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How to Teach Science to Toddlers?

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Abstract: Science education for toddlers is crucial in building early scientific understanding and fostering curiosity. However, several challenges persist in its implementation, such as teaching methods that are not well-suited to early childhood characteristics, limited exploratory facilities, and a lack of understanding among parents and educators regarding effective teaching strategies. This study analyzes various approaches that can be used to teach science to toddlers effectively and engagingly. The methods discussed include inquiry-based learning, hands-on activities, sensory exploration, construction play, and nature observation. Additionally, connecting science with daily life is an essential strategy to help children understand the relevance of scientific knowledge in the real world. The analysis results indicate that exploration-based and hands-on learning approaches enhance children's understanding of scientific concepts more effectively than traditional instructional methods. The active role of parents and educators in guiding children, providing reflective questions, and creating a supportive learning environment significantly influences learning success. With the right strategies, children grasp scientific concepts and develop critical thinking skills, problem-solving abilities, and an early love for science.

Keywords: Construction play; Hands-on experience; Inquiry-based learning; Sensory exploration; Toddler science learning.

Introduction

Learning during toddlerhood is an important foundation for their cognitive and social development. At this stage, children show a high curiosity about their surroundings and have a natural tendency to explore the world through direct interaction. Research shows that children build an initial understanding of science concepts early through observation, simple experiments, and reflective questions that they ask spontaneously (Sáez-Bondía et al., 2023; Piasta et al., 2015). However, many parents and educators still face challenges in instilling an understanding of science in toddlers in a developmentally appropriate way (Reinhart et al., 2016; Pendergast et al., 2015). One of the main problems in science education for early childhood is the lack of learning methods specifically designed for this age group. Many teaching approaches still adopt conventional methods that tend to be based on passive instruction, such as theoretical explanations without the active involvement of children. This is contrary to how toddlers naturally learn, which relies more on direct experience and interaction with the real world (Syarfina, 2024; Piasta et al., 2015). In addition, early childhood education curricula in various countries often do not pay enough attention to science learning because they emphasize language and social skills (Havu-Nuutinen et al., 2021; Yilmaztekin & Erden, 2016). As a result, children lose the opportunity to develop an optimal early understanding of science (Paños et al., 2022). Another challenge is the lack of support for parents and educators in understanding how to teach science to children effectively and interestingly. Many parents feel that science is too complex for young children, so they focus more on other activities considered more appropriate for their child's development (Wade, 2023; Suardi & Samad, 2021). Various studies have shown that children can understand simple science concepts if

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presented in a way that is appropriate for their age (Muntomimah & Wijayanti, 2021; Aktürk & Demircan, 2020). The lack of educational resources that discuss science teaching strategies for toddlers causes many parents and educators to feel less confident in introducing this topic (González-González et al., 2019).

In addition to pedagogy, limited access to learning environments that support science exploration is also an obstacle in introducing scientific concepts to children. Not all families can access teaching aids or environments rich in scientific stimulation, such as science parks, children's museums, or simple laboratories (Astini et al., 2023; Bruder & Dunst, 2014). In some areas, exploration-based educational facilities are also still limited, so science learning relies more on conventional methods in the classroom (Ishma & Syaodih, 2021).

On the other hand, technological developments and research in early childhood education have provided many new insights into how children learn and can be introduced to science concepts more naturally and effectively (İnan & Inan, 2015; Hidayat, 2023). By understanding the various challenges, an approach is needed to bridge the gap between children's potential to understand science and the teaching strategies educators and parents use (Yulianingsih et al., 2020; Aktürk, 2024). This study seeks to identify and analyze the various challenges faced in science education for toddlers and explore approaches that can be used to overcome these problems. By understanding the factors that influence the effectiveness of science learning at an early age, this study is expected to provide broader insights for educators, parents, and policymakers in creating a learning environment that is more supportive of science exploration for children (Aktürk & Demircan, 2020; Pendergast et al., 2015).

Method

This study uses a qualitative approach with a literature study method to analyze various strategies for teaching science to toddlers. Literature studies were chosen because they allow researchers to explore various scientific findings that have been published related to scientific learning methods for early childhood. The data sources used in this study consisted of scientific journals, academic books, and research reports that discuss science education for early childhood. The articles and books reviewed were selected based on the criteria of relevance to the topic, the credibility of the author, and the year of publication within the last 10 years to continue considering the latest developments in early childhood pedagogy. The analysis was done by reviewing the learning approaches developed in various previous studies. Data were classified based on the teaching methods used, their effectiveness in improving children's understanding of science, and the challenges faced in their implementation. The results of this analysis were then used to compile recommendations regarding appropriate science learning strategies for toddlers. Thus, this study can provide evidence-based insights for educators and parents in developing more effective and interesting methods for introducing science to toddlers.

Result and Discussion

Challenges in teaching science to toddlers

Teaching science to young children faces several challenges that need to be understood to make the approach more effective. One of the main obstacles is the dominance of conventional instructional learning methods that do not involve children in active exploration. This one-way method only allows children to receive information without directly experiencing or experimenting. Research shows that young children learn best through direct experience and interaction with their environment Gerde et al. (2013). When they are not allowed to experiment, observe, and ask questions, their understanding of scientific concepts becomes limited and less meaningful (Areljung, 2018). In addition, many educators and parents still think that science is too complicated a discipline for toddlers. This assumption often makes them hesitate to introduce scientific concepts early on. As a result, children do not get enough scientific stimulation in the home or school environment (Fadlelmula et al., 2022). The lack of training for educators in teaching science to young children also worsens the situation. Studies show that educators at the early childhood education level often do not have adequate science backgrounds, so they feel less confident in explaining natural phenomena in ways that are appropriate for children (Kara, 2016). This leads to science learning that is minimally exploratory and emphasizes memorization of facts rather than understanding concepts (İnan et al., 2010). Another challenge is the limited supporting facilities for exploration-based science learning. Not all children have access to science parks, interactive museums, or simple laboratories that allow them to experiment and observe science phenomena directly (Vartiainen & Kumpulainen, 2019). Even tools and materials for simple experiments are difficult to find in some areas. This condition limits science learning to theoretical explanations without real practice. To overcome this obstacle, parents and educators must be more creative in utilizing materials available in the surrounding environment as science exploration tools (Dongjin, 2024). With the right strategy, this obstacle can be minimized so that children can still have a fun and meaningful science learning experience (Erol, 2023).

The Strategies in Teaching Science to Toddlers

Inquiry-based learning

Inquiry-based learning is an approach that places children as active subjects in the learning process. This method provides opportunities for children to ask questions, explore, and find their answers through simple observations and experiments. This is very much in line with the character of early childhood, which is having a high curiosity and tending to learn through direct experience. Children who can find answers independently are likelier to understand scientific concepts than those who only receive information passively (Hutapea et al., 2020).

One example of applying the inquiry method in science learning for toddlers is inviting them to observe everyday phenomena. For example, when children see rainwater pooling outside the house, parents or educators can ask questions such as, "Why doesn't this water just disappear?" From these questions, children can be invited to explore basic concepts about the water cycle, evaporation, and changes in the state of matter. By involving them directly in the scientific thinking process, their understanding of these concepts becomes deeper and lasts longer in memory (Plummer et al., 2019; Gerde et al., 2013).

This inquiry-based approach has systematic stages that can help children understand science concepts in a more structured way. These stages include observation, questions, exploration, and reflection. Children are invited to observe a phenomenon around them at the observation stage. Then, educators or parents can ask questions to stimulate children's critical thinking, such as "What do you think will happen to the ice cubes if they are placed outside?" After that, children can explore by observing the changes to the ice for a few minutes. At the reflection stage, children are asked to explain the changes they see, and educators can help provide further understanding of the concept of changes in the state of matter (Åkerblom et al., 2018). The application of this method can be done in various simple activities that are appropriate to the abilities of early childhood. For example, to teach the concept of changes in the state of matter, children can be given ice cubes and asked to observe them as they melt. Parents or educators can then ask exploratory questions like "Why does this ice turn into water?" Allowing children to observe and try to explain the changes that occur will make it easier for them to understand that ice melts due to temperature changes (Vartiainen, 2019).

In addition to helping children understand science concepts more deeply, the inquiry-based approach also contributes to developing critical thinking and problem-solving skills. Children familiar with this method will be more active in asking questions, seeking answers through exploration, and drawing conclusions based on their experiences. This improves their understanding of science and forms a scientific mindset that can be useful in future aspects of their lives.

However, the success of this method is highly dependent on the role of educators and parents in guiding children during the inquiry process. Parents and educators must be able to ask questions that stimulate children's curiosity and allow them to find their own answers. In addition, it is important to provide a supportive learning environment, such as providing simple experimental materials and creating a pleasant atmosphere in learning. With proper implementation, inquiry-based learning can be a very effective method in introducing science to early childhood.

Direct experience or hands-on activities

Direct experience or hands-on activities are learning methods that allow children to experience science in real terms by interacting directly with objects and natural phenomena. This approach is very effective because early childhood tends to learn in a concrete way, where they understand abstract concepts better if they can touch, see, or experiment with themselves. Through direct experience, children can build a deeper conceptual understanding, improve memory, and develop critical thinking and problem-solving skills (Ikbal & Abdi, 2021).

This method can be applied in science learning by inviting children to do simple experiments or observe natural phenomena directly. For example, to understand the concept of buoyancy, children can be given various objects of different sizes and weights to put in water. From this experiment, they will see that some objects sink while others float. Thus, they can conclude that the weight and density factors of an object affect whether the object will sink or float. In addition to understanding simple physics concepts, children also learn to develop observation and problem-solving skills by comparing the results they obtain.

The direct experience method can also be applied in learning colours by using colour mixing experiments. Children can be given three glasses of water with red, blue, and yellow food colouring. Then, they are invited to mix two primary colours in one glass; for example, red and yellow make orange, or blue and yellow make green. By seeing the results that occur directly, children can more easily understand the concept of colour mixing than if it is only explained in theory.

Direct experience in learning can be arranged systematically and directed through several structured stages. The first stage is initial exploration, where students are allowed to interact with certain materials or tools without too strict instructions so that they can recognize the basic characteristics of the objects used independently. Furthermore, in the experimental stage, students are encouraged to conduct experiments based on their curiosity, allowing them to test various possibilities and gain empirical understanding through active involvement. After the experiment, they enter the

observation stage, where they observe and analyze the changes that occur during the experimental process to understand the observed phenomena' causal relationship. The last stage is discussion, which involves interaction between students and educators or parents to interpret the exploration results, identify patterns or principles underlying the observed phenomena, and draw conclusions based on empirical findings. By following these stages, experiential learning becomes more systematic and more effective in improving students' conceptual understanding.

For example, in exploring changes in the state of matter, children can be given ice cubes and asked to observe them when placed at room temperature. Educators or parents can then ask, "What do you think will happen to this ice after some time?" Children will see the ice melt and turn into water and then be asked to explain the changes they see from this discussion. Children can understand that ice melts due to increased temperature, one of physics's basic principles of changes in the state of matter.

In addition to improving scientific understanding, direct experience supports children's motor development. Activities such as mixing colours, pouring water, or arranging objects in experiments help children develop hand-eye coordination and fine motor skills. On the other hand, their involvement in exploration also fosters self-confidence and independence in learning.

However, in implementing the direct experience method, parents and educators must ensure that the activities are appropriate for the child's age and developmental level. The experiments chosen must be simple, safe, and do not involve risky materials for children. If done well, this method can be very effective in building a foundation of scientific understanding from an early age and increasing children's curiosity and interest in science.

Connecting Science to Everyday Life

One of the challenges in teaching science to young children is making scientific concepts feel relevant and meaningful to them. Many children have difficulty understanding science because they do not see a direct connection between the theories taught and their everyday experiences. Therefore, connecting science to everyday activities is a very effective approach to learning. In this way, children can understand that science is not just something in books or laboratories but also a part of their lives (Astini et al., 2023; Uludağ & Erkan, 2023).

Relating science learning to everyday experiences can help children to understand and remember scientific concepts better. Research shows that when children engage in activities relevant to their lives, they are more likely to develop a deeper interest and understanding of science (Åkerblom et al., 2018). Thus, this approach improves children's understanding of science and encourages them to be more active and involved in the learning process (White & Fleer, 2019).

This approach can be applied by inviting children to observe natural phenomena they encounter daily and explaining the underlying scientific principles. For example, in understanding the concept of photosynthesis, children can be invited to plant and care for their plants. Children can understand that plants need water, sunlight, and fertile soil to grow by observing how plants grow from seeds to larger plants. This activity introduces basic biological concepts and fosters children's concern for the environment.

This approach can also be used to explain weather phenomena. When the sky changes colour from blue to red at sunset, children can be invited to discuss how sunlight is refracted in the atmosphere. To help them understand this concept, a simple experiment can be done using a flashlight directed at a glass of water. Children can see how light changes colour as it passes through different mediums, which resembles the process in Earth's atmosphere.

The learning stages in this approach are arranged systematically and structured to increase the effectiveness of understanding concepts through direct experience. This process begins by connecting learning with children's experiences, where they are invited to observe phenomena around them, such as changes in the weather, plant growth, or other daily events that are relevant to their lives. Next, in the exploration and experimentation stage, children actively carry out activities that demonstrate scientific concepts, such as watering plants and observing their growth process or paying attention to changes in the colour of the sky from morning to evening. After the exploration stage, the process continues with a conceptual explanation, where the teacher or parent explains the observed phenomenon in simple language that is adjusted to the child's level of understanding but still refers to scientific principles. The final stage is the application in everyday life, where children are invited to integrate the knowledge, they have acquired into real activities, such as caring for plants independently or making illustrations of the changes in the colour of the sky that they observe throughout the day. This approach helps build a strong scientific understanding and instils critical thinking skills and the ability to apply concepts in practical contexts.

In addition to the concept of photosynthesis and the refraction of light, this method can also be applied to various other activities. For example, when cooking, children can be invited to understand the changes in state of matter when water boils and evaporates or when cake dough changes texture after being baked. They can also learn about gravity by observing how objects fall to the ground when dropped from a certain height.

Connecting science to everyday life improves children's understanding of scientific concepts and helps them develop a greater curiosity about the world around them. By showing that science is everywhere and plays a role in various aspects of life, children will be more interested in exploring and understanding the world scientifically. This method also helps build critical thinking habits from an early age, where children begin to ask questions about the phenomena, they encounter every day and try to find the answers themselves.

However, for this method to be applied optimally, parents and educators must actively guide children to see the relationship between everyday phenomena and the underlying scientific principles. Open-ended questions such as "Why does rain fall from the sky?" or "Why do our shadows change size throughout the day?" can help children develop scientific thinking skills and naturally improve their understanding of scientific concepts. With the right approach, children will increasingly realize that science is not just something they learn in school but also an integral part of their everyday lives.

Sensory exploration

Sensory exploration is a learning approach involving all of a child's five senses in understanding science concepts. This method is very effective for early childhood because children learn by experiencing something directly through touch, sight, hearing, smell, and taste. By using various senses, children can gain a stronger understanding of abstract concepts and more easily remember the information obtained Sumarni (2023).

Sensory exploration in science learning allows children to participate actively in the learning process. When children interact with their environment through various senses, they observe, feel, and experience the phenomena being studied. This helps them build deeper connections with the subject matter, improving their cognitive abilities and creativity (Sativa & Eliza, 2023).

In addition, sensory exploration can also increase children's curiosity about the surrounding environment. By allowing children to explore and experiment, they will be more motivated to learn and learn more about the world of science. This approach aligns with the principle of active learning, which emphasizes the importance of direct experience in early childhood education (Watini, 2019).

This approach is very useful in introducing basic science concepts such as texture, temperature, shape, sound, and simple chemical reactions. For example, to understand the differences in the texture of objects, children can be given various materials such as sand, cotton, clay, and water. By touching and comparing these various textures, they can understand the concepts of rough, smooth, hard, and soft more realistically than just listening to explanations from adults. In addition, sensory exploration can also be used to introduce the concept of mixing substances and changing the state of objects. One simple experiment that can be done is mixing flour with water and observing how the texture changes from dry powder to sticky dough. This activity helps children understand basic physics concepts and develops their fine motor skills.

The sensory exploration method in science learning can be systematically organized through several interconnected stages. The first stage is sensory exploration, where children are invited to feel, touch, see, or smell various materials or phenomena to build a rich and direct sensory experience. After that, they enter the stage of distinguishing characteristics, which encourages children to compare various objects based on sensory attributes such as texture, colour, temperature, or the sound they produce so that they can recognize the differences and similarities between various stimuli. This process then continues with a reflective discussion, where children talk about their sensory experiences, express their observations, and try to conclude what they have experienced. By following these stages, the sensory exploration method improves children's understanding of scientific concepts more concretely and trains their critical thinking skills and ability to connect sensory experiences with broader scientific principles. For example, to understand the concept of temperature, children can be asked to touch water in three containers: one containing cold water, one with warm water, and one with room temperature water. Educators or parents can ask, "What do you feel when you touch the water in each container?" In this way, children can recognize the temperature difference based on their own sensory experience, which is more effective than just being given a verbal explanation.

Sensory exploration can also involve the senses of smell and hearing. For example, children can be invited to observe the smell of various natural ingredients such as coffee, orange, mint leaves, or cinnamon to understand the difference in aroma. They can also listen to the sounds of different objects, such as tapping on wood, metal, or plastic, to understand how these materials produce unique sounds.

In addition to improving the understanding of science concepts, sensory exploration has other benefits for children's development. This activity can help children develop motor coordination, improve observation skills, and train their communication skills by explaining their feelings. In addition, sensory experiences also play a role in developing critical thinking skills, where children begin to ask questions, compare, and look for patterns in the things they experience.

However, in implementing this method, parents and educators must ensure that the materials used are

safe and appropriate for the child's age. Some children may have certain sensory sensitivities to certain textures or smells, so more appropriate alternatives may be needed. By creating fun and safe sensory experiences, children can learn science more naturally, interactively and meaningfully.

Construction games

Construction play is an effective learning method to introduce science and engineering concepts to young children. This method involves stacking blocks, playing with magnets, building mini bridges, or making structures from various materials. Through these activities, children learn about the basic principles of physics and engineering and develop critical thinking skills, problem-solving, and creativity (Patandung, 2023; Yean, 2024).

In construction play, children can build something independently or collaborate with peers. When they try to stack blocks to build a tower or bridge, they will find that some structures are more stable than others. From this experience, children can begin to understand the principles of balance, gravity, and weight distribution without the need for overly theoretical explanations. For example, when they try to build a tower from wooden blocks, they will see that a tower with a wider base is more stable than a narrow one (Antara & Dewantara, 2022; Nugroho et al., 2022).

Construction play can also teach children about the concepts of force and structure. Children can be asked to build a mini bridge that can withstand a certain weight using simple objects such as paper and straws. They can then test the bridge's strength by placing objects on it. From this experiment, children learn that certain structures are stronger than others, which is the basis of engineering and architecture.

The construction play method in science learning can be implemented systematically through several interconnected stages to improve children's understanding of scientific concepts. The first stage is to let children explore, where they are given various materials without rigid instructions to experiment freely with various possibilities in constructing structures. Next, they enter the challenge-solving stage, where children are invited to solve problems by arranging and adjusting the structures, they build to find the best solution. After that, they analyze the results, which aim to observe which aspects of their construction were successful and identify elements that need improvement or refinement. This process is then complemented by a conceptual discussion, where educators explain the principles of physics or engineering related to their play, such as balance, force, or structural stability. By following these stages, the construction play method develops critical thinking and problem-solving skills and strengthens children's understanding of scientific concepts through direct and exploratory experiences. For example, in exploring why buildings can collapse, children can be asked to build a tower from wooden blocks. After that, educators can ask, "How do I make the tower taller without collapsing?" Children will try various ways, such as widening the base of the building or arranging the blocks more evenly. From this process, they learn that the distribution of weight and balance greatly influences the stability of the building.

In addition, construction games can also be used to introduce the concept of magnetism. Children can be given different magnets and metal objects to see how magnets attract certain objects but not others. This way, they can understand that magnets have different pulling forces depending on the materials used.

Construction games improve children's understanding of science and engineering concepts and develop their social skills. Children who play in groups learn to work together, share ideas, and solve problems collectively. They also develop fine motor skills and hand-eye coordination when stacking blocks or arranging structures.

However, to ensure the effectiveness of this method, parents and educators need to provide a supportive environment. The play materials should be varied enough for children to explore various concepts. In addition, the challenges given in the game should be appropriate to the child's cognitive development level so that they can feel challenged but still motivated to try. With the right approach, construction play can be a highly effective tool in building children's understanding of science, engineering, and design principles while enhancing their creative thinking and problem-solving skills from an early age.

Nature observation

Nature observation is one of the most effective science learning methods for early childhood because it allows them to interact directly with their surroundings. This method helps children understand scientific concepts concretely and fosters curiosity and concern for nature. Children accustomed to observing natural phenomena will be more sensitive to changes in their environment and more easily understand the relationship between living things and the environment in which they live (Fitriani et al., 2023).

This approach is very suitable for introducing the concepts of biology, ecology, and environmental science. For example, children can be invited to observe plant growth by planting their seeds and recording the changes that occur every day. They can see how plants start to grow from seeds, observe changes in leaf colour, and understand that plants need sunlight, water, and fertile soil to survive. In this way, children understand the plant growth cycle and learn about the importance

of maintaining the environment so plants can grow well (Risma & Dewantara, 2022).

Nature observation can also be applied to understanding the concept of changes in weather and seasons. Children can be invited to observe the changing colours of the sky at sunrise and sunset, see how the clouds move, or feel the difference in temperature between morning, afternoon, and night. To help them understand this concept, educators or parents can ask questions such as, "Why does the sky change colour in the afternoon?" or "How is the temperature different between morning and afternoon?" In this way, children can learn that natural phenomena occur because of the interaction between the sun, atmosphere, and earth.

The stages of learning with the nature observation method can be arranged systematically to increase children's understanding of natural phenomena through direct experience. This process begins with observing nature directly, where children are invited to see and experience various phenomena in the surrounding environment, such as plant growth, seasonal changes, or animal behaviour, to build an understanding based on experience. After making observations, children enter the stage of recording changes, where they are asked to draw or record the results of observations in a simple form so that they can document the observed process systematically. The final stage is discussing the results. It involves discussions between children and educators to interpret their findings, ask questions, and draw conclusions based on patterns or changes identified during observations. By following these steps, the nature observation method strengthens observation and analysis skills and encourages curiosity and reflective thinking, which are essential in science learning.

For example, when exploring how plants grow, children can plant seeds in small pots and observe them daily. They can record the changes that occur, such as when shoots begin to appear, how the leaves increase in size, and how the plant responds to sunlight. Educators can then ask, "What happens if we do not water this plant for a few days?" so that children can understand that water is one of the important factors in plant growth.

Nature observation can also be used to understand animal behaviour. For example, children can be invited to observe butterflies flying in the garden, birds looking for food, or ants carrying food to their nests. From these observations, children can learn about the food chain, animal habitats, and how living things interact with each other in the ecosystem.

In addition to improving scientific understanding, nature observation also benefits children's development. This activity can improve observation skills, build environmental awareness, and train their patience and perseverance. In addition, regular nature exploration can help children develop an appreciation for the beauty of nature and increase their sense of responsibility for their surroundings. However, for this method to be effective, parents and educators must ensure that children can access a safe, natural environment to explore. If the outdoor environment is not possible, observations can also be made through simple experiments at home, such as observing how plants grow in different light conditions or how water evaporates from a glass surface over time.

With the right approach, the nature observation method can effectively build children's scientific understanding from an early age. This method provides a fun learning experience and helps children develop critical thinking skills, curiosity, and awareness of the importance of preserving the environment for future generations.

Adaptation Strategies for Parents and Educators

For science learning methods for early childhood to be applied optimally, parents and educators need to adjust the approach to the characteristics of the child's development. Each child has a different level of cognitive readiness, so it is important to choose a method that suits their developmental stage (Shaifudin & Nugrawitati, 2022). Children aged 3-4 years, for example, tend to enjoy sensory exploration that involves direct experience with various textures, colours, and sounds, while children aged 5-6 years have begun to be able to understand more abstract concepts through inquiry-based learning. Therefore, parents and educators must recognize their children's abilities and provide appropriate stimulation so that they can understand science fun and effectively. In addition to cognitive development, children's interests and learning styles also play an important role in learning effectiveness. Some children are more interested in physical and exploratory activities, while others prefer observation or construction-based games. Introducing various learning methods allows children to find the way of learning that best suits their preferences. For example, active and mobile children may enjoy science experiments involving water, air, or gravity. In contrast, more observant children may prefer activities such as observing plant growth or the changing colours of the sky at sunrise and sunset. By adapting learning strategies to children's interests, parents and educators can increase their engagement in learning and help them understand science concepts more deeply (Lin et al., 2023; Gerde & Wasik, 2021).

Table 1. Strategies in Teaching Science to Toddlers

Method	Steps
Inquiry-Based Learning	1. Ask simple questions. 2. Observe surroundings carefully. 3. Make small guesses. 4. Do simple experiments. 5. Think about results.
Hands-on Activities	1. Provide safe tools. 2. Try easy experiments. 3. Touch, see, feel. 4. Watch and discuss. 5. Repeat the process.
Sensory Exploration	1. Give different materials. 2. Describe what is felt. 3. Compare different things. 4. Connect to science. 5. Share and explain.
Construction Play	1. Use blocks or magnets. 2. Try building shapes. 3. Learn about balance. 4. Test and observe. 5. Fix and improve.
Nature Observation	1. Look at plants, animals. 2. Draw or write changes. 3. Ask simple questions. 4. Connect with science. 5. Share what is learned.
Science in Daily Life	1. Use real examples. 2. Talk about causes. 3. Try small tests. 4. Explain in simple words. 5. Keep exploring more.

The availability of resources is also a factor that needs to be considered when implementing science learning methods for early childhood. Not all parents can access complex experimental materials or large spaces to explore nature. Therefore, a more flexible approach can be applied, for example, by utilizing household objects for simple experiments or inviting children to observe natural phenomena around them, such as how rainwater collects or how shadows change throughout the day. Thus, science learning can still occur effectively without relying on expensive or complicated facilities (Kominsky et al., 2023; Gregoriadis & Evangelou, 2022).

In addition to providing appropriate resources, parental involvement in the learning process is also a key factor in increasing the effectiveness of science education for early childhood. Studies show that children who receive active support from parents in exploring their environment better understand scientific concepts. Therefore, parents should provide materials and guide children in exploring, asking questions that stimulate curiosity, and discussing the results of their observations and experiments. Through this approach, children will feel more motivated to learn and more open to developing their scientific thinking (Lin et al., 2023; Jadhav et al., 2021). However, in providing exploratory experiences to children, safety factors must also be a primary concern. Some science experiments may involve simple chemicals, sharp objects, or experiments with water and electricity that can be risky if not properly supervised. Therefore, parents and educators must ensure that every activity is appropriate to the child's age and abilities and takes place in a safe environment. For example, experiments involving liquid mixtures should use safe and easily found ingredients in the kitchen, such as water, oil, and food colouring, without involving harmful chemicals (Sciberras et al., 2020). In addition, to ensure long-term learning effectiveness, parents and educators need to establish consistent learning routines. Science learning does not always have to be in the form of large experiments or formally structured activities; it can be integrated into everyday activities. For example, children can be invited to understand the concept of changes in the state of matter while helping to cook in the kitchen, observing weather patterns while playing outside, or caring for plants in the yard. With a continuous approach and based on real experiences, children will find it easier to understand and remember science concepts daily (Gregoriadis & Evangelou, 2022).

In addition to direct approaches, technology can also be an effective tool in early childhood science learning. Educational videos, interactive applications, and virtual experiments can help children understand concepts that are difficult to grasp through direct experience. However, the use of technology must be done wisely so as not to replace direct interaction with the real environment. For example, after watching a video about the water cycle, children should be invited to observe how water evaporates from a puddle after sunlight exposure. Thus, technology is a learning support, not a substitute for direct exploration, which remains the core of early childhood science education (Kominsky et al., 2023). Overall, for early childhood science learning to be effective, parents and educators must adjust the methods used for each child's age, interests, available resources, and environmental conditions. By understanding children's characteristics and providing fun, meaningful, and safe learning experiences, children will find it easier to understand science concepts and develop their curiosity and critical thinking from an early age. Science learning that is tailored to children's needs and conditions will not only improve their understanding of science but also form scientific thinking habits that are beneficial for their future development (Lin et al., 2023; Jadhav et al., 2021).

Conclusion

Science learning for toddlers requires an appropriate approach to their cognitive and motor developmental stages so scientific concepts can be understood easily and enjoyably. Although there are various challenges, such as teaching methods that are still instructional, limited exploration facilities, and a lack of understanding of parents and educators in

delivering science materials effectively, the right strategy can overcome these obstacles. Inquiry-based approaches, direct experience, sensory exploration, construction games, and nature observation have increased children's engagement in learning and helped them build a deeper understanding of scientific concepts. In addition, connecting science to everyday life also allows children to see the relevance of science in the real world, so they are more interested in exploring and asking questions. The active role of parents and educators is very important in guiding children during the exploration process, providing reflective questions, and creating a safe and supportive learning environment. With the application of appropriate methods, science learning will improve children's understanding of scientific concepts and develop critical thinking skills, problem-solving, and curiosity that will benefit their future development.

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The authors declare no conflict of interest.

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