learning module.

Table 4: Challenges faced by preschool teachers in relation to early science teaching competencies

No	Item	*n* (%)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	Difficulty Understanding Science Concepts	51 17.0%	77 25.7%	66 22.0%	92 30.7%	14 4.7%
2.	Tendency to Memorize Texts Before Teaching	33 11.0%	87 29.0%	76 25.3%	91 30.3%	13 4.3%
3.	Challenges Using Appropriate Teaching Methods and Aids	16 5.3%	95 31.7%	57 19.0%	113 37.7%	19 6.3%
4.	Difficulty Explaining Science Concepts	15 5.0%	110 36.7%	32 10.7%	120 40.0%	23 7.7%
5.	Time Constraints in Lesson Planning	10 3.3%	52 17.3%	102 34.0%	112 37.3%	24 8.0%
6.	Lack of Proficiency in Play-Based Methods	32 10.7%	95 31.7%	112 37.3%	52 17.3%	9 3.0%
7.	Limited Problem-Solving Skills	53 17.7%	68 22.7%	114 38.0%	45 15.0%	20 6.7%
8.	Difficulty Integrating Existing Knowledge	31 10.3%	107 35.7%	109 36.3%	40 13.0%	13 4.3%
9.	Challenges in Conducting Appropriate Early Science Activities	27 9.0%	108 36.0%	95 31.7%	53 17.7%	17 5.7%
10.	Generating Ideas and Seeking Relevant Information.	42 14.0%	101 33.7%	80 26.7%	63 21.0%	14 4.7%

The highest challenge reported was difficulty explaining science concepts with 40.0% agreeing and 7.7% strongly agreeing, indicating a lack of conceptual understanding or training. Teachers also tend to rely on memorization before teaching (34.6%), a strategy that contradicts best practices in inquiry-based or play-based pedagogy. Conversely, challenges like using play-based methods (20.3%) and conducting early science activities (23.4%) were less frequently reported, suggesting that teachers may be open to using play if equipped with the right tools. These findings support the urgent need **for targeted professional development and structured teaching aids**, which are the key objectives of the proposed module.

Table 5: Teachers' perceptions of the importance of developing a play-based science module

No	Item	*n* (%)				
		Strongly Agree	Disagree	Neutral	Agree	Strongly Agree
1.	I need a Learning Module that is suitable for children'	11 3.7%	5 1.7%	0 0%	111 37.0%	173 57.7%
2.	I need a Learning Module with the latest learning model that can aid teaching and learning.	0 0%	0 0%	7 2.3%	101 33.7%	192 64.0%
3.	I need an Early Science learning module based on a play-based learning approach.	0 0%	0 0%	16 5.3%	81 27.0%	203 67.7%
4.	I support the development of an Early Science learning module based on a play-based learning approach.	0 0%	0 0%	3 1.0%	94 31.3%	203 67.7%
5.	Developing a learning module will attract children to participate in Early Science learning.	0 0%	0 0%	11 3.7%	95 31.7%	194 64.7%
6.	Developing a learning module will help prevent dropouts in Early Science learning.	0 0%	4 1.3%	6 2.0%	142 47.3%	148 49.3%
7.	Early Science teaching through play-based learning can enhance children's scientific skills and critical and creative thinking skills.	0 0%	0 0%	0 0%	120 40.0%	180 60.0%
8.	Early Science learning through play-based learning offers children opportunities to interact, share information, and solve problems.	0 0%	0 0%	5 1.7%	120 40.0%	175 58.3%
9.	Early Science learning through play-based learning provides chances for children to interact, share information, and solve problems.	0 0%	0 0%	4 1.3%	113 37.7%	183 61.0%

10.	Early Science activities focusing on play-based learning can foster curiosity and interest in children.	2 0.7%	7 2.3%	1 0.3%	118 39.3%	172 57.3%
11.	Early Science activities based on play-based learning can cultivate moral values in children.	4 1.3%	7 2.3%	0 0%	126 42.0%	163 54.3%

The highest level of strong agreement (67.7%) was for the statement: "I need an Early Science learning module based on a play-based learning approach," indicating strong support for a structured module that integrates play into science instruction. Other highly endorsed needs include a child-appropriate module (57.7%) and one incorporating up-to-date learning models (64.0%). Although the belief that such a module could help prevent dropouts received slightly lower agreement (49.3%), it still reflects positive expectations. Overall, teachers believe that a play-based module can enhance science process skills, foster curiosity, and support problem-solving—directly aligning with the study's objective of improving early science engagement and foundational learning.

Table 6: Essential need for a play-based science module.

No	Item	*n* (%)				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I need a module that includes appropriate activities based on the learning standards in the teaching plan.	7 2.3%	0 0%	3 1.0%	68 22.7%	222 74.0%
2.	I need a module that outlines objectives suited to the children's existing knowledge.	0 0%	0 0%	11 3.7%	79 26.3%	210 70.0%
3.	I need a module that specifies the Teaching and learning resources used (ABM/BBM).	0 0%	0 0%	3 1.0%	92 30.7%	205 68.3%
4.	I need a module that identifies the thinking skills and moral values being applied.	0 0%	7 2.3%	0 0%	84 28.0%	209 69.7%
5.	I need a module that provides systematic implementation steps.	0 0%	0 0%	1 0.3%	97 32.3%	202 67.3%
6.	I need a module that includes suggestions for worksheet activities.	7 2.3%	0 0%	1 0.3%	86 28.7%	206 68.7%

7.	I need a module that includes assessment activity suggestions (observation/checklist).	0 0%	0 0%	7 2.3%	86 28.7%	207 69.0%
8.	I need a module with diverse activities that encompass all areas of development.	7 2.3%	0 0%	5 1.7%	83 27.7%	205 68.3%

The most strongly supported item (74.0%) was the need for a module with activities aligned with the teaching standards, highlighting the teachers' preference for structured, curriculum-aligned resources. Other highly rated needs include modules that outline clear learning objectives (70.0%) and specify teaching aids (68.3%). Although slightly lower, the strong support for systematic implementation steps (67.3%) suggests that while structure is essential, teachers also value flexibility for classroom adaptation. These findings indicate that the absence of well-structured materials hinders effective implementation, reinforcing the study's rationale for a comprehensive, contextually relevant early science module.

5. Discussion

This section presents a detailed discussion of the research findings obtained from the quantitative data. The discussion includes the challenges faced by preschool teachers in relation to early science teaching competencies as well as the findings related to the importance of developing an early science learning module based on a play-based learning approach. This discussion also highlights the key theoretical, practical, managerial, and policy implications derived from the study.

5.1 Challenges Faced by Preschool Teachers in Early Science Teaching Competency

The findings revealed that teachers face pedagogical challenges of moderate intensity that have meaningful instructional implications. The most important issues relate to problems delivering science concepts effectively, as well as selecting and using appropriate teaching methods and materials, and dealing with lesson planning time limitations. Many teachers feel pedagogically unconfident to apply science process skills effectively. This mainly stems from inadequate content knowledge and poor pedagogical training (Maraisane et al., 2024).

Failure to control science teaching by Ramli & Tajudin (2021) and failure to be prepared in the field of science education can negatively impact the quality of early science teaching (Silva et al., 2020). Kasdiah et al. (2024) also found that many preschool teachers indicate they feel they have not been trained sufficiently to implement the early childhood curriculum. The absence of professional development makes it hard for teachers to deliver quality education and meet the curriculum.

Children's comprehension of even basic science concepts can be impeded by the teachers' lack of pedagogical preparation and content expertise, which frequently

results in a decrease in their enthusiasm in science-related lessons. According to Fleer (2021), teachers who lack conceptual knowledge are thought to be unable to support children's scientific thinking and will instead reinforce their misconceptions. It is crucial to give teachers organized, play-based teaching materials and ongoing training in order to boost their confidence and enhance their instructional competency. Professional development programs should include science process skills being implemented into play-based teaching frameworks from a developmental perspective.

In addition, the limited preparation time for lesson planning presents a significant barrier to designing practical and engaging science activities (Bustamate et al., 2017). Teachers also face difficulties maintaining pedagogical continuity (Due et al., 2022), which underscores the importance of modifying teaching approaches to achieve better learning outcomes. According to the Malaysia Education Blueprint (Ministry of Education Malaysia, 2017), learning experiences should be creative, enjoyable, and meaningful to foster children's holistic development and prepare them for future challenges.

Furthermore, the teachers' ability to plan and implement suitable activities is essential to nurture children's curiosity and their understanding of scientific concepts (Viskovic, Sunko, & Mendes, 2019). However, many educators lack the professional training, resources, and guidelines to apply PBL in early science (Tavares et al., 2020; Rashid & Subramaniam, 2024). This suggests an urgent need for interventions aimed at enhancing early science teaching competencies.

In response, professional development workshops and internal training programs must be put in place to give educators the information and abilities they need. It is recommended that policymakers set aside funds to promote national teacher training initiatives that prioritize science literacy and playful learning, as well as curriculum change. Time management techniques, resource availability, and pedagogical training ought to be given top priority in these programs. Preschool teacher certification programs should require play-based learning (PBL) training in order to meet the STEM objectives of the Malaysia Education Blueprint.

5.2 Teachers' Perceptions on the Importance of Developing a Play-Based Early Science Learning Module

This study shows a clear consensus among teachers on the importance of developing a play-based Early Science learning module. Most teachers believe that such a module would foster curiosity, critical thinking, creativity, motivation, and interest in early science. The play-based approach is viewed as an effective method that enhances children's engagement in science learning and enables them to explore new concepts while applying foundational science process skills (Laali, 2021). The findings validate constructivist learning theories, which emphasize that children learn best through active participation and self-discovery. The study provides empirical support for integrating play-based learning within the science curriculum to enhance concept internalization and long-term retention. Children are more likely to interact meaningfully with abstract ideas through practical, exploratory activities, which enables them to actively create knowledge rather than merely memorize facts. This method

strengthens memory consolidation through experiential learning in addition to improving instant comprehension.

This agreement highlights the need for an inventive module that is consistent with modern educational practices, supports developmental benchmarks, and minimizes learning attrition in early science education. The demand for inquiry-based approaches indicates that teachers understand how important it is for children to actively participate in their learning. Similarly, a play-based learning approach that uses hands-on practical experiences boosts the children's understanding and curiosity by allowing them to play and interact with concepts. Compared to conventional methods, this practical engagement approach, like activity-based learning, improves the students' comprehension (Mondal et al., 2024).

The results also highlight the need for practical tools, including teaching aids and clear instructional guidelines. Although teachers demonstrate moderate confidence in generating ideas and managing diverse activities, they consistently prioritize the availability of structured resources to support effective instruction. Challenges such as limited preparation time and difficulty grasping scientific concepts indicate that additional support and professional development are necessary. Targeted training workshops in play pedagogy can equip teachers with the competencies required to implement engaging, child-centered science instruction. As noted by Piele and Sava (2024), professional learning focused on playful teaching strategies is critical to improving the delivery of early science education.

5.3 The Need for an Early Science Learning Module Incorporating Play-Based Learning

The findings show a strong need module for an early science that incorporates and consolidates well-structured objectives, lesson plans, and instructional guidance that is aligned with the learning standards of preschool. A well-structured module gives clear direction for teachers, guaranteeing consistency in the direction of approach while permitting adaptability to adjust to the children's needs and classroom setting. This adaptability is fundamental in meeting differing learning styles and paces, as highlighted by Yuswandi et al. (2024).

All of the module's components are necessary. However, their effective application may be hampered by unclear implementation guidelines and learning objectives. Cerbo (2025) argues that high-quality teaching materials and comprehensive instructional guidance are crucial to ensure the effectiveness of learning modules. The development of the module should follow a structured framework that aligns with the national curriculum standards, as demonstrated in the successful design of social studies modules (Li, 2022).

The findings prove that teachers require a module that clearly outlines objectives aligned with the children's existing knowledge and developmental readiness. A well-developed module tailored to the children's developmental stages can significantly enhance the learning outcomes (Lestari et al., 2025). Additionally,

curriculum-aligned goals boost the instructors' self-esteem and efficacy. Children can study at their own pace thanks to the tailored instruction made possible by such a module. Tavares et al. (2020) support this, having noted the importance of structure in facilitating inquiry-based teaching.

The study's findings suggest that a structured module can help teachers in schools facilitate children's learning activities that align with their interests and prior knowledge. This would support the achievement of the learning objectives while encouraging children to construct new knowledge. It would also prompt teachers to evaluate and refine their instructional approaches to improve the overall quality of science education in the classroom.

A properly designed module should be a self-directed learning tool for teachers as well as being a form of teaching assistance. According to Shahruddin et al. (2023), instructional modules serve as resources and manuals that provide teachers with the confidence they need to conduct lessons successfully. Learning exercises are kept cognitively engaging and developmentally appropriate by incorporating playful tactics within the module.

Globally speaking, the nationwide distribution and standardization of play-based science modules can improve the quality of instruction, encourage student participation, and advance fair science education in preschools. Policymakers and educational leaders should prioritize these efforts by investing in resources and ensuring equal access for all institutions. Ultimately, such a module supports the strategic aims of the Malaysia Education Blueprint, which emphasizes STEM education and lifelong learning. When children nurture their scientific curiosity through play, they experience both cognitive and socio-emotional growth, while educators help close any gaps in access and quality in early science education.

5.4 Limitation and Recommendation

This study has several limitations that should be acknowledged. First, the data collection was geographically limited to preschool teachers in Sabah, which may affect the generalizability of the findings to other regions in Malaysia with different educational contexts and resources. Second, the study relied solely on self-reported data obtained through questionnaires which may be subject to biases such as social desirability or inaccurate self-assessment.

Third, the study did not employ triangulation methods such as interviews or classroom observations, which could have enriched the data and provided deeper insights into the actual implementation challenges and pedagogical practices. Future research is recommended to expand the geographical scope of the study, incorporate multiple data sources, and adopt mixed method approaches to enhance the validity, reliability, and applicability of the findings across diverse educational settings.

6. Conclusion

Early science instruction is an area that preschool teachers in Malaysia are still facing challenges in. This is despite strong policy emphasis on inquiry-based and

child-centered learning approaches as outlined in the National Preschool Curriculum Standard (KSPK) and the Malaysia Education Blueprint 2013–2025. These frameworks suggest a holistic, play-based approach for developing creativity, curiosity, and critical thinking. However, due to limited teacher training, inadequate access to developmentally appropriate resources and systemic imbalances in urban-rural contexts, the implementation of this is weak.

Many teachers do not feel prepared to use inquiry-based strategies because of their own content knowledge and professional development limitations. In addition, a lack of implemented framework makes the teaching practices inconsistent. We need to develop a play-based science module that is relevant to local contexts and aligned to the curriculum. However, this will not take care of these challenges alone. Additional and ongoing teacher professional development, the equitable distribution of resources and robust monitoring are equally important.

This research study seeks to address the gap between policy and practice. Future research should involve developing a module and piloting its implementation. In particular, it identifies the need for scalable, evidence-informed strategies to support preschool teachers in promoting the national objectives regarding STEM education in the early years.

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Appendix 1

QUESTIONNAIRE

This questionnaire consists of four sections:
Section A: Demographics
Section B: Challenges faced by preschool teachers in terms of competency in Early Science teaching.
Section C: The importance of developing an Early Science learning module based on a play-based learning approach.
Section D: Module Content Requirements

Section A: Respondent's Demographic Information
Instructions: Please mark (√) in the appropriate box.

1. Age

   < 20
   20 – 25
   26 – 30
   31 – 35
   >36

2. Education

   SRP/PMR
   SPM/SPMV
   STPM/Diploma
   Ijazah
   Master
   PHD

3. Teaching Experience

   Less than 3 years
   3 - 5 years
   More than 5 years

4. Course/ Workshop

   Have attended
   Never

Instruction: Indicate your opinion regarding children's level of knowledge in Early Science learning. Mark (√) in the appropriate box based on the scale guide below.

Scale Guide:
1: Strongly Disagree (STS)
2: Disagree (TS)
3: Not Sure (TP)
4: Agree (S)
5: Strongly Agree (SS)

Section B: Challenges Faced by Preschool Teachers in Early Science Teaching Competency

No	Item					
		Strongly Disagree 1	Disagree 2	Neutral 3	Agree 5	Strongly Agree 5
1.	Difficulty Understanding Science Concepts					
2.	Tendency to Memorize Texts Before Teaching					
3.	Challenges in Using Appropriate Teaching Methods and Aids					
4.	Difficulty Explaining Science Concepts					
5.	Time Constraints in Lesson Planning					
6.	Lack of Proficiency in Play-Based Methods					
7.	Limited Problem-Solving Skills					
8.	Difficulty in Integrating Existing Knowledge					
9.	Challenges in Conducting Appropriate Early Science Activities					
10.	Generating Ideas and Seeking Relevant Information.					

Section C: Teachers' Perceptions on the Importance of Developing an Early Science Learning Module Based on a Play-Based Learning Approach

No	Item					
		Strongly Disagree 1	Disagree 2	Neutral 3	Agree 5	Strongly Agree 5
1.	I need a Learning Module that is suitable for children'					
2.	I need a Learning Module with the latest learning model that can aid teaching and learning.					
3.	I need an Early Science learning module based on a play-based learning approach.					
4.	I support the development of an Early Science learning module based on a play-based learning approach.					
5.	Developing a learning module will attract children to participate in Early Science learning.					
6.	Developing a learning module will help prevent dropouts in Early Science learning.					
7.	Early Science teaching through play-based learning can enhance children's scientific skills and critical and creative thinking skills.					
8.	Early Science learning through play-based learning offers children opportunities to interact, share information, and solve problems.					
9.	Early Science learning through play-based learning provides chances for children to interact, share information, and solve					

	problems.					
10.	Early Science activities focusing on play-based learning can foster curiosity and interest in children.					
11.	Early Science activities based on play-based learning can cultivate moral values in children.					

Section D: Necessity of an Early Science Learning Module Based on a Play-Based Learning Approach

No	Item					
		Strongly Disagree 1	Disagree 2	Neutral 3	Agree 5	Strongly Agree 5
1.	I need a module that includes appropriate activities based on the learning standards in the teaching plan.					
2.	I need a module that outlines objectives suited to the children's existing knowledge.					
3.	I need a module that specifies the Teaching and learning resources (ABM/BBM).					
4.	I need a module that identifies the thinking skills and moral values being applied.					
5.	I need a module that provides systematic implementation steps.					
6.	I need a module that includes suggestions for worksheet activities.					
7.	I need a module that includes assessment activity suggestions (observation/checklist).					
8.	I need a module with diverse activities that encompass all areas of development.					