

**ECEY5005 Awe and wonder, science, mathematics and the
outdoors**

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Basic Acknowledgement format of AI tool use:

I acknowledge the use of AI Tool throughout this study 8th September to 8th October 2025

I used the prompt(s):

1. Co-pilot, google to find resources
2. Co-pilot to summarise articles
3. Grammarly to check spelling and grammar, along with plagiarism.

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.

Image:1 Photograph of an outdoor space which has opportunities for children to explore through play



Exploring How the Photographed Environment Supports Young Children's Scientific and Mathematical Learning

A group of twelve preschool children, aged four years old, visit Afon Llwyd, which runs through Cwmbran boating lake park. They are accompanied by five childcare practitioners, three of whom are qualified to level three or above, exceeding the National Minimum Standards for adult-to-child ratios in regulated daycare (Welsh Government, 2023). All children are dressed appropriately for the weather with splash suits and wellington boots.

Curiosity begins with the walk from the car park to the stream. Children are given paper bags to collect 'treasure' along the way. This includes conkers, leaves, sticks, wild flowers and pine cones. The children are also provided with recyclable loose parts, clipboards, pencils, and magnifying jars. This initial activity encourages observation and early data collection, which are key skills for both Science and Technology Areas of Learning and Experience (AoLEs) (Welsh Government, 2020) and Mathematics and Numeracy AoLE. (Welsh Government, 2020a).

Discovering Forces on the Slope

Image: 2 Slope down the embankment



(Source: Sullivan, 2025)

Children navigate a small embankment. A practitioner offers a hand to a nervous child, but another child shouts, "It's okay, go on your bum!" The child slides down on their bottom and climbs back up the slope to repeat the action. This peer encouragement reflects confidence building and resilience, which is central to the Health and Well-Being AoLE (Welsh Government, 2020b).

As more children slide down the slope, one child observes, “The slope is smoother”, and fetches water from the river to pour down the slope. Another rolls a conker down the slope and shrieks with delight as their conker bounces off a rock and propels into the air. An observer joins in and slides down a small pebble. This falls to one side and doesn’t reach the bottom of the slope. The children begin experimenting and exploring trajectory schemas, cause and effect, which aligns with progression Step 1, being curious and searching for answers, Science and Technology AoLE (Welsh Government, 2020c) and Schemas (Welsh Government, 2022). A child tries with another larger pebble, rolling it successfully down the slope and bouncing off the rock. The child announces, “It doesn’t fly as high as the conker”. The practitioner prompts, “What else can you find, that can fly high?”. The children look around and gather more ‘treasure’ to roll down the slope. One child rolls down a handful of conkers, several roll to the slide, with just two making it down the slope, bouncing off the rock. He cheers with delight. The practitioner asks, “Wow, why do some things roll faster than others?”. The second child picks up a flat pebble and attempts to roll it down the slope. This doesn’t move. The children look confused. “It’s round”, states one child. “Maybe it’s too heavy?” asks another. A third child suggests fetching more water to “make it more slippery”. The children pour more water down the slope. A child volunteers to slide down the slope on their bottom to help it “make it faster”. The children pick up their objects, taking turns sliding them down the slope again. Some bounce off the rock at the bottom of the slope, and some fall to the slides. The child with the flat pebble has another attempt. A child suggests, “Give it a big push!”. The pebble doesn’t travel very far, getting stuck in the sticky mud. The practitioner encourages “Have another go”. The child feels the pebble in their hand, turning it on its edge and rolling it down the slope, where it hits the rock at the bottom and cracks into two pieces. All children cheer.

This activity supports progression step 2 when communicating the effect of forces on the child and on objects Science and Technology AoLE (Welsh Government, 2020c), in partnership with progression step 1, Mathematics and Numeracy AoLE (Welsh Government, 2020d), particularly with shape, space and measures, along with counting, sorting and categorising objects based on their properties.

Water Play: Floating and Sinking

Another group wades into the shallow stream with a practitioner. A child drops a pebble into the water and observes it making a small splash. He picks up another pebble, "This is a big one!" and drops it into the river. "That makes a big splash". He calls for a friend to join him. They attempt to lift a larger stone together. "This is heavy, it's going to make a big splash". The children struggle to pick up the stone and roll it back into the water. The child shouts "Tiny fish!", which they discover after the large stone is moved.

He calls his friend to go and get a fishing rod. The practitioner asks 'What can you use for a fishing rod?'. The children looked around the bank of the stream and found some sticks. "I've got a big one and a small one for you". The child holds up two sticks and compares them. Another children join them with their sticks. They take them back into the stream. The children role-play fishing, and one child recalls fishing with his gramps. A child swirls their stick, "I'm making soup". One child drops their stick into the water and shouts, "Look, it's floating". Each child, in turn, drops their sticks into the water. They observe some sticks getting stuck next to some raised stones. A child picks up a pebble and drops it onto the stick, sinking the stick. The practitioner asks, "Why do some things float and others sink?". A child replies, "Cause they're heavy". The children attempt to sink the sticks, sometimes missing them. The children look around to see what else they could use to sink the sticks. A child fetches some pinecones and leaves. The children count out five pinecones each and drop them onto the sticks. The practitioner asks, "How many pinecones do you think you need to sink the stick?" The pinecones bounce into the water and float away. One child shouts, "Get some conkers". The children fill up the different-sized cans with conkers. Children observe that some cans have more conkers than the small ones. When bringing them to the water's edge, they tip them out, lining them up. They are predicting who has the most. They back up

Image. 3 Shallow stream

(Source: Sullivan, 2025)

their predictions by counting each line. The children gather a few in their hands and drop them into the water. “Ah, they sink!”

The children develop mathematical thinking, progression stage 1, comparing size and weight during their predictions through exploration (Welsh Government, 2022a). The children also discover the concepts of floating and sinking, weight and volume. The children repurpose the sticks for fishing, linking both Science and Technology and Mathematics and Numeracy AoLEs. (Welsh Government, 2020e).

Exploring Life Cycles and Living Things

Image. 4 Tree roots and large stones



(Source: Sullivan, 2025)

A third group of children are playing near the tree roots, digging in the mud with sticks. They start to explore the exposed tree roots and begin to talk to each other about who lives in the tree. “I think a pigeon”, as the child points up to a branch where a bird is perched. The practitioner asks, “Who else lives in the tree?” One child points out a woodlouse crawling up the tree root. The practitioner responds, “Yes, what do you think that is?”. A child replies, “A woodlouse, we have them in our garden under a rock”.

The practitioner asks, “What else can you find?”. The children fetch the magnifying glasses and start to look for more woodlice. A child discovers an ant carrying a small piece of a leaf. The children stop and watch where the ant. The practitioner asks, “Where do you think the ant is going?” as it disappears behind the tree root. A child replies, “Home for their tea”. Another child asks, “What do they eat for tea?”. A child replied, “Leaves and sugar”. A child moves a small rock, and lots of woodlice and centipedes scurry out. The children move another rock, and other bugs scurry out. The practitioner asks, “Can you find more insects under different rocks?” They roll a rotten tree branch, which falls apart, revealing more woodlice. One child responds, “They eat

trees and mushrooms”, pointing to a mushroom growing out of the side of the tree. The practitioner asks if the children like mushrooms and reminds them that we only eat safe ones, and shows the children the plant identifier app. A child uses a tablet to photograph the mushroom, and the practitioner tells them they can check when they return to the setting.

This discovery enables practitioners to strengthen children's curiosity about the world around them, building on their firsthand knowledge and extending children's learning with life cycles back in the setting through observational drawings, caring for living things, and building habitats, working towards progression step 1 Science and Technology AoLE (Welsh Government, 2020f).

Throughout this experience, children develop holistically with language, literacy and communication AoLE using describing language and retelling stories, supported by the practitioner scaffolding.

It crosses curriculum over into physical and emotional development through gross motor skills such as climbing, lifting and balancing and confidence through discovery linking to Health and Well-Being AoLE.(Welsh Government, 2020g). As well as links to Humanities AoLE (Welsh Government, 2022h), understanding our natural world and ecosystems, and using a plant ID tool responsibly.

Risk-benefit assessment for the outdoor space

● Low (1) – Minimal risk of harm/injury ● Medium (2) – Possible harm/injury ● High (3) – Likely danger of harm/injury

Hazard	Potential Harm	Pre-control Assessment of Risk			Benefits for Children	Who is at risk?	Control Measures Prevention	Final Assessment of Risk
		Level of harm if the hazard occurs	Likelihood of hazard occurring	Assessment of risk				
Transport to/from Afon Llwyd: Age/height car seats are not suitable.	It won't protect the child in the event of a crash.	3	1	1	Encourages safe travel routines, community awareness, and promotes patience and cooperation during transitions.	Children	Parents to give advanced permission on the registration form for outings. Parents are to provide their own car seat.	Low
	Heavy traffic.	1	1	1		Children Adults	The journey is planned, and travel is scheduled for quieter times. Child record forms contain personal information relating to sickness. A first aid kit must be carried in all vehicles.	Low
Invalid insurance.	Won't be able to get the correct care in an emergency. Illegal, risk of prosecution.	3	1	1	Counting and comparing. Shared lived experiences.	Children Adults	Business use is required for any staff member transporting children. Staff to have access to insurance information in the event of a crash. MOT, insurance, and driving licence copy	Low

Drivers under the influence of alcohol, drugs, medication or tiredness.							to be retained in the risk assessment file and checked annually on the expiration anniversary.	
	Impair driving ability, which could cause a crash.	3	1	2		Children Adults	The senior team is responsible for checking staff suitability for work/driving each day. Driving policy is in place, covered in the staff handbook and induction.	Low
Lack of petrol.	Breakdown in an inappropriate place, placing everyone in danger.	2	1	1		Children Adults	Staff to check petrol/diesel levels the day before the trip. Advance subs available.	Low
No mobile phone.	Staff members will not be able to phone for assistance in the event of an emergency.	3	1	1		Children Adults	Staff must have access to a mobile phone if a designated driver.	Low
Mobile phone distractions.	It could cause a crash. Illegal, face prosecution.	3	2	2		Children Adults	Staff must refer to the safe driving policy and refrain from answering the phone unless using a hands-free device. Staff are NOT to use personal	Low

							phones to take photographs.	
Arriving: Parking and crossing the car park.	Parked too close to the other cars, restricting access in/out of the vehicle. Hit by a vehicle, bumping heads on wing mirrors. Fears and running off.	1	3	1	Learn about road and personal safety.	Children	Park in a space next to the grassed area so there is always an unobstructed exit. Avoid busy times and high staff ratios. Staff to supervise children when exiting the car. Staff member to release the child from the vehicle directly to the second staff member on the path. Children are to always hold hands. Staff to remind children about appropriate behaviour when walking to the park. All children wear high viz jackets and emergency wrist bands with contact details on. Road safety activities in the lead-up to the trip. Staff to carry out dynamic risk assessments and act.	Low

Unknown Adults	Abduction	3	1	1	Teaches personal safety.	Children	High staff ratios, supervise children at all times, holding hands, and children made aware of the hazards in advance in an age-appropriate manner. Children to wear high viz jackets and emergency wrist bands with nursery contact details. Staff carry walkie talkies for emergencies. Lost child policy.	Low
In the grounds: Wandering off.	Getting lost from the group	3	2	2	Develops sense of belonging, part of a group.	Children	A high adult to child ratio, children wear high-visibility jackets and emergency wristbands. Regular head count. Staff to be allocated a small number of children each. Staff to carry walkie talkies. Lost child policy.	Medium
Boating lake and river.	Geese bites, drowning, getting cold/wet	3	2	2	Environmental awareness and respect for all living things.	Children	High adult ratio for supervision. Children are reminded about the dangers of water in an age-appropriate manner. Discourage	Medium

Animals lead.					Encourages curiosity. Promotes gross physical development. Learn about the eco system and recycling. Lifecycles and habitats.		the children from approaching the geese. Minimum 2 adult first aiders. Staff to carry walkie-talkies, leader to carry a nursery phone/tablet. Children are taught about water safety in the lead up to the trip. All children to carry spare clothes. Staff to have flask with warm drinks during colder months.	
	Animal bites, children's fears, causing them to run off	3	2	2	Learn about animal behaviour safety. Lots of opportunities to ask "why?" Promotes personal hygiene regime.	Children	Children's information is checked for fears. Staff are to be aware of dogs off the lead and keep children near. Hold hands with a child who has fears and reassure them. Discourage children from petting animals. Lost child policy. Carry a first aid kit. Nursery software contact details. Paediatric first aider attending. Nearest	Medium

Animal faeces.							hospital: The Grange, Caerleon Rd, Cwmbran, NP44 8YN	
	Cross contamination – eyes, hands, mouth.	3	1	1		Children	Staff are to report hazards to the leader, such as animal faeces, when walking around the grounds. Carry wet wipes, disposable gloves to clean hands, and shoes. Wash hands in the bathrooms. Carry spare soap and blue paper towels in case they are not available.	Low
Bugs	Insect bites, stings.	3	2	1		Children Adults	Staff to carry medication for children with allergies. First aid kit contains insect bite spray. Ingredients are checked against children's records before administering.	Low
	Poisonous if touched or ingested, vomiting, swelling.	3	2	2		Children	Staff should make a visual check upon arrival. Discourage children from touching plants or flowers that are	Low

Uneven ground.	Reaction, itching.						unfamiliar. Supervise children and remind them not to eat any berries. Staff can use Google Lens to identify unknown plants and flowers to check for safety. Children are encouraged to use the magnifying glasses to study them or use the tablet to take photographs. Magnifying glasses to be stored out of direct sun. Staff to seek immediate medical attention if a child eats an unknown plant, flower or berries.	
	Trips, falls, bumps, bruises, cuts	2	2	1		Children Adults	Adults and children are to wear appropriate footwear and spot hazards as they walk/run around. Staff may call out unsafe areas to inform the group to take care. Children will be assisted if	Low

Toilets.							needed when navigating uneven ground. First aid kit.	Low
	Cross-contamination levels of cleanliness, slippery floors, and children getting locked in the toilet cubicles.	2	1	1		Children Adults	Carry a Radar key for the disabled toilets. Conduct a visual check of the toilet before use, and report to the park ranger if it is unclean or lacks facilities. Carry your own soap, paper towels and hand gel.	
Rubbish/ litter.	Falling into the rubbish, grazes, cuts, and bruises.	2	1	1		Children	Pick up any litter and put it in park bins. Antibac gel and spare carrier bag to be available, to take rubbish home.	Low
Seasons: Weather.	Sunburn, dehydration, overheating, cold, wet	3	2	2	Promotes adaptability. Weather awareness and patterns, effect on animals and plants. Sensory experience.	Children Adults	Plan the trip earlier in the day, look for shaded spots to play rather than out in midday sun. Take plenty of rest and water breaks. Dress appropriately for the weather with sun cream, a hat and shoulders covered. Dress in layers,	Low

							including a hat, gloves, wellington boots, and splash suits. Pack spare change of clothes. Staff to carry spare water to refill bottles and a flask of hot chocolate during the winter season -check dairy allergies before. Staff to follow same procedures.	
Natural play opportunities: Rope swings, tree climbing.	Falls, bumps, bruises, broken limbs.	3	2	2	Physical activity, gross and fine motor skills. Spatial awareness and body confidence. Learn about forces and gravity. Builds confidence and resilience.	Children	Children are encouraged to assess their own abilities. Staff will support children to climb low-level branches. Insurance will not be valid for tree climbing above the height of the staff's waist. Parents are reminded to dress children in appropriate clothing and footwear. Staff to carry first aid boxes.	Medium
Slopes/sliding down the banks.	Slips, trips, falls, bumps, bruises, cuts.	2	2	2		Children	Adult supervision, clean up unsafe debris, limit the	Medium

Rolling conkers/pebbles Digging in the tree roots with sticks. Wading in the stream. Jumping and splashing. Throwing stones					Promotes observations and investigative skills.		number of children sliding at once	
	Trips, slips, putting in the mouth, choking.	3	2	2		Children	Supervise closely, explain safe handling, and avoid throwing at others.	Low
	Eye injury, scratches, insect bites	3	2	2	Exploration of materials and properties and imaginative play.	Children	Use blunt sticks, enforce safe distances, handwashing after play	Low
	Slips on rocks, cold water – child cold, wet. Minor bumps. Drowning	3	2	2	Data handling Encourages hypothesis testing.	Children	Adults in water with the children, appropriate footwear, limit depth, spare clothing, and a first aider. Nearest hospital The grange.	Medium
	Drowning Water in eyes, Slipping on rocks	3	2	2	Turn-taking and problem-solving opportunities.	Children	Limit group size in the water, supervise closely, and reinforce rules	Medium
	Stones hitting children, bumps, cuts, bruises	3	2	2	Encourages curiosity, understanding nature. Sensory play, confidence in the water.	Children	Clear rules: only throw into the water, never at people, and supervise the area.	Medium

					Bonding and team building. Cause and effect discoveries. Develop risk-taking. Promotes mathematical language.			
Snacks	Allergies. Anaphylaxis. Hand hygiene.	3	1	2	Personal hygiene practice. Social interactions.	Children Adults	Wash your hands with soap and water before eating. Remind children only to eat their own snack, no sharing of food/drink. Parents are reminded about the healthy snack requirement, and the setting is nut-free. Staff allergy and dietary requirement checks.	Medium
Additional learning needs. Out of routine, familiarity. Not	Not familiar surroundings that could cause distress.	2	2	1	Inclusive participation is key to supporting	Children	1:1 supervision. Speak to parents in advance of the trip to discuss suitability and	Low

following the expectations.	Child running off.				experiencing success. Emotional regulation and confidence. Builds trust and communication opportunities. Sensory play.		address any concerns or triggers that may upset the child. Agree on a plan. Put a storyboard together for the setting and parents to share with the child in advance of the trip. Parents may wish to visit the site beforehand. The child will travel in the leader's car. Plan to return to the setting if distressed or overstimulated. A high staff ratio is required for the remaining children to continue with the outing.	
Children's behaviour.	Children are not listening to staff instructions, putting themselves at risk of harm.	2	2	2	Learn about expectations and rules to keep themselves safe.	Children	Remind children of the rules and expectations, emphasising the importance of listening to and following instructions. Speak to any children who are not following these expectations.	Low

Unpredictable harm.	Unpredictable hazards.	1	1	1	Having staff who are risk aware to keep them safe.	Children Adults	Staff have completed training to conduct dynamic risk assessments during visits and to respond to and mitigate unknown risks. This risk assessment will be updated upon return.	Low
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Completed by : Natasha Sullivan

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Evaluating How Adults Support and Encourage Children's Engagement with Mathematical and Scientific Concepts in an Outdoor Environment.

Introduction

Outdoor environments are widely recognised as being able to offer rich opportunities for young children to explore, learn and experiment directly with the natural world (Adams and Short, 2025; Kelly *et al.*, 2022). Within the early years, mathematical and scientific concepts often emerge spontaneously as children manipulate materials, make comparisons and test out their own ideas according to Piaget and Montessori.

Moreover, the Welsh Government (2024) states that adults play a pivotal role in shaping children's learning experiences by acting as enabling adults through intentional planning, responsive interactions and creating engaging learning environments.

Adults can enrich learning opportunities by providing resources, scaffolding language, and role-modelling curiosity. However, they may also constrain learning through overcontrol, limited subject knowledge, or restrictive attitudes toward risk. (Gunn and Hedges, 2023; Cooke and Francisco, 2021).

This essay examines how adults in early years settings support and encourage children's understanding of mathematical and scientific concepts in outdoor environments. Drawing on sociocultural and ecological theories, including Vygotsky's (1978) concept of scaffolding, Gibson's (1979) affordance theory and Nicholson's (1971) loose parts theory. Alongside research and policy guidance from the Curriculum for Wales.

Theorists' Perspective on Adult Roles in Outdoor learning.

Vygotsky's sociocultural theory emphasises that learning occurs on a social level and then at the individual level. Adults support this process through language, introducing new vocabulary and asking questions that prompt responses and reflection.

Scaffolding enables children to progress from what they can do independently to build skills with support from the adult. Adults pose questions like "What will happen if we pour the water faster?" or "What can you use for fishing rods?". Asking open-

ended questions promotes problem-solving, predicting outcomes, and cause-and-effect reasoning, aligning with the foundations of scientific curiosity and mathematical reasoning (Siraj-Blatchford, 2009).

Gibson (1979) proposed that environments offer affordances. An outdoor environment that affords climbing, balancing, rolling, dropping, digging, and observing each affords mathematical and scientific opportunities. Adults play a key role in recognising and enhancing these affordances by providing resources, removing unnecessary barriers, and ensuring the environment remains both challenging and safe (Waller *et al.*, 2017). Through this lens, the adult is not merely a supervisor but an active enabler of learning opportunities.

Nicholson (1971) argues that children who are provided with loose parts, open-ended resources that can be moulded, combined, and transformed, will use their imagination and engage in experimental play. Objects such as sticks, stones, fabric, and recycled materials provide opportunities to count, measure, compare, construct, and test predictions. Research continues to support this view. (Canyaka *et al.*, 2024; Nasution *et al.*, 2024) agree that loose parts encourage cognitive, social, emotional, and physical development by promoting problem-solving and creativity. Trina *et al.*, (2024) recognise the need for children to learn through hands-on experiences.

The Role of Adults Supporting Mathematical and Scientific Learning Outdoors

Adults in early years settings fulfil multiple interconnecting roles, as observers, facilitators, co-learners and environment designers. Each role can enhance children's engagement with mathematical and scientific ideas (Rose and Rogers 2012). Recognising patterns of play, or schemas (Athey, 2007), such as trajectory, enables the adult to connect children's natural actions to concepts like force, speed and spatial reasoning. Responsive planning of materials and provocations builds on these interests, respecting children's autonomy while introducing mathematical and scientific language naturally through play, consistent with the Curriculum for Wales, which emphasises the practitioner noticing and responding to children's developmental needs.

However, Stylianidou *et al.* (2018) agree with Vygotsky's model of child–adult collaboration, emphasising that adult involvement should be to scaffold the child's needs, asking questions and collaborating rather than taking over to impose a

curriculum. Effective practitioners use open-ended questions to promote curiosity. “How could you make it go faster?” “What would happen if we used a big pebble?” “Which stick is the longest?” Such prompts transform everyday play into opportunities to practice prediction and problem-solving skills. When adults model curiosity and thinking aloud, including metacognitive talk, this helps children verbalise their thought processes. For example: “I wonder why that one rolled in a straight line?” or “Maybe if the slope was smoother?” These reflective statements help construct deeper understanding more effectively than rote instruction, Mushi (2024) and aligns with the Curriculum for Wales stance on partnership and learner agency.

However, some adults may unintentionally misinterpret the presence of mathematical and scientific thinking in children’s play. For example, mathematics is often narrowly viewed as formal counting or number recognition, and science as structured experiments with clear outcomes. This limits the adult’s ability to recognise the rich conceptual learning already taking place when children sort by size, measure sticks by length or question why a conker sinks. As Gifford (2014) and Johnston (2012) note, failure to see the informal and embedded nature of mathematical and scientific exploration in everyday play can lead to missed opportunities for support and scaffolding. Adults require both subject knowledge and training in observation to recognise and extend this embedded learning.

Inclusivity is central to the adult’s role, ensuring the environment is adapted for accessibility, alternative clothing is available, and allowing all children to participate regardless of physical or sensory needs, Hollyhock, J. (no date).

Observations allow adults to identify emerging mathematical and scientific concepts by noticing how and what children play with, such as comparing the sizes of stones, measuring the length of their sticks, or investigating what floats. They can then plan timely interventions to extend the child’s learning as a method of scaffolding (Wood, 2010).

Adults’ enthusiasm for the outdoors has a strong influence on children’s engagement. Practitioners who express curiosity, enjoyment, and confidence foster similar dispositions in children they interact with (Tovey, 2021). Conversely, adults who are uncomfortable outside, dislike cold weather, or fear mess tend to limit their

outdoor exploration. Tinney (2023) highlights that, despite the Welsh Government's curriculum for Wales having a strong focus on outdoor learning, barriers remain based on adults' lack of confidence and safety concerns. Aarts *et al.*, (2010) agree that adults do influence outdoor play through their own comfort levels, availability and encouragement and that adults can restrict due to their own fears or time constraints. Therefore, professional reflection and continuing development are essential to ensure practitioners model positive engagement with the natural world.

Despite the clear benefits, adults may also unintentionally limit children's outdoor mathematical and scientific opportunities through their own beliefs, constraints, or lack of confidence. Some individuals feel unprepared to discuss concepts such as forces, measurement, or life cycles, fearing they might provide incorrect information or be unable to answer more in-depth questions. Research indicates that adult confidence in subject knowledge is correlated with children's engagement and achievement. (Sylva *et al.*, 2010). The Welsh Government (2022) stresses that practitioners must understand the Science and Technology and Mathematics and Numeracy Areas of Learning and Experience (AoLEs) to provide meaningful support, and despite claiming to have invested over £1 million at both learner and practitioner levels in 2022 to 2023, practitioner confidence is still low in these areas. Costa *et al.*, (2023) found that attitudes towards rating literacy and life skills are more important than mathematics, regardless of investment. However, adults who see the outdoors as a dynamic learning environment integrate mathematics and science seamlessly into everyday experiences, from counting conkers to predicting weather patterns (Girolami, 2024).

High ratios, especially when working with minimum regulated adult-to-child ratios, where staff often become supervisors, can limit their interaction due to the size of the group, documentation demands, and rigid timetables, thereby reducing opportunities for extended outdoor exploration. Inquiry-based processes require time. When adults rush, limit time, or prioritise task completion as a tick-box exercise, children's investigation process may be interrupted. Reflective practitioners plan flexible, open-ended routines and use observations rather than task-driven measures to allow exploration (Waite, 2017).

Adults who fear accidents can restrict risk-taking and experimentation. Over-cautiousness limits opportunities for children to predict, explore materials, test predictions and build an understanding through trial and error. While safety is non-negotiable, adults are responsible for ensuring they complete a risk-benefit analysis to support adults in judging when a risk is developmentally beneficial for the child. Waller *et al.* (2017) argue that learning how to manage minor risk is itself a scientific process of hypothesis testing and evaluation. The Health and Safety Executive (no date) has a balanced approach to accidents and the fear of litigation, which has been blown out of proportion. The United Nations Committee on the Rights of the Child (UNCRC) Article 31 recognises the benefits of risk and challenge as a necessary component that is integral to play. (Chwarae Cymru, 2013)

Conclusion

Adults have a profound influence on how young children engage outdoors with mathematical and scientific concepts. When practitioners act as sensitive observers, skilled questioners and co-learners, they holistically transform natural curiosity into structured inquiry. Theories from Vygotsky, Gibson and Nicholson highlight how social interaction, the environment and affordances, along with open-ended materials, foster conceptual growth. Research consistently supports that adult scaffolding, metacognitive dialogue, and well-designed environments enhance mathematical and scientific understanding.

However, barriers persist. Limited subject knowledge, time pressures, risk aversion and negative attitudes can curtail children's opportunities. To overcome these challenges, adults require confidence, reflective training, and support from the government and the workplace. Ultimately, outdoor learning flourishes when practitioners view themselves not as controllers of knowledge but as partners in discovery, creating spaces where every puddle, pebble and gust of wind becomes a catalyst for mathematical and scientific exploration.

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