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Efforts to Improve Children's Naturalist Intelligence Through Planting Activities Using Hydroponic Growing Media at TKIT As-Sunnah Napabalano

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ABSTRACT

Naturalist intelligence refers to children's ability to recognize, understand, and demonstrate concern for the natural environment around them. Initial observations at Integrated Islamic Kindergarten (TKIT) As-Sunnah Napabalano revealed that the naturalist intelligence of Group B children had not yet developed optimally. The children still experienced difficulties in recognizing plants, understanding plant growth processes, and showing concern for the environment. This study aimed to improve children's naturalist intelligence through planting activities using hydroponic growing media at Integrated Islamic Kindergarten (TKIT) As-Sunnah Napabalano. This study employed a Classroom Action Research (CAR) approach conducted in two cycles. Each cycle consisted of planning, action implementation, observation, and reflection stages. The research subjects were 11 Group B children, consisting of 5 boys and 6 girls. Data were collected through observation and documentation techniques. The data were analyzed using descriptive qualitative analysis based on early childhood development categories. The findings indicated that planting activities using hydroponic growing media were effective in improving children's naturalist intelligence. Teacher teaching activities increased from 73.33% in Cycle I to 93.33% in Cycle II. Children's learning activities also improved from 71.42% to 92.86%. In addition, the results of children's naturalist intelligence development increased from 72.73% in Cycle I to 90.91% in Cycle II. The children became more capable of recognizing plants, understanding plant growth processes, and demonstrating environmental awareness through direct plant-care activities. Therefore, planting activities using hydroponic growing media can be considered an effective learning strategy for improving early childhood naturalist intelligence.

Keywords:
Classroom action research, early childhood, hydroponic cultivation in schools, naturalist intelligence, planting activity learning.

INTRODUCTION

Education is a fundamental aspect of improving the quality of human resources and continues to undergo development in various dimensions. One of the current priorities in educational policy is strengthening early childhood education (ECE) (Halfiani et al., 2022). ECE is designed to provide optimal stimulation for children's overall growth and development, encompassing both physical and psychological aspects. The learning process at this level is structured to create an environment that enables children to actively explore and develop their full potential and multiple intelligences (Utami, 2020). Therefore, ECE is not only oriented toward cognitive achievement but also toward preparing children mentally, socially, and emotionally to adapt to and understand their surrounding environment.

As the foundation of education, ECE plays a strategic role in preparing children for higher levels of education. Law of the Republic of Indonesia Number 20 of 2003 emphasizes that ECE is a developmental effort for children from birth to six years of age through the provision of appropriate educational stimulation (Azlin et al., 2022). At this stage, children's development is holistic; therefore,

optimal growth is strongly influenced by meaningful stimulation, health conditions, and a supportive learning environment (Amiluddin et al., 2021; Meilia et al., 2023). Consequently, learning activities in kindergarten are designed based on the principle of learning through play to support various developmental aspects, including religious and moral values, physical-motor skills, cognitive abilities, language, socio-emotional development, and art (Selpin et al., 2021).

One important type of intelligence that should be developed in early childhood is naturalist intelligence. Naturalist intelligence refers to an individual's ability to recognize, classify, and demonstrate concern for flora, fauna, and natural phenomena in the surrounding environment (Azizah, 2021; Ray et al., 2024). Developing this intelligence from an early age is important because it contributes to the formation of environmental awareness and concern for ecosystem sustainability (Ulfa et al., 2024). In addition, naturalist intelligence can support the development of children's interests and potential that are relevant to their future lives (Fitria et al., 2024).

Efforts to develop naturalist intelligence should be implemented through contextual and experiential learning strategies. Activities such as watering plants, caring for animals, and maintaining environmental cleanliness have been shown to improve children's sensitivity toward nature (Sari et al., 2023). One relevant activity is planting cultivation, as it provides children with concrete experiences in understanding plant growth processes (Sofia et al., 2022). In this context, the use of hydroponic growing media offers an innovative alternative. Hydroponics is a cultivation technique that does not require soil and provides a cleaner, more efficient, and more observable process for children (Ningrum et al., 2023). Furthermore, hydroponics has educational value because it introduces concepts of modern and environmentally friendly agriculture.

Although numerous studies have examined the development of naturalist intelligence through planting activities, the use of hydroponic media in the context of early childhood education remains relatively limited, particularly in practical kindergarten-based learning implementation. Most previous studies have focused on conventional methods using soil media and have not extensively explored the potential of hydroponics as a systematic and integrated learning medium for developing children's naturalist intelligence. Therefore, a research gap remains regarding the effectiveness of hydroponic media in improving naturalist intelligence among early childhood learners.

The results of preliminary observations conducted at a kindergarten in Napabalano, Muna Regency, indicated that children's naturalist intelligence had not yet developed optimally. This condition was reflected in the children's limited ability to recognize different types of plants and animals, their lack of environmental awareness, and their limited skills in caring for plants. These findings indicate the need for more contextual and engaging learning interventions for children.

This study proposes the implementation of planting activities using hydroponic growing media as an effort to improve children's naturalist intelligence. The novelty of this study lies in the integration of hydroponic media as a learning tool that not only provides direct experience but also introduces concepts of modern agriculture from an early age. This study aims to improve children's naturalist intelligence through planting activities using hydroponic growing media at TKIT As-Sunnah Napabalano. The findings of this study are expected to provide practical contributions for educators in developing innovative learning strategies and to enrich the literature on the development of naturalist intelligence in early childhood education.

LITERATURE REVIEW

Early Childhood Education

Early Childhood Education (ECE) is an educational level that focuses on providing developmental stimulation for children aged 0–6 years as a foundation for subsequent stages of development. ECE aims to optimize all aspects of children's development, including cognitive, socio-emotional, language, physical-motor, artistic, moral, and religious development through learning activities that are appropriate to children's developmental stages (Black et al., 2017). Early childhood is widely recognized as a critical period because brain development and children's learning abilities progress rapidly during this phase (UNICEF, 2019). Therefore, learning in ECE is designed based on the principle of play-based learning so that children can gain meaningful learning experiences through direct interaction with their surrounding environment (Mohammed et al., 2026). Play-based approaches have been proven to improve communication skills, social interaction, creativity, and emotional

regulation in early childhood learners (Hyndman, 2026). Research by Putri and Hasiana (2025) also demonstrated that the role-play method is effective in improving speaking, listening, and social interaction skills among children aged 5–6 years. In addition, a conducive and stimulating learning environment greatly influences children's holistic development because children learn through active exploration and direct experience (O'Keeffe & Mcnally, 2026).

ECE is characterized by contextual and child-centered learning. In the learning process, educators serve as facilitators who provide learning experiences that encourage children's exploration, curiosity, and creativity (Aji et al., 2026). Learning activities involving direct experience have been shown to improve logical thinking, cause-and-effect understanding, and communication skills in early childhood learners. This is reflected in the study conducted by Afrianti and Hidayah (2026), which found that the color experiment method effectively enhanced children's cognitive abilities through experiential learning activities. In addition to cognitive development, the cultivation of moral and religious values is also an essential component of ECE. Nurhumairah et al. (2026) found that storytelling activities were effective in fostering positive behavior, worship habits, and respectful attitudes toward others among young children. Therefore, the selection of appropriate learning methods and instructional media is an important factor in supporting the optimal and comprehensive development of children's intelligence (Emenike & Afamefuna, 2025).

Naturalist Intelligence in Early Childhood

Naturalist intelligence is one of the intelligence types in the theory of multiple intelligences and is associated with the ability to recognize, classify, and understand natural phenomena, including flora, fauna, and the surrounding environment (Gardner, 2008). Children with well-developed naturalist intelligence generally demonstrate an interest in nature, the ability to distinguish various types of living organisms, and concern for environmental sustainability (Hasanah et al., 2019). This intelligence is also reflected in children's curiosity about their environment, enjoyment of outdoor activities, and ability to observe changes occurring in nature (Sugiyana et al., 2025). Therefore, the development of naturalist intelligence from an early age is important as part of fostering children's ecological awareness.

The development of naturalist intelligence in early childhood can be achieved through environment-based and experiential learning approaches. Indicators of naturalist intelligence in children include the ability to recognize plants and animals, understand elements of nature, demonstrate environmentally responsible behavior, and care for living organisms in their surroundings (Priadi & Fatria, 2024). Stimulation through practical activities such as gardening, environmental exploration, outing classes, and outdoor learning is considered more effective than abstract instruction because children gain concrete learning experiences (Roaina & Sitorus, 2025). Research conducted by Hasanah et al. (2019) demonstrated that gardening activities can improve early childhood naturalist intelligence because children learn to recognize plants while also understanding the importance of environmental preservation. Furthermore, environment-based learning has been shown to enhance children's ecological awareness and observational skills regarding natural phenomena in their surroundings (Setyaningsih et al., 2024). Therefore, learning activities involving direct interaction with nature are considered an important strategy for optimally supporting the development of naturalist intelligence in early childhood.

Planting Activities as a Learning Strategy

Planting activities represent a form of experiential learning that is effective in developing naturalist intelligence in early childhood learners. Through these activities, children are actively involved in the process of learning about plants, beginning with planting seeds, watering them, and observing plant growth regularly (Hasanah et al., 2019). Planting activities help children understand natural concepts concretely because they learn through direct interaction with their surrounding environment (Roaina & Sitorus, 2025). In addition to increasing environmental knowledge, gardening and plant-care activities can also foster responsibility, environmental awareness, and respect for living organisms from an early age (Prochner & Nawrotzki, 2026). Research conducted by Faridy and Sufri (2026) demonstrated that simple activities such as gardening and caring for plants can serve as effective stimulation for developing children's naturalist intelligence through everyday experiences.

Planting activities also support the development of other aspects, including fine motor, cognitive, and socio-emotional skills. During planting activities, children use hand and finger coordination to handle soil, seeds, and gardening tools, thereby promoting the optimal development of

fine motor skills (Thomas & Boulton, 2025). From a cognitive perspective, children learn to understand cause-and-effect relationships, such as the connection between watering and plant growth. Findings by Afrianti and Hidayah (2026) indicated that experiential learning can improve logical thinking and observational skills in early childhood learners. In addition, planting activities help develop children's socio-emotional skills through cooperation, patience, and responsibility during the process of caring for plants (Bayraktaroğlu & Cevher Kalburan, 2026). Therefore, planting activities are considered relevant as an integrative learning strategy in the context of early childhood education because they support the simultaneous development of multiple aspects of children's growth and development.

Hydroponic Growing Media in Early Childhood Learning

Hydroponics is a cultivation method that does not use soil but instead utilizes nutrient solutions as the primary medium for plant growth (Sharma et al., 2018). This method offers several advantages, including being cleaner, more practical, space-efficient, and allowing plant growth processes to be observed more clearly than conventional planting media (Alshrouf, 2017). These characteristics make hydroponics suitable for implementation in early childhood learning because children can directly and systematically observe plant development. Hydroponic-based learning also provides concrete learning experiences that support the experiential learning approach in early childhood education (Thomas & Boulton, 2025).

In the educational context, hydroponics can be used as a medium for introducing basic concepts of modern agriculture and environmental awareness to children from an early age. Hydroponic activities encourage children to observe, care for plants, and understand the needs of living organisms through simple and enjoyable activities (Sugiyana et al., 2025). In addition, environment-based and hands-on learning has been proven to increase children's interest in nature and strengthen their observational skills (Priadi & Fatria, 2024). Hydroponic activities can also be designed in simple forms that are easy for early childhood learners to understand and practice. Therefore, hydroponic media are considered to have strong potential as an innovative learning alternative for developing children's naturalist intelligence.

The Relationship Between Planting Activities Using Hydroponic Media and Naturalist Intelligence

Planting activities using hydroponic media are closely related to the development of naturalist intelligence in early childhood learners. Through direct involvement in planting processes, children learn to observe plant growth, recognize environmental changes, and understand the relationship between water, nutrients, light, and the growth of living organisms (Hasanah et al., 2019). These activities help children develop a concrete understanding of nature through hands-on learning experiences that are easier to comprehend than abstract instruction (Afrianti & Hidayah, 2026). The use of hydroponic media also provides engaging new learning experiences that can increase children's attention, curiosity, and active participation in the learning process (Roaina & Sitorus, 2025).

Conceptually, hydroponic-based planting activities function as a form of stimulation that can influence the development of children's naturalist intelligence. Through these activities, children not only gain knowledge about plants and the environment but also learn to care for living organisms, cooperate with others, and develop environmental awareness from an early age (Faridy & Sufri, 2026). Studies on nature-based learning have shown that gardening and environmental exploration activities can improve ecological awareness, observational skills, and logical thinking abilities in early childhood learners (Setyaningsih et al., 2024). Therefore, the implementation of planting activities using hydroponic media can serve as an effective and innovative learning strategy for improving naturalist intelligence in early childhood education.

METODE

Research Design

This study employed a Classroom Action Research (CAR) approach aimed at improving the learning process continuously through practical classroom interventions. This approach was selected because it aligns with the objective of the study, namely improving children's naturalist intelligence through planting activities using hydroponic growing media. According to Kemmis et al. (2014), action research is a reflective process conducted collaboratively through stages of planning, action,

observation, and reflection in cyclical forms to improve educational practices. The CAR cycle model used in this study is presented in Figure 1.

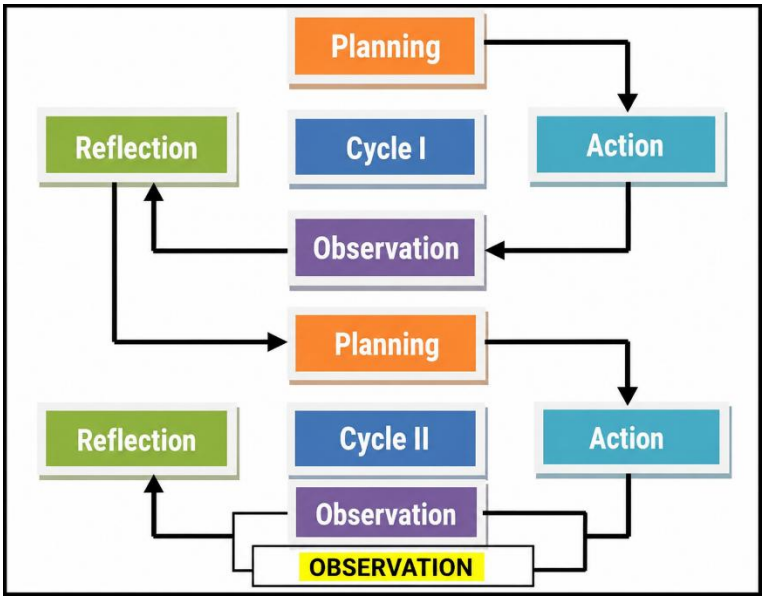

Figure 1. Classroom Action Research Cycle Model (adapted from Kemmis and McTaggart)

The study was conducted at TKIT As-Sunnah Napabalano, located in Tampo Village, Napabalano District, Muna Regency, Southeast Sulawesi Province. The research activities were carried out during the second semester of the 2023/2024 academic year. The research subjects consisted of 11 Group B children, including 5 boys and 6 girls. This study focused on observing two factors: the child factor and the teacher factor. The child factor was observed to identify children's activities during hydroponic planting activities and to assess the development of their naturalist intelligence. Meanwhile, the teacher factor was observed to examine the implementation of learning activities aimed at improving children's naturalist intelligence through planting activities using hydroponic growing media.

The study was conducted in two action cycles. Each cycle consisted of the stages of planning, action, observation, and reflection, as described by Kemmis et al. (2014). During the planning stage, the researcher prepared the learning design and the hydroponic media to be used in the activities. The action stage involved implementing hydroponic planting activities in the learning process. Subsequently, the observation stage was carried out to monitor teacher activities and the development of children's naturalist intelligence throughout the learning activities. The reflection stage was used to evaluate the results of the intervention and determine improvements for the following cycle to ensure a more optimal learning process.

Data Collection

Data were collected through observation and documentation techniques. Observation was used to obtain data regarding teacher activities and the development of children's naturalist intelligence during planting activities using hydroponic media. This technique was conducted directly during the learning process to ensure that the data accurately reflected actual classroom conditions.

The primary research instruments used in this study were observation sheets for children's activities and teacher activities. The children's observation sheet was developed based on indicators of naturalist intelligence, including the ability to recognize plants, care for plants, demonstrate environmental awareness, and participate actively in planting activities. Meanwhile, the teacher observation sheet was used to assess the implementation of the learning process according to the planned instructional actions. In addition to observation, the researcher also used documentation in the form of activity photographs, field notes, and other supporting documents to strengthen the research data.

The research instruments were validated through content validity procedures. The validation process involved obtaining assessments from academic supervisors and classroom teachers regarding the suitability of the indicators with the research objectives. Furthermore, the observation indicators

were developed based on early childhood developmental achievement standards, ensuring that the instruments were relevant for measuring the development of children's naturalist intelligence. Through these procedures, the instruments were expected to produce accurate data appropriate to the needs of the study.

Data Analysis

The data in this study were analyzed using descriptive qualitative analysis techniques. The analysis process followed the stages proposed by Miles et al., namely data reduction, data display, data interpretation, and conclusion drawing and verification (Miles et al., 2014; Ode et al., 2024). The data reduction stage involved selecting and focusing on data relevant to the research objectives. Subsequently, the data were systematically presented in the form of tables, percentages, and descriptive explanations to facilitate the identification of patterns and changes occurring in each learning cycle.

The next stage involved data interpretation and conclusion drawing. At this stage, the researcher interpreted the observation results to determine the development of children's naturalist intelligence after the implementation of planting activities using hydroponic growing media. Children's developmental achievements were assessed based on the categories of Not Yet Developed (NYD), Beginning to Develop (BD), Developed as Expected (DAE), and Developed Very Well (DVW) (Depdiknas, 2004: 26). The percentage of developmental outcomes was used to identify improvements in children's abilities in each cycle. The study was considered successful if at least 85% of the children achieved the categories of Developed as Expected (DAE) and Developed Very Well (DVW), both individually and classically.

To enhance data credibility, this study employed technique triangulation through observation and documentation. Observation results were also discussed collaboratively with the classroom teacher as a research collaborator to minimize interpretive bias. In addition, reflection processes were conducted repeatedly in each cycle to ensure that the analysis results were more objective and accurately represented the actual learning conditions.

RESULTS

Initial Condition of Children's Naturalist Intelligence

The initial condition of the naturalist intelligence of Group B children at TKIT As-Sunnah Napabalano indicated that the children's ability to recognize the natural environment still needed improvement. The children were not yet able to identify various types of plants and animals properly. In addition, some children had not demonstrated concern for their surrounding environment and were not yet able to care for plants independently.

The results of the preliminary observation showed that learning activities related to the development of naturalist intelligence were still limited. Planting activities using hydroponic growing media had also never been implemented in the learning process. As a result, the children had not gained direct experience in recognizing and caring for plants.

In this study, 15 aspects of teacher teaching activities and 15 aspects of children's learning activities were observed. These aspects were related to the implementation of learning activities, children's involvement in planting activities, their ability to recognize plants, their environmental awareness, and their ability to follow the steps of hydroponic activities. The results of the initial observation served as the basis for implementing actions in Cycle I to improve children's naturalist intelligence through planting activities using hydroponic growing media.

Cycle I Intervention

Teacher Teaching Activities

The observation results of teacher teaching activities in Cycle I indicated that the learning process had not yet been implemented optimally. Of the 15 observed aspects, 11 aspects were successfully implemented, representing 73.33%, while 4 aspects were not implemented, representing 26.67%.

The teacher successfully carried out several learning activities effectively. These activities included opening the lesson, guiding the children in prayer, explaining the learning objectives, describing the planting procedures, and assisting the children throughout the activities. The teacher also introduced pakcoy plants as learning media in the hydroponic activities.

However, several aspects had not been implemented optimally. The teacher had not provided adequate apperception activities and had not explained the plant growth process in detail. In addition, question-and-answer activities with the children were still limited, resulting in less active classroom interaction. These findings indicated that the teacher's teaching activities in Cycle I had not yet achieved the predetermined success indicator of 85%.

Children's Learning Activities

The observation results of children's learning activities in Cycle I showed that children's participation in the learning process had begun to develop. Of the 15 observed aspects, 10 aspects were successfully implemented, representing 71.42%, while 4 aspects were not implemented, representing 28.58%.

At this stage, the children began to show interest in planting activities using hydroponic media. They were able to follow the teacher's instructions and started to understand the steps involved in planting pakcoy. The children also appeared enthusiastic when using the prepared planting media.

Nevertheless, some children were still less active during the learning activities. They were not yet able to answer the teacher's questions properly and had not fully understood the plant growth process. In addition, the children's attention toward examples of poorly maintained plants remained low. These conditions indicated that the children's learning activities in Cycle I had not yet met the research success indicators.

The Results of Children's Naturalist Intelligence Development in Cycle I

The evaluation results of children's naturalist intelligence development in Cycle I indicated improvement compared to the initial condition. Most children had begun to recognize plants and participate effectively in planting activities. However, the results had not yet reached the target criteria established for the study. The data on the development of children's naturalist intelligence in Cycle I are presented in Table 1.

Table 1. Results of Children's Naturalist Intelligence Development in Cycle I

Category	Number of Children	Percentage
Developed Very Well (DVW)	3	72.73%
Developed as Expected (DAE)	5	18.18%
Beginning to Develop (BD)	2	9.09%
Not Yet Developed (NYD)	1	-
Total	**11**	**100%**

Based on Table 1, as many as 8 children, or 72.73%, achieved the categories of Developed as Expected (DAE) and Developed Very Well (DVW). Meanwhile, 3 children were still categorized as Beginning to Develop (BD) and Not Yet Developed (NYD). These results indicated that the research success indicator of 85% had not yet been achieved; therefore, the intervention was continued in Cycle II.

Cycle II Intervention

Teacher Teaching Activities

Teacher teaching activities in Cycle II showed improvement compared to the previous cycle. Of the 15 observed aspects, 14 aspects were successfully implemented, representing 93.33%, while only 1 aspect was not implemented, representing 6.67%.

In Cycle II, the teacher conducted the learning activities in a more structured and interactive manner. The teacher provided apperception activities before the lesson began and explained the growth process of water spinach more clearly. The teacher also involved the children in question-and-answer activities, making the learning atmosphere more active.

In addition, the teacher provided more effective guidance during the planting activities. The children were given opportunities to observe the plants and engage directly in the activities. These results indicated that the teacher's teaching activities in Cycle II had achieved the predetermined success indicators.

Children's Learning Activities

Children's learning activities in Cycle II showed significant improvement. Of the 15 observed aspects, 13 aspects were successfully implemented, representing 92.86%, while only 1 aspect was not implemented, representing 7.14%.

The children appeared more active and enthusiastic throughout the learning activities. They were able to recognize water spinach plants and understand the planting procedures more effectively. In addition, the children began to demonstrate environmental awareness by watering and caring for the plants independently.

The children's ability to answer the teacher's questions also improved. They began to explain the activities they had carried out and showed curiosity about plant growth. These findings indicated that the children's learning activities in Cycle II had achieved the research success indicators.

The Results of Children's Naturalist Intelligence Development in Cycle II

The evaluation results of children's naturalist intelligence development in Cycle II showed significant improvement compared to Cycle I. Most children had achieved the categories of Developed Very Well (DVW) and Developed as Expected (DAE). In addition, no children remained in the Not Yet Developed (NYD) category. The data on the development of children's naturalist intelligence in Cycle II are presented in Table 2.

Table 2. Results of Children's Naturalist Intelligence Development in Cycle II

Category	Number of Children	Percentage
Developed Very Well (DVW)	8	72.73%
Developed as Expected (DAE)	2	18.18%
Beginning to Develop (BD)	1	9.09%
Not Yet Developed (NYD)	-	-
Total	**11**	**100%**

Based on Table 2, as many as 10 children, or 90.91%, achieved the categories of Developed as Expected (DAE) and Developed Very Well (DVW). These results exceeded the predetermined research success indicator of 85%. Therefore, planting activities using hydroponic growing media were considered effective in improving the naturalist intelligence of Group B children at TKIT As-Sunnah Napabalano.

DISCUSSION

Improvement of Children's Naturalist Intelligence Through Planting Activities Using Hydroponic Media

The results of this study indicate that planting activities using hydroponic growing media were effective in improving the naturalist intelligence of Group B children at TKIT As-Sunnah Napabalano. This improvement was reflected in the children's enhanced ability to recognize plants, understand plant growth processes, and demonstrate environmental awareness. The children also became more capable of caring for plants independently through activities such as watering and observing plant growth during the learning process.

The improvement in children's naturalist intelligence in this study occurred because the children gained direct learning experiences. The children not only received verbal explanations but were also actively involved in planting and caring for plants. These activities provided concrete experiences that helped children understand the natural environment more realistically. This finding is consistent with the view of Roaina and Sitorus (2025), who stated that experiential learning is more effective in developing children's understanding of the environment than abstract learning approaches.

Planting activities using hydroponic media also encouraged children to actively observe changes occurring in plants. The children began to pay attention to leaf growth, changes in plant color, and the water requirements of hydroponic plants. These activities reflected the development of children's observational skills and curiosity about natural phenomena in their surroundings. This condition supports Gardner's (2008) view that naturalist intelligence is related to the ability to recognize, classify, and understand the natural environment more deeply.

In addition, the use of hydroponic media provided a different learning experience compared to conventional planting activities. Hydroponic media are cleaner, easier to observe, and more attractive for early childhood learners. Children can directly observe root development and plant growth without obstruction from soil. These characteristics made the children more interested and focused during the learning activities. This finding supports the opinions of Sharma et al. (2018) and Alshrouf (2017), who argued that hydroponics is a practical learning medium that allows plant growth processes to be observed more clearly.

The Role of Experiential Learning in the Development of Naturalist Intelligence

The improvement of children's naturalist intelligence in this study was closely related to the implementation of experiential learning. During the planting activities, the children learned through direct activities such as planting seeds, watering plants, and observing plant growth regularly. These activities provided opportunities for children to learn through concrete experiences and direct environmental exploration.

Experiential learning was shown to increase children's engagement in the learning process. In Cycle II, the children appeared more active in asking questions, answering the teacher's questions, and explaining the activities they had completed. This finding indicates that direct experience can increase children's curiosity and participation in learning activities. These results are consistent with the study conducted by Hasanah et al. (2019), which found that gardening activities can improve children's naturalist intelligence because children learn through direct interaction with the environment.

In addition to improving children's ability to recognize the environment, planting activities also supported the development of other aspects of child development. The children learned to cooperate, be patient, and take responsibility in caring for plants. Through this process, the children understood that plants require attention and care in order to grow properly. Therefore, planting activities not only developed naturalist intelligence but also supported children's socio-emotional development.

The implementation of hydroponic-based planting activities was also consistent with the characteristics of learning in early childhood education, which emphasize the principle of learning through play. The children learned in an enjoyable and non-pressuring environment. The activities were conducted through direct practice, making it easier for the children to understand the concepts being taught. This condition supports the opinion of Mohammed et al. (2026), who argued that activity-based and experiential learning can create more meaningful learning experiences for early childhood learners.

Improvement of Teacher Activities and Children's Learning Activities

The results of this study indicate that the improvement in children's naturalist intelligence was accompanied by improvements in teacher teaching activities and children's learning activities. In Cycle II, the teacher was able to conduct the learning process more interactively through apperception activities, question-and-answer sessions, and opportunities for children to engage in direct observation. The teacher also provided more active guidance during the planting activities, resulting in a more structured learning process.

The improvement in teacher activities had a positive impact on children's engagement in learning. The children became more active in participating in activities, paying attention to the teacher's explanations, and showing enthusiasm throughout the planting process. These findings indicate that the quality of interaction between teachers and children plays an important role in supporting successful learning outcomes. This finding is consistent with the view of Aji et al. (2026), who stated that teachers in early childhood education function as facilitators who provide learning experiences to encourage children's exploration and curiosity.

More active question-and-answer activities in Cycle II also helped children develop their thinking and communication skills. The children began to explain the planting process and plant growth using simple language. This finding suggests that experiential learning not only improves naturalist intelligence but also supports the development of children's cognitive and language abilities.

The results of this study also reinforce the findings of Ningrum et al. (2023), which demonstrated that planting activities using hydroponic media have a positive effect on the naturalist intelligence of early childhood learners. The similarity can be seen in the improvement of children's ability to recognize plants, understand the environment, and demonstrate environmental awareness after participating in hydroponic activities. Therefore, hydroponic growing media can serve as an effective and innovative learning alternative for developing naturalist intelligence in early childhood education.

Research Implications

This study provides practical implications for early childhood learning, particularly in the development of naturalist intelligence through experiential learning activities. Planting activities using hydroponic growing media can be used as an alternative learning strategy that is more contextual, engaging, and aligned with the learning characteristics of early childhood learners. The use of hydroponic media also helps teachers create a more active learning environment because children are directly involved in planting, caring for, and observing plant growth.

In addition to practical implications, this study also provides pedagogical implications for early childhood educators. Teachers function not only as providers of instructional content but also as facilitators who create meaningful learning experiences for children. Environment-based learning through hydroponic media can encourage teachers to develop more innovative and child-centered learning methods. Consequently, the learning process focuses not only on cognitive aspects but also on developing children's environmental awareness, responsibility, and social skills.

Theoretically, the findings of this study strengthen existing literature regarding the effectiveness of environment-based learning in developing naturalist intelligence in early childhood education. This study also demonstrates that hydroponic media have strong potential as an innovative learning tool that can be integrated into early childhood learning activities. Therefore, the findings of this study may serve as a reference for future research examining the development of naturalist intelligence through nature-based and experiential learning approaches in early childhood education.

CONCLUSION

The results of this study indicate that planting activities using hydroponic growing media were effective in improving the naturalist intelligence of Group B children at TKIT As-Sunnah Napabalano. This improvement was reflected in the children's ability to recognize plants, understand plant growth processes, and demonstrate concern for their surrounding environment. In addition, the children became more active in participating in learning activities and showed greater enthusiasm in caring for plants throughout the learning process.

The improvement in children's naturalist intelligence was also supported by increased teacher teaching activities and children's learning activities in each action cycle. Teacher activities increased from 73.33% in Cycle I to 93.33% in Cycle II. Meanwhile, children's learning activities increased from 71.42% to 92.86%. The results of children's naturalist intelligence development also improved, from 72.73% in Cycle I to 90.91% in Cycle II. Therefore, planting activities using hydroponic growing media can be considered an effective learning strategy for improving naturalist intelligence in early childhood education.

This study still has several limitations. The number of research subjects was relatively limited because the study involved only one group of children in a single early childhood education institution; therefore, the findings cannot yet be generalized broadly. In addition, the limited duration of the study prevented long-term observation of children's naturalist intelligence development. Future studies are expected to involve broader research subjects and develop a wider variety of environment-based activities in order to obtain more comprehensive findings regarding the development of naturalist intelligence in early childhood education.

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