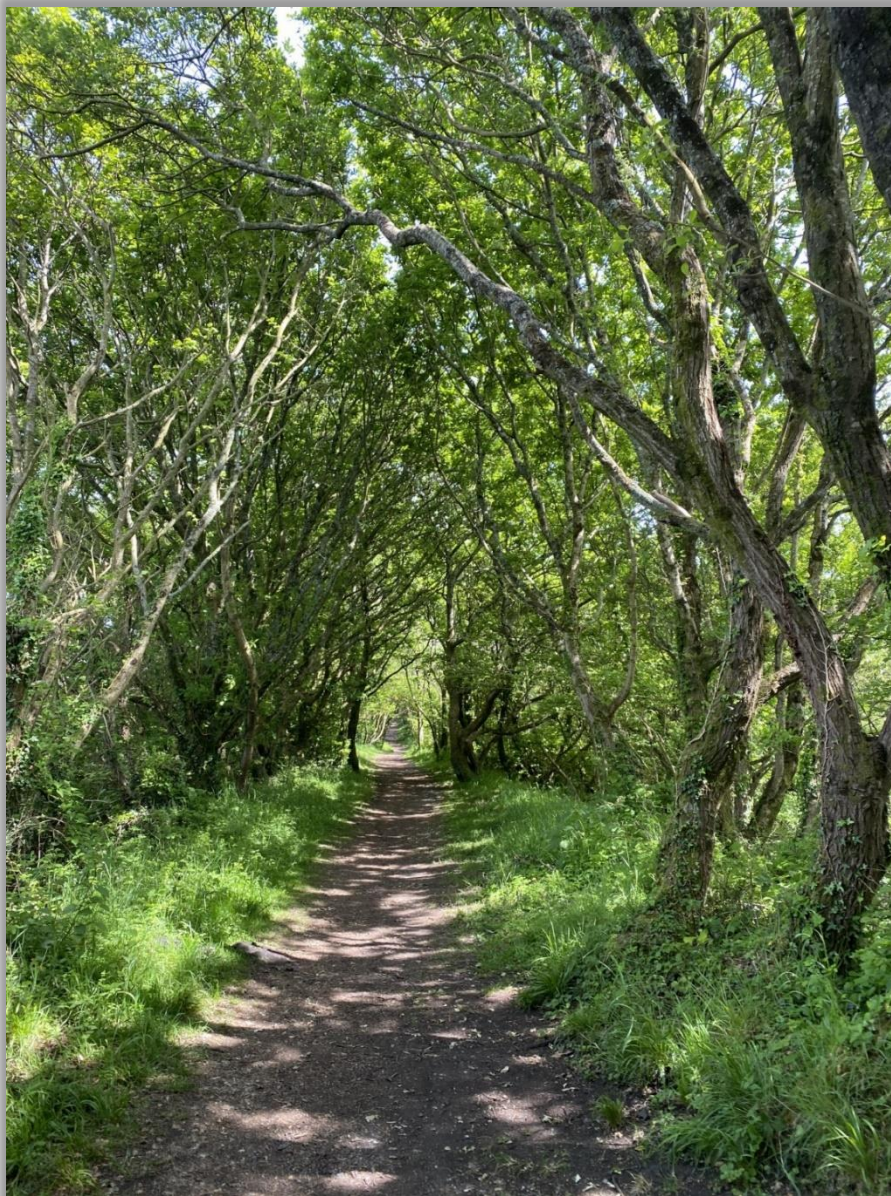


I acknowledge the use of ChatGPT (<https://chatgpt.com/>) on 27th September 2024 to proofread my work. I used the prompt:

1. Can you check the following text for grammatical and syntactical mistakes?

I confirm that I have not presented any AI generated text as my own work. I confirm I have copies of my drafts, notes, and other resources I used before, and after the use of AI tools which I may be asked to provide in evidence.

Using Woodland Spaces to Encourage Mathematical and Scientific Exploration in Early Years



Woodland Area (Hughes, 2024a)

ECEY5005: Awe and Wonder – Science, Mathematics and the Outdoors.

Carys Hughes

2314177

Introduction

The outdoor environment in the photograph, as seen in **Figure 1**, presents a woodland path, shaded by a natural canopy of trees, with uneven ground, overhanging branches, and scattered natural resources such as leaves, twigs, and rocks. The area is ideal for promoting children's curiosity and engagement with the natural world, offering a diverse range of opportunities for learning about scientific and mathematical concepts.

This site will be used by a group of children aged 3-5 years from a Nursery and Reception class in a primary school. Practitioners will support the children's holistic development by encouraging inquiry-based learning and scientific thinking through play. The focus of this portfolio is to explore how this woodland setting can be used to promote specific mathematical and scientific ideas, aligned with the Curriculum for Wales (Welsh Government, 2021) and how practitioners can scaffold learning without interrupting the children's natural curiosity.

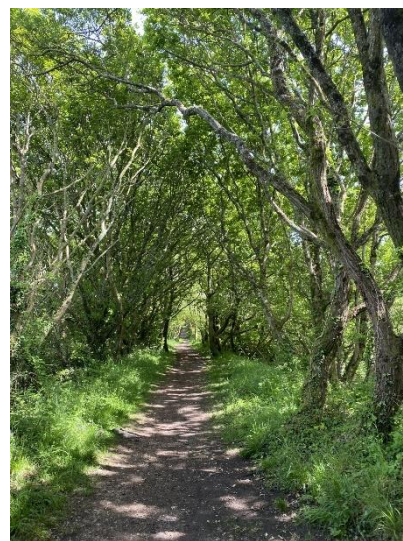


Figure 1 – Woodland Area (Hughes, 2024a)

Scientific Exploration: Forces and Motion

The Environment: The woodland has gentle slopes, dips, and uneven surfaces as shown in **Figure 2**, which are key features that support learning about forces and motion. As children run, jump and roll objects down these slopes, they will begin to explore the concept of gravity, as well as experiment with friction as different objects move across surfaces of varying textures.



Figure 2 – Woodland Floor (Hughes, 2024b)

What Children Might Do: In this environment, children may start by rolling natural materials, such as leaves, sticks, or stones, down the slopes. They might notice how some objects roll faster than others or how certain objects do not roll at all. These playful interactions with the landscape enable children to grasp abstract concepts like gravity and friction, providing a foundation for scientific understanding.

Play-based learning in natural environments has been shown to promote children's critical thinking skills and problem-solving abilities, as they make predictions, test hypotheses, and observe results. This aligns with Vygotsky's (1978) theory of social constructivism, where children construct knowledge through social interaction and active exploration of their environment.

Practitioner's Role: Practitioners can scaffold children's learning by observing closely and asking open-ended questions that promote sustained shared thinking. For instance, they might ask:

- “I wonder why that rock rolls faster than the stick?”
- “What do you think will happen if you roll the stone on the grass instead of the dirt path?”
- “Let's see if the big stick rolls differently than the small one.”



Thought Bubble
(FreePik, no date)

These types of questions help children to observe the effects of different forces, such as gravity, on objects, and how friction between surfaces influences speed. Open-ended questioning also encourages children to make predictions, test their ideas, and engage in inquiry-based learning. This is essential for supporting children's metacognitive development, as they reflect on their thinking and actions. This also aligns with Progression Step 1 of the Curriculum for Wales (Welsh Government, 2021), which emphasises developing curiosity about the world through experiential play.



Figure 3 – Sports Balls
(Adobe Stock, no date)

Resources: To enhance this exploration, practitioners could provide additional resources such as balls or objects of different shapes and weights as illustrated in **Figure 3**. Introducing loose parts into the environment allows children to experiment with how these different objects behave on uneven surfaces, fostering deeper engagement with the concepts of force and motion. The provision of a rich array of natural resources has been shown to significantly enhance learning outcomes in outdoor play settings. By repeating and varying their experiments, children consolidate their understanding, building on Piaget's (1964) stages of cognitive development, where children learn through active interaction with their environment.

Mathematical Exploration: Size, Shape, and Measurement

The Environment: The woodland is full of natural materials of varying sizes, shapes, and textures, such as twigs, leaves, and stones. These provide endless opportunities for children to explore mathematical concepts like comparison, measurement, and pattern recognition through play.



Natural Woodland Materials
(The Practical Forest School,
no date)



Figure 3 – Measuring Sticks (Creative Star Learning, no date)

What Children Might Do: Children may collect items such as sticks and leaves, comparing their lengths, widths, and weights, like in **Figure 4**. They may also arrange them into patterns or attempt to build small structures from twigs and rocks. By engaging in these activities, children are exploring mathematical concepts such as size, shape, and symmetry in a natural, tactile way. Early mathematical learning, particularly in outdoor contexts, is enhanced when children engage in play that involves sorting, measuring, and patterning.

For example, while building with twigs, children might use trial and error to balance them, naturally investigating ideas about length and stability. Practitioners can gently guide this learning by introducing mathematical language, for instance:

- “How many stones did you find?”
- “Can you find a stick longer than this one?”
- “Which leaf is the biggest?”



Speech Bubble
(Stockio, no date)

These questions encourage children to engage in counting, comparing, and measuring. This kind of informal measurement and comparison helps children develop an intuitive understanding of size and scale, laying the foundation for more formal mathematical learning in the future. Such experiential learning is supported by Bruner’s (1966) theory of discovery learning, where children learn best through active exploration and hands-on experience.

Practitioner’s Role: Practitioners can extend the children’s exploration by encouraging them to group and categorise the materials they collect. By doing this, children can begin to engage with the mathematical concepts of sorting and classification, which are important early numeracy skills.

Life Cycles and Ecosystems: Exploring Natural Change

The Environment: The woodland path offers a rich environment for exploring the life cycles of plants and animals, shown in **Figure 5**. Fallen leaves, insects, and signs of plant growth provide children with opportunities to observe changes in nature and understand the concept of life cycles. Outdoor play spaces, particularly in woodland settings, can support children’s developing understanding of biological concepts and environmental stewardship.



Figure 5 – Life Cycle of a Tree
(Ecotree, no date)



Figure 6 – Children Observing
Wildlife (Shutterstock, no date)

What Children Might Do: Children may find fallen leaves and notice how they differ from the green leaves still attached to trees. They might also observe insects or small animals, sparking curiosity about the living organisms around them, illustrated in **Figure 6**. Through these observations, children can begin to understand life cycles and ecosystems, key components of early scientific learning.

Practitioner’s Role: Practitioners can further support this learning by asking open-ended questions that provoke deeper thought. For example:

- “Where do you think these insects go at night?”
- “Why do you think some leaves are green and some are brown?”
- “What do you think will happen to the leaves after they fall?”

These questions can help children develop an understanding of the processes of growth, change, and decay in the natural world. Introducing books or diagrams about plant growth or insect life cycles can provide additional context for children's observations, linking their discoveries to larger scientific concepts.

Resources: To enhance learning, practitioners could provide magnifying glasses for children to observe insects or fallen leaves more closely, encouraging detailed observation and fostering a deeper connection with nature. The use of additional tools such as magnifiers or observation jars can deepen children's understanding of ecosystems and biodiversity, as they engage in close observation and record their findings.



*Magnifying Glass for Observing
Wildlife (Imagniphy, no date)*

Learning through Metacognitive Talk and Play

Metacognitive talk is an essential aspect of early learning, helping children reflect on their actions and think about their thinking processes. In this woodland environment, metacognitive dialogue could occur naturally as children engage with the physical world. Practitioners might prompt reflective conversations with questions like:

- “Why do you think that happened?”
- “How did you make the twig balance?”
- “What could you try next time to make the rock roll faster?”

These questions help children become aware of their own problem-solving strategies and encourage them to experiment further. By allowing children time to repeat activities, practitioners ensure they have opportunities to consolidate their learning through trial and error, a key element of both scientific and mathematical inquiry.

Conclusion

The woodland setting offers a natural and dynamic environment where children can explore foundational concepts in science and mathematics through play. With the support of attentive practitioners, children can develop an understanding of forces and motion, engage with size, shape, and measurement, and learn about life cycles and ecosystems. This type of inquiry-based learning, grounded in open-ended questioning and playful exploration, aligns closely with the Curriculum for Wales (Welsh Government, 2021) and promotes a holistic approach to early years education.

RISK BENEFIT ASSESSMENT

Location / Activity:	Woodland Area – Tree Climbing, Shelter Building, Water Play and Wildlife Exploration	Date:	24.09.2024
Assessor:	Carys Hughes	Review date:	24.03.2025

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk after precautions RATING: L/M/H
Exploration of forces and motion (rolling objects)	Children will engage with the concept of gravity and friction by rolling natural materials like sticks and stones down slopes. This activity enhances problem-solving skills and fine motor coordination as children explore how objects move across different surfaces. It also supports physical development and curiosity about the physical world.	- Uneven ground may cause children to trip or fall. - Rolling objects could accidentally hit another child or adult.	Children and practitioners	- Close adult supervision to ensure that children remain at a safe distance from each other during rolling activities. - Practitioners should check the terrain for particularly hazardous areas (e.g., steeper slopes or areas with sharp rocks). - Encourage the use of smaller, lightweight objects like twigs and pinecones. - Areas with sharp drops or hazardous ground should be avoided.	Low
Building structures using natural materials (e.g., sticks, stones)	Constructing structures with sticks and stones helps children develop critical thinking, problem-solving, and fine motor skills. By building dens or small structures, children also learn about balance, stability, and spatial awareness. This activity fosters creativity, teamwork, and resilience.	- Sticks may cause splinters or minor injuries. - Heavy stones could be dropped, leading to foot or hand injuries.	Children building with natural materials and practitioners	- Ensure children are wearing gloves to protect against splinters. - Supervision by adults to ensure that only manageable materials (small stones and sticks) are used. - Guide children in proper lifting techniques to prevent injury. - Ensure adults assist in checking the stability of any larger structures.	Low
Climbing or exploring tree trunks	Climbing improves children's gross motor skills, balance, and coordination. It also supports their confidence and encourages them to take healthy risks in a safe environment. Through climbing, children engage with concepts of gravity and body awareness.	- Falling from a height while climbing. - Scratches or cuts from tree bark. - Practitioners may strain themselves while assisting children.	Children climbing or exploring trees and practitioners	- Designate specific trees as safe for climbing, avoiding any with unstable branches or large heights. - Adult supervision is required at all times during climbing activities. - Ensure children stay low on tree trunks to reduce the risk of falling from significant heights. - Practitioners should ensure they have support when helping children. - Ensure that both children and adults know the limits of safe climbing.	Medium

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk after precautions RATING: L/M/H
Physical play on uneven terrain (running, jumping)	Children develop coordination and balance, while practitioners can observe or join in to support physical play.	- Risk of sprained ankles, falls, or collisions on uneven surfaces. - Adults may trip or fall while supervising or interacting with children.	Children and practitioners	- Children and adults should wear sturdy shoes that offer ankle support. - Practitioners should be aware of uneven or hazardous terrain and mark it off. - Adults must model safe play and awareness of their surroundings.	Medium
Exploring water features (if present)	Children can engage in hands-on experiments with water, learning about buoyancy and flow.	- Risk of slipping near wet surfaces. - Potential for waterborne illness if water is contaminated. - Adults assisting may also slip and injure themselves.	Children and Practitioners	- Conduct water quality checks before allowing interaction with natural water features. - Provide waterproof footwear for children and adults. - Ensure clear boundaries are set to prevent slipping or over-reaching into deeper water.	Medium
Observing insects and wildlife	Children learn about biodiversity and ecosystems, and practitioners can guide observations.	- Potential insect bites or stings affecting both children and adults. - Allergic reactions to contact with certain wildlife.	Children and practitioners	- Conduct a thorough inspection for hazardous insects, such as wasps or ants. - Ensure both children and adults understand how to observe wildlife from a safe distance. - Provide first aid kits equipped for insect bites or stings.	Low
Shelter building using natural materials (e.g., branches, leaves)	Children will engage in teamwork and problem-solving by constructing simple shelters. This activity fosters collaboration, creativity, and understanding of structures.	- Risk of falling branches during construction. - Risk of materials collapsing if not properly balanced.	Children and practitioners	- Practitioners should supervise closely to ensure structures are stable. - Encourage children to use smaller, lighter branches. - Set clear safety boundaries around the construction area.	Low
Campfire activities (if appropriate and supervised)	Children can learn about fire safety, cooking, and outdoor survival skills. Practitioners can facilitate discussions on heat, combustion, and responsible fire usage.	- Risk of burns from open flames. - Potential for the fire to spread if not properly controlled.	Children and practitioners	- Ensure that campfires are built in designated, contained areas. - Practitioners must closely supervise the fire and ensure all participants are at a safe distance. - Provide clear instructions on how to safely engage with campfires (e.g., roasting marshmallows with proper tools).	Medium
Use of sharp tools in outdoor woodworking activities (e.g., knives, saws)	Woodworking encourages the development of practical skills, fine motor coordination, and an understanding of tools and materials. Children can engage in	- Cuts or punctures from sharp tools. - Risk of infection from untreated cuts. - Inappropriate use of tools leading to accidents.	Children and practitioners	- Tools should only be used under the strict supervision of trained adults. - Provide protective gear, such as gloves and safety goggles. - Ensure children are properly trained in the safe use of tools before engaging in the activity.	High

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk after precautions RATING: L/M/H
	creative activities like carving or building with wood.				

The Role of Adults in Supporting Early Years Mathematical and Scientific Exploration in Outdoor Environments

Introduction

In early childhood education, outdoor environments offer rich opportunities for engaging children with foundational mathematical and scientific concepts. Adults play a critical role in facilitating and supporting these experiences, guiding children through exploration and inquiry in natural settings. This essay evaluates how adults support early years children's engagement with mathematical and scientific concepts outdoors, focusing on three key areas: the role of loose parts and affordance theory, the importance of curiosity-driven, child-led play, and the concept of sustained shared thinking in fostering deeper learning. These concepts will be critically examined through the lens of theories from Vygotsky, Piaget, Nicholson, and Bruner, while also addressing the challenges and barriers adults face when implementing outdoor learning activities. While not all aspects of outdoor learning can be covered in detail, this essay will explore these specific areas in depth to highlight how adults can create enabling environments that foster curiosity and engagement.

The Role of Adults as Facilitators of Mathematical and Scientific Learning

Adults in early years settings have a dual role as facilitators and enablers of learning. Rather than directly instructing children, adults support their exploration and engagement by creating environments that invite inquiry, problem-solving, and discovery.

Vygotsky's Social Constructivism and the Zone of Proximal Development

Vygotsky's theory of social constructivism emphasises the importance of social interaction in learning, proposing that children's development is best supported when adults provide scaffolding to guide children through tasks they cannot yet complete independently (Vygotsky, 1978). In an outdoor environment, scaffolding might involve an adult offering gentle guidance as children explore natural elements - helping them understand size, shape, weight, and balance through observation and experimentation. The Zone of Proximal Development (ZPD) is the space where children can achieve more with the support of a knowledgeable other (Vygotsky, 1978). Adults can help extend children's mathematical thinking by introducing concepts like measurement while they explore natural materials.

For instance, during a forest walk, a practitioner might ask, "How many steps do you think it will take to reach that tree?" or "Which stick do you think is longer?" These simple prompts allow children to

engage in measuring, a fundamental mathematical concept, while also encouraging estimation and comparison. The role of the adult is to facilitate, not control, the learning process—allowing children to experiment and test their ideas within a supportive framework (Johnson & Watts, 2019). This approach aligns with the Curriculum for Wales 2022, which encourages practitioners to create opportunities for children to learn through hands-on, inquiry-based exploration (Welsh Government, 2022).

As children grow, the nature of scaffolding changes. Younger children may need more direct prompts or physical assistance when engaging with concepts such as balance or measurement, while older children may benefit from subtle, open-ended questioning to extend their thinking. For children under three years of age, outdoor environments present a unique opportunity for sensory exploration, where adults play a crucial role in providing guidance and ensuring safety while allowing space for independent discovery (Bilton, Bento, and Dias, 2017). This dynamic adjustment of support is key to scaffolding within the Zone of Proximal Development, as the adult provides guidance tailored to each child's individual needs. For instance, while a younger child might require help in stacking stones to understand balance, an older child could be encouraged to experiment with additional variables, such as surface friction, by asking, "How does this stone balance differently on the grass compared to the dirt?"

Bruner's Theory of Discovery Learning and the Importance of Inquiry

Bruner's theory of discovery learning highlights the significance of self-directed exploration as a key method of learning (Bruner, 1961). In outdoor settings, adults can foster an environment where children are encouraged to ask questions, explore, and make discoveries. This requires practitioners to provide the necessary materials and stimuli—such as loose parts—while stepping back to allow children to lead their own learning.

Loose parts, as described by Nicholson (1971), are open-ended materials that children can manipulate in various ways, facilitating problem-solving and creative thinking. Adults play a vital role in ensuring that these materials are available, safe, and diverse enough to encourage mathematical and scientific exploration. For example, providing children with access to objects like stones, sticks, and water allows them to explore concepts such as gravity, friction, and volume in a natural, tactile way (White, 2020). The flexibility of loose parts allows children to experiment and refine their understanding of how the physical world operates, thus embodying Bruner's belief in the power of discovery learning (Bruner, 1961).

However, Bruner's model also implies that while children are actively involved in learning, adults need to carefully structure the environment and materials provided. Without thoughtful preparation, children's play may become disengaged from meaningful learning experiences (Keith, 2018). Therefore, adults must strike a balance between offering freedom and providing subtle prompts that guide children towards deeper understanding. Research by Davies (2019) supports this view, showing that when adults engage in sustained shared thinking, children are more likely to consolidate and extend their scientific understanding.

Loose Parts and Affordance Theory in Outdoor Learning

Loose parts theory is grounded in the belief that environments rich in flexible, open-ended materials promote creativity, experimentation, and problem-solving (Nicholson, 1971). In outdoor environments, adults can encourage mathematical and scientific exploration by providing natural materials such as leaves, sticks, stones, and water for children to manipulate. This not only aligns with Nicholson's theory but also resonates with Gibson's affordance theory, which posits that the environment offers opportunities, or affordances, for action depending on the interaction between the individual and the environment (Gibson, 1986).

How Adults Utilise Loose Parts to Foster Engagement with Mathematical and Scientific Concepts

In outdoor environments, loose parts allow children to engage with mathematical concepts such as sorting, classification, and measurement, and scientific ideas such as forces and material properties (Sargent, 2015a). For example, children might sort stones by size or weight, building an understanding of classification and sequencing, key mathematical skills (Keith, 2018). Alternatively, they might explore balance by attempting to build structures with uneven or irregular materials, thereby experimenting with scientific concepts such as gravity and friction (Robertson, 2017). These actions are driven by children's curiosity, and adults act as facilitators, offering challenges, guiding inquiry, and providing feedback where necessary.

Adults can enhance the learning potential of loose parts by asking probing questions, such as "What do you think will happen if you add more stones to this side?" or "How could you make this structure more stable?" Such questions encourage sustained shared thinking, a process where adults and children engage in extended discussions that help deepen understanding (Johnson & Watts, 2019). Adults are thus critical in transforming what might be casual play into opportunities for rich mathematical and scientific learning.

However, while loose parts can significantly enhance children's engagement, their effectiveness depends on the adult's ability to create a conducive environment. If the materials are not varied enough or the adult does not offer the right balance of freedom and guidance, the learning potential may not be realised (Sargent, 2015b). Research by Ouvry (2003) suggests that even with access to loose parts, children's engagement is often limited by adults' reluctance to embrace less structured play environments, underscoring the need for professional development in this area.

Adults must also understand how different elements of the environment afford varying learning opportunities. For example, a sloped hill may afford the exploration of gravity and speed by rolling objects down, while tree branches could invite challenges in balance and stability through climbing. Recognizing these affordances is a critical skill for adults, as it enables them to subtly guide children toward more complex scientific and mathematical thinking (Knight, 2016).

Curiosity, Discovery, and Sustained Shared Thinking

Curiosity is a powerful driver of children's engagement with their environment, and adults have a pivotal role in nurturing and supporting this natural inclination (Fisher, 2013). In outdoor settings, curiosity-driven exploration allows children to make discoveries about the natural world, leading to a deeper understanding of scientific processes. Piaget's theory of cognitive development positions children as active learners who build knowledge through interaction with their environment (Piaget, 1954). Adults can support this by providing children with opportunities to observe, ask questions, and test their ideas.

Sustained Shared Thinking as a Tool for Deepening Understanding

One of the most effective ways adults can support children's curiosity is through sustained shared thinking, where adults and children engage in a collaborative dialogue, reflecting on ideas and extending thinking (Siraj-Blatchford *et al.*, 2002). For instance, when a child observes water flowing down a hill, the adult might ask, "What do you think would happen if we blocked the water here?" This type of questioning encourages children to hypothesise, experiment, and reflect, thereby deepening their understanding of scientific concepts such as flow, volume, and resistance (Knight, 2013).

A study by Tunnicliffe (2015) found that children who engaged in sustained shared thinking with adults demonstrated a greater understanding of complex scientific and mathematical ideas compared to children who received less adult interaction. This highlights the importance of adult facilitation in supporting inquiry-based learning. Adults need to be aware that the quality of interactions, rather than the quantity, is key to fostering meaningful learning experiences.

However, fostering sustained shared thinking requires skill and attentiveness. Adults must be able to recognise teachable moments without interrupting the child's natural flow of inquiry (Johnson & Watts, 2019). Moreover, time constraints and curriculum pressures can often limit the opportunities for these rich interactions, posing a significant barrier to outdoor learning (Waite, 2017).

Challenges and Barriers in Supporting Outdoor Learning

While the benefits of outdoor learning are well-documented, various challenges hinder the ability of adults to fully support mathematical and scientific exploration in outdoor settings. Limited resources, lack of training, and safety concerns are significant barriers (White, 2020).

Curriculum Demands and Safety Concerns

One major challenge is the tension between the structured demands of academic curricula and the open-ended nature of outdoor learning (Waite, 2017). Although frameworks like the Curriculum for Wales 2022 emphasise outdoor learning, practitioners often feel pressured to meet academic targets, which can lead to less time spent outdoors (Welsh Government, 2022). Additionally, safety concerns, particularly in unpredictable outdoor environments, can discourage adults from facilitating free exploration, even when it would benefit the child's learning (Bilton, 2010).

To overcome these challenges, research suggests that adults need more training in risk management and the educational value of outdoor play. This would enable them to strike a balance between ensuring safety and allowing children the freedom to explore and experiment (Knight, 2016).

Conclusion

Adults play a critical role in supporting and encouraging children's engagement with mathematical and scientific concepts in outdoor environments. By creating enabling environments, providing loose parts, and engaging in sustained shared thinking, adults help children make meaningful discoveries about the world around them. The theories of Vygotsky, Piaget, Bruner, and Nicholson provide a strong foundation for understanding how adults can facilitate learning; however, barriers such as curriculum demands and lack of training continue to limit the potential for outdoor education. Overcoming these challenges requires a commitment to professional development and a recognition of the value of inquiry-based learning in natural settings.

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