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Integrating Local Wisdom and Scientific Inquiry in Early Childhood Education: A Contextualized Science Learning Approach

Suharti[1*], Hapidin[2], Yuli Pujianti[3], Edi Suwandi[4], Muhammad Naufal Fairuzillah[5]

[1,5] *Department of Early Childhood Teacher Education, Universitas Negeri Surabaya, Indonesia*
[2] *Doctoral Program in Early Childhood Education, Universitas Negeri Jakarta, Indonesia*
[3] *Department of Islamic Early Childhood Education, STIT Al Marhalah Al 'Ulya Bekasi, Indonesia*
[4] *Department of Education and Human Potentials Development, National Dong Hwa University, Taiwan*

*Corresponding e-mail: suhartisuharti@unesa.ac.id
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Abstract

This study explores the integration of local wisdom and scientific inquiry in early childhood education (ECE) on Untung Jawa Island, Administrative City of Kepulauan Seribu, Jakarta. Employing a mixed-method approach, the quantitative phase utilized a one-shot posttest experimental design involving 21 children aged 5-6 years old, consisting of 11 boys and 10 girls. The children participated in culturally contextualized science activities that incorporated local wisdom. In addition to quantitative data collection, qualitative data were gathered through observations and interviews with five ECE teachers to gain deeper insights into the implementation process. The results indicate that integrating local wisdom enhances children's engagement and understanding of scientific concepts. This study also provides a learning model that can be used in many other parts of Indonesia, a country with many different cultures, to help create more inclusive and meaningful learning experiences for young children. Further research is recommended to explore local wisdom's long-term impacts and broader applications of culturally responsive teaching methods in early childhood settings.

Keywords: *local wisdom; scientific inquiry; early childhood education; science learning; a culturally contextualized approach; marine environment awareness*

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A. INTRODUCTION

The scientific inquiry method is the most effective approach to fostering critical and scientific thinking skills. This approach is designed to encourage children to actively ask questions, observe, experiment, and draw conclusions based on direct experience. However, implementing scientific inquiry in ECE often faces challenges, especially related to the relevance of the local cultural context.

Local wisdom is a valuable cultural heritage that can be used as a contextual and meaningful learning resource for children in certain areas. Integrating local wisdom into science learning increases learning motivation while strengthening cultural identity from an early age (Asrial et al., 2022; Novitasari & Walid, 2024). Most previous studies have focused on mainland or urban areas, paying little attention to island or coastal areas.

Untung Jawa Island in the Seribu Islands Administrative City of Jakarta is an ideal location for the development of early childhood education based on local wisdom. It is a small island with a coastal community that has unique cultural traditions, such as traditional fishing activities and community values of cooperation (Rideng et al., 2022). Many studies have overlooked this island, particularly in relation to the scientific inquiry approach and the integration of local wisdom in early childhood education.

Integrating local wisdom into the early childhood education curriculum is essential. It provides cultural context for children and encourages them to think critically through a scientific inquiry approach. Research has shown that contextual learning methods enhance students' learning motivation (Azainil et al., 2019; Triyanto et al., 2022). Additionally, research by Alghamdi and Malekan (2020) found that integrating cultural values into science learning can improve students' understanding of scientific concepts at the elementary level. However, despite awareness of the importance of this integration, many ECE programs still use conventional methods that do not consider the local cultural context. This results in limited active engagement from children during the teaching and learning process.

Although there have been several studies discussing the integration of local wisdom in education, there is still a lack of literature that explores explicitly the application of this approach in the context of early childhood education. In addition, there is minimal empirical exploration of how local wisdom integration can be effectively applied in inquiry-based science learning in an island context such as Untung Jawa Island. Furthermore, there is a lack of data on the concrete impact of this method on the development of observation skills and scientific understanding in early childhood in island areas. By focusing on Untung Jawa Island as a unique case study location in the administrative archipelago of Jakarta, this study contributes to enriching the literature on culture-based inclusive education while providing practical recommendations for the development of a contextual ECE curriculum in line with the characteristics of coastal areas. Thus, this study not only addresses the academic need for a deeper understanding of the integration of local values into early childhood science education but also offers an implementable model that educators and policymakers can apply to improve the quality of basic education in Indonesia's island regions in general.

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B. METHOD

1. Population and sample

The population in this study consisted of all early childhood children aged 5-6 years enrolled in two Early Childhood Education (ECE) institutions on Untung Jawa Island, Kepulauan Seribu Administrative City, Jakarta Province. The sample consisted of 21 children selected through purposive sampling based on age criteria and readiness to participate in science-based learning rooted in local wisdom. Of these, 11 were boys and 10 were girls. Additionally, to obtain supporting qualitative data, interviews were conducted with 5 ECE teachers who teach at both institutions.

2. Sampling Techniques

The sampling technique used was purposive sampling, which is the deliberate selection of participants based on specific characteristics in accordance with the research objectives (Palinkas et al., 2015). This selection took into account the readiness of students to participate in the learning intervention and the involvement of teachers as key informants in the local wisdom-based learning process.

3. Research Design

This study uses a mixed-methods approach (Creswell & Creswell, 2018), combining quantitative and qualitative methods to obtain a comprehensive picture of the effectiveness of integrating local wisdom into science learning in early childhood education. In terms of quantitative aspects, a one-shot post-test design was used, in which one experimental group was given treatment in the form of science learning activities that integrated local wisdom values, followed by immediate measurement of learning outcomes through a post-test without a pretest. In the qualitative aspect, a case study design was applied through participatory observation during the learning process and in-depth interviews with five ECE teachers to explore their experiences in applying the method.

4. Research Procedures

The research procedure consists of the following stages:

- Preparation of instruments: development of local wisdom-based learning modules and post-test measurement tools. The preparation stage involved identifying the research locations at two ECE institutions on Untung Jawa Island, Kepulauan Seribu Administrative City, Jakarta. Next, teaching materials based on local wisdom were developed in accordance with the national ECE curriculum.
- Implementation of intervention: delivery of contextual science material to the experimental group in one meeting.
- Collection of quantitative data: Post-tests are administered after the learning activities are completed to measure the students' scientific competence.

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- Qualitative data collection, including observation and interviews. Observation was conducted directly during the learning process to record student behavior and classroom dynamics. Semi-structured interviews were conducted with five early childhood education teachers regarding their perceptions of the effectiveness of cultural values integration in the science curriculum.
- Data analysis was conducted separately for quantitative and qualitative data before being combined at the result interpretation stage.

5. Data Analysis

Quantitative data from the post-test results were analyzed using descriptive statistics such as mean (average), standard deviation, and minimum-maximum scores as an overview of student learning outcomes after the intervention. Furthermore, for qualitative data analysis, the steps taken were to analyze the observation data descriptively and narratively by recording patterns of student behavior during the learning process and their responses to the locally-based teaching materials. After that, the interview results were analyzed using thematic analysis, which is the identification of main themes from interview transcripts to understand teachers' perceptions of the benefits and obstacles of implementing this learning model. The theme analysis process went through six phases, including familiarization, generating initial codes, searching for themes, reviewing themes, and final reporting (Kevin Fuchs, 2021)

The final stage of this data analysis involves combining the results of quantitative and qualitative data analysis. This combination of analyses will obtain a comprehensive picture of the impact of local wisdom integration on improving the quality of science education for young children in Untung Jawa Island, Seribu Islands Administrative City, Jakarta Special Capital Region.

C. RESULT AND DISCUSSION

1. Result

a. Quantitative Data

The following data presents the post-test results of children's scientific abilities obtained through learning based on the 5M approach (observing, questioning, trying, reasoning, and communicating). This approach aligns with Ministry of Education, Culture, Research, and Technology Regulation No. 12 of 2024 on the Operational Curriculum for Educational Institutions at the Early Childhood Education Level, Basic Education Level, and Secondary Education Level, which emphasizes the importance of experience-based and inquiry-based learning as part of strengthening the *Pancasila* Student Profile (Kemendikbud, 2024). The scores displayed in Table 1 reflect the variation in children's achievements in applying scientific thinking processes according to their developmental stages. Additionally, Figure 1 presents the distribution of post-test scores for children's scientific abilities.

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Tabel 1. Post-test scores for Children's Scientific Abilities

No	Code	Post-Test Scores
1	OSK	46
2	AUL	42
3	OBR	45
4	AFK	34
5	JNB	32
6	ZOY	46
7	CCL	44
8	AFR	51
9	SFN	22
10	JSM	40
11	AZK	37
12	JYD	41
13	SNM	28
14	FTN	44
15	FAT	44
16	KSW	47
17	HSN	52
18	RYA	44
19	AYD	47
20	HAF	44
21	ABN	35

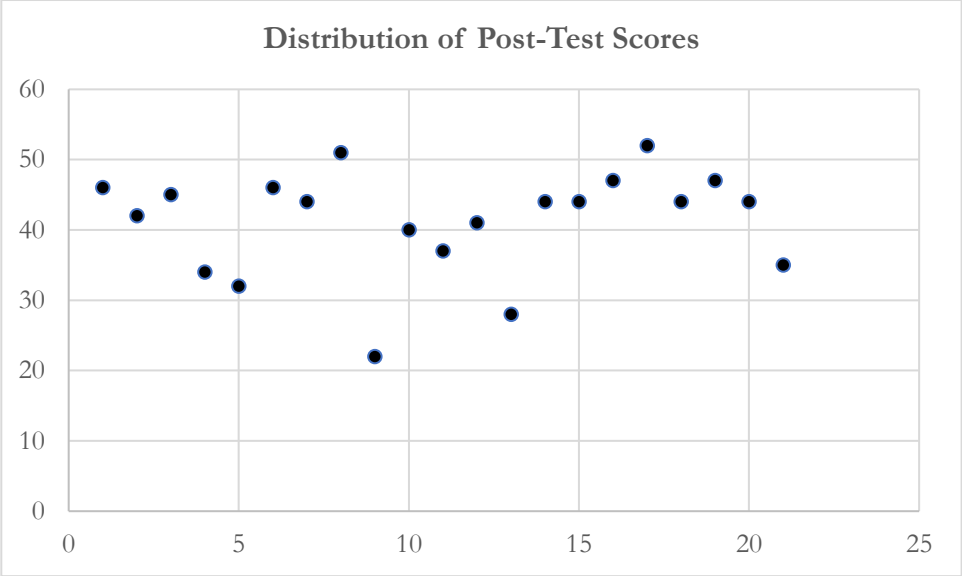

Figure1. Distribution of Post-Test Scores

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b. Qualitative Data

(1) Interview Results

Interviews were conducted with five teachers at two early childhood education institutions on Untung Jawa Island, Kepulauan Seribu Administrative City, Jakarta, regarding their experiences in integrating local wisdom into science learning. The following is a summary of the findings from the interviews:

Theme 1: Increased Interest in Learning

"Children become more enthusiastic when learning about their surroundings." (P1, W2)

"They show a high level of interest when we use folk tales as part of the lesson." (P3, W5)

Theme 2: Understanding Local Wisdom

"By teaching local cultural values, children can understand the importance of protecting the environment." (P4, W5)

"They begin to recognize various plants and animals around them through traditional stories." (P2, W3)

Theme 3: Challenges in Implementation

"We often struggle to find teaching materials that are appropriate for the local cultural context." (P2, W3)

"Some parents do not fully support this approach due to a lack of understanding about its benefits." (P5, W1)

(2) Observation Results

Observations were conducted during learning activities in the early childhood education classroom to observe children's interactions during the learning process. The following is a summary of the findings from the observations:

Theme 1: Interactive Activities

Children were seen to actively participate in group discussions about folk tales related to nature. (O10)

Theme 2: Use of Culture-Based Teaching Aids

Teachers use teaching aids such as pictures of local flora and fauna, such as mangrove trees, sea grapes, and clownfish, to explain scientific concepts to children. It makes learning more interesting for them. (O12)

Theme Analysis

Thematic analysis was conducted by identifying common patterns that emerged from the interviews and observations. Each theme was coded to

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facilitate the grouping of information based on specific categories. The results of the analysis showed that the integration of local wisdom not only increased children's interest in learning but also deepened their understanding of the surrounding environment and the challenges faced by educators in its implementation. The following is a thematic analysis in table form, accompanied by participant coding and data sources.

Tabel 2. Theme Analysis based on Interview and Observation Results

No	Theme	Data Citation	Data Source
1	Increased Interest in Learning	"Children become more enthusiastic when learning science using local stories, such as sea ghosts."	(P1, W2)
2	Understanding Local Wisdom	"They began to understand the importance of protecting the marine environment through stories about fishermen."	(P3, W5)
3	Parental Involvement	"Parents also participate in learning activities that involve local culture."	(P2, O8)
4	Creativity Development	"Activities based on local wisdom encourage children to be creative and think critically."	(P5, O12)
5	Environmental Awareness	"Children are more concerned about environmental cleanliness after learning about local ecosystems."	(P4, W10)

2. Discussion

a. Integration of Local Wisdom in Early Childhood Education

The integration of local wisdom into the early childhood education curriculum is crucial for creating contextual and meaningful learning experiences for children. In Untung Jawa Island, the Administrative City of the Seribu Islands, Jakarta Special Capital Region, where maritime culture and local traditions are rich, integrating these elements into science education can help children understand scientific concepts in a more relevant way. The results of this study are in line with research by Intang et al. (2024), which shows that when teaching materials are adapted to the local cultural context, students tend to be more engaged and motivated to learn.

Local wisdom also serves as a bridge between traditional knowledge and modern scientific knowledge. For example, fish farming or mangrove management practices on Untung Jawa Island not only teach practical skills but also introduce basic ecological concepts to children. As previous research has stated, a local wisdom-based approach can improve students' understanding of their environment and encourage a sense of responsibility for nature conservation (Mulyanie & Setiawan, 2024).

However, challenges remain in the implementation of this integration. Many educators still feel unconfident or lack sufficient resources to implement these methods effectively (Pingge, 2017). Therefore, educational institutions need to provide training and support for teachers so that they can design learning activities that optimally utilize local wisdom. Additionally, the successful implementation of local wisdom in education requires collaborative efforts from teachers, schools, and parents.

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Each group plays a crucial role in reinforcing the importance of local culture and values in students' educational experiences (Fairus et al., 2024). Thus, synergistic cooperation among all elements is necessary to optimize the success of the local wisdom approach in education, including early childhood education.

b. Increasing Interest in Learning through Scientific Inquiry Approach

The scientific inquiry approach is a teaching method that emphasizes active exploration by students through critical questions and direct experiments. In the context of early childhood education on Untung Jawa Island, this approach has proven effective in increasing children's interest in science. Research by Dewi et al. (2020) shows that when children are encouraged to actively participate in the learning process through simple experiments related to their surroundings, such as observing marine life, they become more enthusiastic and curious.

The application of scientific inquiry also enables teachers to build critical thinking skills in children from an early age. By giving them the opportunity to ask questions and find answers themselves through direct observation or small experiments in the classroom or outdoors, teachers help shape analytical thinking patterns in young children (Armiah et al., 2025; Hooven, 2017). The results of this study are also consistent with previous research findings that state that the integrative thematic and scientific approach is well-suited as it allows subject matter to be explored through diverse contexts that are closely related to children's daily experiences and familiar themes (Harjanty & Muzdalifah, 2022). This is in line with Piaget's constructivist theory, which states that knowledge is constructed through direct experience. However, the success of implementing the scientific inquiry approach depends on the readiness of the educators themselves and the support from their school environment. Teachers need to be trained to be able to design inquiry activities that are appropriate for the cognitive development of early childhood while considering safety aspects during the activities (Martínez et al., 2024; Ogieriakhi et al., 2020). Therefore, collaboration between local governments and higher education institutions is essential to provide ongoing training programs for early childhood educators.

c. Challenges in Implementing Local Wisdom in the Early Childhood Education Curriculum

Although integrating local wisdom into the ECE curriculum and applying a scientific inquiry approach has many benefits, significant challenges remain when it is implemented in practice on Untung Jawa Island and other areas in Indonesia in general. One challenge is the lack of deep understanding of what local wisdom is and how to integrate it into daily learning processes by educators (Aulia et al., 2025).

Furthermore, numerous schools encounter limitations concerning resources, including locally-based teaching materials or other educational aids that facilitate contextual learning activities (Musyarofah & Fajarini, 2018; Noor & Purnamasari,

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2019). Without such material support, it will be difficult for early childhood education teachers to apply innovative methods such as using folk tales as a medium for science teaching or conducting experiments based on the natural environment without specific visualization tools.

Finally, integrating cultural values into local government policies is crucial for the education of the younger generation, particularly the "golden generation" of 2045 (Ali & Mulasi, 2023; Karomi et al., 2025). This integration must extend from school principals to parents, fostering a shared understanding of its significance for the future of Indonesia.

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D. CONCLUSION

This study successfully demonstrated that integrating local wisdom into science learning in early childhood education on Untung Jawa Island had a positive impact on children's observation and inquiry skills. Quantitative analysis showed a significant increase in pretest and post-test scores in the experimental group that participated in local wisdom-based learning compared to the control group. A contextual approach that utilizes local culture can improve children's scientific understanding while making the learning process more interesting and relevant to them.

In addition, the results of interviews and observations support the quantitative findings by showing that children became more active in participating in learning activities when the teaching material was related to local wisdom. Teachers reported an increase in students' interest in learning and their ability to relate scientific concepts to their daily experiences. It is in line with Vygotsky's theory on the importance of socio-cultural context in children's cognitive development, which emphasizes that knowledge is constructed through social interaction and direct experience (Vygotsky, 1978).

This study not only provides empirical evidence on the effectiveness of integrating local wisdom in early childhood education but also offers a learning model that can be widely applied in other regions of Indonesia. Given Indonesia's rich cultural diversity, similar approaches can be adapted to create more inclusive and meaningful learning experiences for the younger generation.

Although this study provides valuable insights into integrating local wisdom in science education in ECE, several limitations need to be considered. First, the sample size was limited to two early childhood education institutions on Untung Jawa Island, so the results may not be fully representative of the overall early childhood education population. Additionally, the duration of the study was relatively short, making it impossible to evaluate the long-term impact of this approach on the academic or social-emotional development of the children after the intervention was completed.

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