

Awe and Wonder: Science, Mathematics and The Outdoors

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[Risk assessment forest school.pdf](#) (737 words)

Learning Journal

The observation took place within a forest school area designed to support open-ended, child-led exploration. The environment consisted of a wooded space with uneven ground, natural materials such as logs and trees, and additional resources including tyres, rope structures, a tyre swing, corrugated tubing and wheelbarrows. These resources were arranged to encourage children to move freely and engage in self-directed play. The children observed were from an early years setting, approximately aged 3-5 years, supported by practitioners who facilitated their play and exploration.

This environment reflects key principles of the Curriculum for Wales (Non-maintained settings), particularly in supporting learning through first-hand experiences, active exploration and engagement with the natural world (Welsh Government, 2022). It also aligns with the Areas of Learning and Experience, where children develop understanding through practical, meaningful contexts, particularly within Science and Technology, Mathematics and Numeracy, and Health and Well-being (Welsh Government, 2022). Furthermore, the approach reflects Forest School principles, which promote child-led, experiential learning in natural environments (Forest School Association, 2011).

The focus of this observation emerged from the children's play, particularly their exploration of forces and weight through transporting materials using wheelbarrows. Additional observations included children's interactions with the tyre swing and wind chime structure, supporting exploration of movement and sound.

Practitioners adopted a facilitative role, observing and using questioning to extend children's thinking when appropriate. This aligns with the Curriculum for Wales

emphasis on supporting children to become ambitious, capable learners who can explore, question and solve problems through experience (Welsh Government, 2022).

Wheelbarrows



During the observation, a group of children were drawn to a row of wheelbarrows positioned near a collection of loose materials, including logs, stones and bark. The children independently began filling the wheelbarrows, selecting and transporting materials across the forest school area. A practitioner remained nearby, observing the children's choices and allowing them time to explore without immediate intervention. This reflects the Curriculum for Wales emphasis on children learning through active, first-hand experiences (Welsh Government, 2022).

As the children engaged with the resources, the practitioner commented, "I can see you're collecting lots of materials, what are you planning to do with them?" This prompted some children to describe their intentions, while others continued focusing on filling their wheelbarrows.

The children appeared focused on collecting as much as possible. One child, A, placed several large logs into their wheelbarrow, filling it to the top. Observing this, the practitioner asked, "I wonder what will happen when you try to move it?" A then attempted to push the wheelbarrow forward, but it became unstable and difficult to control, tilting slightly to one side. A paused and stated, "It's too heavy," before beginning to remove some of the logs. This demonstrates early problem-solving and

enquiry skills, which are key aspects of learning within the Curriculum for Wales (Welsh Government, 2022).

The practitioner responded, “You noticed it was heavy, what could you change to make it easier?” This encouraged A to think about their actions. After reducing the number of items, A attempted to move the wheelbarrow again. This time, they were able to push it forward more successfully, maintaining better balance and control.

Another child observing this interaction commented, “You need less. It’s easier,” before adjusting their own load in response. The practitioner acknowledged this, saying, “You’ve worked out something important there, less can sometimes make it easier to move.”

This pattern of behaviour was repeated across the group. Children actively experimented with the number and type of materials they placed in their wheelbarrows, testing how much they could carry before it became too difficult to move. As they worked, the practitioner continued to support their thinking through questions such as, “Which one feels heavier?” and “How do you know when it’s too much?” Additional conversations emerged between children, such as “Why won’t it move?” and “Maybe it’s too full,” demonstrating early metacognitive thinking as children reflected on their actions and outcomes.

Some children chose to transport fewer, lighter items, while others continued to test their limits, adjusting their approach through trial and error. The practitioner gave children time to revisit and refine their ideas, reinforcing a sense of independence.

At one point, a child attempted to push a heavily loaded wheelbarrow up a slight incline. After struggling, they stopped and looked towards the practitioner. In response, the practitioner asked, “What’s making it harder here?” The child replied, “It’s too heavy,” before removing several items and trying again. This time, they were more successful in moving the wheelbarrow up the slope.

The practitioner followed this by asking, “Did changing the load help? What was different?” This supported the child in reflecting on how both the weight of the materials and the uneven ground influenced the effort required.

Throughout the activity, practitioners maintained a balance between observation and interaction, using open-ended questioning to extend children’s thinking without directing their play. This approach encouraged children to reflect on their experiences, test ideas and make connections between their actions and outcomes. This approach is consistent with play-based learning, where adults support rather than direct children’s exploration. It also reflects Forest School principles, where children are encouraged to explore, take risks and learn through hands-on experiences in a natural environment (Forest School Association, 2011). To further extend this play, additional resources such as different sized materials or transporting objects across varied terrain could support deeper exploration of weight and movement.

Tyre Swing



While observing the forest school environment, I noticed a small group of children engaging with the tyre swing. The swing was suspended from a tree by rope and provided an inviting opportunity for physical exploration. The children approached it confidently, taking turns to sit inside the tyre while others pushed. This provides opportunities for children to explore movement and physical forces through first-hand experiences, as outlined within the Science and Technology Area of Learning (Welsh Government, 2022, Science and Technology AoLE).

One child, B, climbed into the swing and called out, "Push me higher!" Two other children stood behind and began to push. Initially, their pushes were gentle, resulting in slow movements. As B encouraged them again, "Higher!", the children increased the strength of their pushes, and the swing began to move in a wider arc. This demonstrates how children begin to understand that forces, such as pushes, affect how objects move (Welsh Government, 2022, Science and Technology AoLE).

Standing nearby, I observed this interaction and commented, "The swing is going higher now, what are you doing differently?" One child responded, "We're pushing harder." I followed this by asking, "What do you think will happen if you push softly again?" Children also began to verbalise their thinking, with comments such as "It's going faster now" and "It slowed down," showing an emerging ability to reflect on changes in movement.

The children began to test this immediately, alternating between soft and strong pushes. They watched closely as the swing responded, noticing that gentle pushes caused smaller movements, while stronger pushes made the swing travel higher and faster. This reflects early mathematical understanding through the use of comparative language such as higher, lower, faster and slower, as outlined within the Mathematics and Numeracy Area of Learning (Welsh Government, 2022, Mathematics and Numeracy AoLE).

After a short time, the children stopped pushing. B, still seated in the tyre, noticed the change and said, "It's slowing down." The swing gradually reduced its movement until it almost came to a stop. I responded, "I wonder why it doesn't keep going?" The children

did not answer directly but instead asked to be pushed again, repeating the process and observing the change in movement. This supports children's developing understanding of how movement changes over time when forces are applied or removed (Welsh Government, 2022, Science and Technology AoLE).

Later, one child attempted to make the swing move independently by shifting their body and moving their legs. I acknowledged this, saying, "You're trying to get it moving by yourself, what does your body need to do?" The child continued experimenting, adjusting their movements to create momentum. This also links to physical development within the Health and Well-being Area of Learning, where children develop coordination and control through active play (Welsh Government, 2022, Health and Well-being AoLE).

Throughout this experience, the children remained highly engaged, revisiting the activity several times. They explored how their actions influenced the movement of the swing, particularly focusing on how hard to push, how often to push, and what happened when the pushing stopped.

This experience highlighted how children naturally explore concepts of movement and force through play. The children demonstrated an emerging understanding that stronger pushes resulted in greater movement, while the absence of force caused the swing to slow down. This experience could be further developed by encouraging children to explore different types of movement or revisit the activity to consolidate their understanding through repeated play.

Awe and Wonder: Science, Mathematics and The Outdoors

Supporting mathematical and scientific learning in outdoor environments

Outdoor environments provide rich opportunities for children to engage with mathematical and scientific concepts through meaningful, first-hand experiences. Within early years practice, the role of the adult is not to direct learning, but to create conditions in which children can explore, question and make sense of the world around them (Welsh Government, 2022). This is particularly evident in forest school environments, where open-ended resources and natural features encourage children to engage in self-directed, exploratory play (Forest School Association, 2021).

One key concept that supports this type of learning is affordance, which refers to the opportunities for action that an environment provides. In an outdoor context, features such as uneven ground, slopes, loose materials and climbing structures naturally invite children to test ideas related to movement, balance and force (Waters, 2017). For example, when children push a wheelbarrow or engage with a tyre swing, they are not simply playing, but exploring scientific concepts such as weight, resistance and motion. The adult's role is to recognise these affordances and support children in making connections through subtle intervention, rather than direct instruction (Welsh Government, 2022).

This approach aligns closely with Piaget's theory of cognitive development, where children are seen as active learners who construct knowledge through interaction with their environment (Piaget, 1952). In the forest school context, children are able to engage in hands-on experiences that support this process of discovery. For instance, when a child realises that a wheelbarrow is too heavy to push and decides to remove some items, they are demonstrating accommodation and adaptation of their understanding through experience. This reflects a constructivist approach to learning, where knowledge is actively built through experience (Triantafyllou, 2022).

Similarly, Vygotsky's theory highlights the importance of social interaction and the role of the adult in supporting learning (Vygotsky, 1978). The concept of the Zone of Proximal

Development (ZPD) is particularly relevant in outdoor play, where practitioners can extend children's thinking through carefully timed questioning. Rather than providing answers, adults scaffold learning by asking open-ended questions such as "What do you think will happen?" or "Why did that move faster?" This type of interaction supports children in developing deeper understanding while maintaining ownership of their learning (Keith, 2018; Welsh Government, 2022).

This process is often referred to as sustained shared thinking, where adults and children work together to solve problems, clarify ideas and build understanding (Johnson and Watts, 2019). In outdoor environments, this may occur when a practitioner engages in conversation with a child about why a swing slows down or how to make a load easier to move. These moments are particularly valuable as they encourage children to reflect on their thinking and make connections between actions and outcomes (White, 2020).

In addition to interaction, the use of loose parts plays a significant role in supporting mathematical and scientific learning. Loose parts, such as logs, stones and tyres, can be used in multiple ways, allowing children to explore concepts such as quantity, size, weight and balance (Robertson, 2017; Nicholson, 1971). Unlike fixed resources, loose parts encourage creativity and experimentation, enabling children to test hypotheses and adapt their ideas through play (White, 2020; Early Education, 2021).

Within outdoor environments, loose parts also provide opportunities for children to engage in scientific enquiry, as they observe, predict and test how materials behave in different contexts. Research suggests that nature-based environments rich in open-ended resources support the development of early mathematical and scientific (STEAM) concepts, as children learn through direct interaction with materials and their surroundings (Trina, 2024). This highlights how learning emerges through experience, rather than structured instruction.

In addition, loose parts play has been strongly linked to cognitive development, particularly in supporting problem-solving, creativity and flexible thinking (Cankaya, 2023). The open-ended nature of these materials encourages children to explore

multiple solutions and adapt their thinking through trial and error. Similarly, research highlights that environments incorporating loose parts promote more complex and sustained play, as children are able to create their own meanings and purposes for the materials (Spencer et al., 2019).

Bruner's theory of learning also supports this approach, particularly his emphasis on active learning and discovery (Bruner, 1961). Bruner suggests that children learn best when they are actively involved in the learning process, rather than passively receiving information. In outdoor environments, this is evident as children manipulate materials, test ideas and revisit experiences, gradually building understanding over time (Kiviranta, 2024).

Overall, the role of the adult in outdoor environments is to create a balance between freedom and support. By providing a rich environment, observing closely and using thoughtful questioning, practitioners can encourage children to engage deeply with mathematical and scientific concepts in a way that is meaningful and developmentally appropriate (Goldenberg, 2023).

Adult's Role

The environment itself plays a significant role in supporting children's mathematical and scientific learning, often described within the Reggio Emilia approach as the "third teacher" (Reggio Children, 2020). This perspective views the environment as an active contributor to learning, rather than simply a backdrop for play. In outdoor environments, natural features such as trees, uneven ground, loose materials and open space provide rich opportunities for exploration, investigation and discovery, supporting children's engagement with their environment (Learning Through Landscapes, 2023). These elements encourage children to engage in problem-solving, testing ideas and making connections through their own experiences.

In a forest school context, the environment offers multiple possibilities for learning without the need for structured activities. For example, children may explore how objects move on different surfaces, compare the weight of materials, or investigate how

natural elements such as wind influence movement. These experiences support both mathematical and scientific thinking, as children are actively engaged in observing, predicting and experimenting (Welsh Government, 2022, Science and Technology AoLE).

The role of the adult within this approach is to carefully observe how children interact with the environment and respond in ways that extend their thinking. Rather than directing play, practitioners support learning by noticing children's interests and providing opportunities for further exploration (DfE, 2021). This may involve introducing additional resources, asking open-ended questions, or allowing children time to revisit and develop their ideas.

This approach also supports the development of curiosity and inquiry, which are essential for both mathematics and science. When children are given the freedom to explore a well-considered environment, they are more likely to ask questions, test their ideas and reflect on their experiences (Education Scotland, 2022). As a result, learning becomes more meaningful, as it is driven by the child's own interests and engagement, with outdoor environments providing rich opportunities for active learning and exploration (Nursery World, 2021).

Barriers and Challenges

While outdoor environments provide rich opportunities for mathematical and scientific learning, there are also several barriers and challenges that practitioners may face when implementing this approach. One key challenge is balancing risk and safety. Forest school environments often involve uneven ground, climbing structures and loose materials, which can increase the likelihood of minor injuries. Practitioners may feel pressure to minimise risk, which can lead to overly cautious approaches that limit children's opportunities to explore and take manageable risks (Play Wales, 2019). However, restricting these experiences can reduce opportunities for children to develop problem-solving skills, confidence and an understanding of physical concepts such as balance and force (Brussoni et al., 2015; Forest Research, 2017).

Another challenge is the role of the adult in supporting learning without interrupting child-led play. It can be difficult for practitioners to judge when to intervene and when to step back. Over-direction may limit children's independence and creativity, while too little interaction may result in missed opportunities to extend thinking. This reflects the importance of Vygotsky's concept of the Zone of Proximal Development, where learning is supported through interaction with a more knowledgeable other (Vygotsky, 1978). The idea of scaffolding highlights that support should be gradually reduced as children become more confident and capable, rather than controlling the activity. This requires practitioners to develop strong observational skills and an awareness of when to use questioning effectively to support learning, ensuring that interactions extend thinking without taking control of the activity (Frankenberg, 2023).

Environmental factors can also present challenges. Weather conditions, such as rain or cold temperatures, may impact children's engagement or limit access to outdoor spaces. In addition, not all settings have access to well-developed outdoor environments, which can restrict opportunities for exploration and experimentation, with research highlighting variability in the quality of outdoor learning experiences across Wales (Ellis et al., 2023). Resources may also be limited, particularly in settings where outdoor provision is not prioritised, with studies identifying access to sites, facilities and administrative demands as key barriers to implementing Forest School approaches (Dabaja, 2024).

There may also be challenges related to practitioner confidence and knowledge. Supporting mathematical and scientific learning in outdoor environments requires an understanding of how these concepts can emerge through play. Some practitioners may lack confidence in identifying and extending learning opportunities, particularly in science, which can result in missed opportunities for deeper learning (Ofsted, 2021; Peñarrubia-Lozano et al., 2021).

Despite these challenges, they can be addressed through careful planning, reflective practice and a positive approach to outdoor learning. By recognising the value of outdoor environments and developing confidence in their role, practitioners can create

meaningful opportunities for children to engage with mathematical and scientific concepts in a way that is both enjoyable and developmentally appropriate.

In conclusion, adults play a crucial role in supporting children to engage with mathematical and scientific concepts within outdoor environments. Through the use of observation, open-ended questioning and carefully timed interaction, practitioners are able to extend children's thinking while maintaining the integrity of child-led play. This balance is essential in ensuring that learning remains meaningful and rooted in children's own experiences.

The importance of this role is supported by key theories of learning, including Piaget's view of children as active learners, Vygotsky's emphasis on social interaction and the Zone of Proximal Development, and Bruner's focus on discovery learning (Piaget, 1952; Vygotsky, 1978; Bruner, 1961). These theories highlight the value of children constructing knowledge through interaction with both their environment and others, with adults providing appropriate support to guide and extend understanding.

Approaches such as the use of loose parts, child-led exploration and sustained shared thinking further support children in developing curiosity, problem-solving skills and deeper understanding of mathematical and scientific concepts (Robertson, 2017; Johnson and Watts, 2019). However, as discussed, practitioners may face challenges related to balancing risk, confidence and environmental limitations, which can impact the quality of learning experiences (Ofsted, 2021; Peñarrubia-Lozano et al., 2021).

Overall, by adopting a reflective and responsive approach, practitioners can create rich outdoor learning environments that support children to explore, question and develop understanding in a way that is engaging, meaningful and developmentally appropriate.

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