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Module: ECEY5005 Awe and Wonder: mathematics, science and the outdoors	
Word Count: Part 2: 1378 Part 3: 2428 Part 4: <u>1978</u>	

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ECEY5005

**Awe and
Wonder -
Science,
mathematics
and the
outdoors**

**The
photograph**

**(Source:
Homestead, 2025).**



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Module:ECEY5005

Our learning Journey - Exploring the mud pit

Some of the children were drawn to the mud pit, where they quickly noticed that the overnight rain had transformed the soil. The previous day, the dry earth had crumbled through their fingers and resembled sand when manipulated. Today, however, the properties of the material had changed.

M and O explored the mud using their hands, noticing differences in both texture and smell. O looked at his hands and observed, 'Ooh, it's stuck on my hands!' as he squeezed and moulded the wetter mud into different shapes. The practitioner encouraged the children to reflect on their observations, asking, 'Does this mud feel the same today?' T responded, 'No, it's squishy,' while M added, 'It's wet.'

The children continued to investigate the mud by digging, squeezing, pouring and shaping it. T smiled and exclaimed, 'Big mud hill!' as she added more mud to the top of a growing mound. The practitioner responded, 'It is getting bigger. I wonder how high you can make it?'. As T continued patting the mound, she noticed it change shape and announced, 'Flat now!' The practitioner replied, 'You've squashed it down with your hands. What do you think will happen if we add more mud?'.

T collected another handful of mud and placed it on top. The practitioner commented, 'You are adding more mud. Is your mound bigger or smaller now?'.

Listening carefully to the sounds around her, T laughed and said, 'Squish, squish!' The practitioner extended her thinking by saying, 'The mud makes a squishy sound because it is wet. I wonder what it would sound like with our feet?'.

T took off her shoes and socks and pressed her footprint into the mound. She noticed the mark left behind. Pointing excitedly, she exclaimed, 'My foot!' The practitioner responded, 'You've made a footprint. Can you see its shape?'.

(Source: Canva
stock image, 2026)



(Source: James,
2026)

Word count: 1378



As the mud began to spread and change shape, the practitioner encouraged further scientific exploration, commenting, 'The mud is changing shape when you push it. You're using force with your hands and feet to move it'.

The mud pit also provided rich mathematical opportunities. The children compared the depth of holes they had created and noticed that some held more water than others. As they filled and emptied buckets, they began exploring ideas linked to capacity and quantity.

The practitioner asked, 'Which bucket has more water inside?' M confidently responded, 'The big one.'

The adult then asked, 'Can all the water from the little bucket fit into the big bucket?' O replied, 'Yes, look,' as he poured the water between containers.

Through their exploration of the mud, the children investigated early scientific understanding of materials and cause-and-effect relationships. Simultaneously, they engaged with mathematical concepts including quantity, capacity, depth and comparative measurement. Through sustained shared thinking, practitioners encouraged observation, prediction, problem-solving and the testing of ideas. This learning reflects the CFNMS (2022) areas of exploration, communication and wellbeing, supporting children's curiosity, enquiry and sense making, whilst also aligning with the ECPLC (2024) strands of exploration and play, communication and physical development, which emphasises active learning, interaction and experiential development through meaningful experiences.

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Our learning Journey - Playing in the stream



(Source: James, 2017)

While exploring freely a small group of the children decided to play beside the stream, there had been rain overnight and the water was moving faster than it had for a while. This group of children have developed a connection with their environment and enjoy revisiting experiences in natural spaces.

A exclaimed 'oooh look it's the water, its bubbly and moving fast'. The children marvelled at the discovery that the water looked and behaved differently since the last time they were here.

M responded 'Wow! Splashy water!'. The practitioner responded 'Yes that's right, I can hear the water splashing. What can you hear?' M responded, 'splashy splashing'.

A and M began collecting natural items from the ground to throw in from the side. A repeatedly dropped leaves, sticks and small stones into the water with M watching with interest and then copying. They watched carefully noticing what happened to the objects, the practitioner asked, 'I wonder how the leaf is moving'. The children became visibly excited when the leaves floated away down stream. When a large stick moved quickly along the water the children shrieked with excitement, when a pebble dropped to the stream bed, M began making simple observations about how the different materials behaved. 'Oh, it's not floating, it fell down'. The practitioner responded, 'it sank'.

At two years old, the children are not expected to understand scientific concepts such as density or water resistance. However, they are beginning to develop the foundations of scientific thinking by observing, predicting, questioning and noticing patterns. By repeatedly throwing the stones, leaves and sticks into the shallow stream they test different materials, learning that objects have different properties and that these properties influence how they behave in the water.

Mathematical learning also emerged naturally. S and T compared the size of sticks, describing some as 'big' and others as 'little'. They noticed that the larger sticks and leaves travelled further along the stream and they followed them with interest becoming excited when they gained speed shouting 'it's moving fast'.

The practitioner asked, 'what do you think will happen when we throw the big leaf in the water?' T responded, 'it goes fast' S responded, 'the small one doesn't go fast, it stops'.

Through these experiences they are developing concepts of size, comparison, position and movement supporting the Exploration Pathway within the Curriculum for Non Maintained Nursery Settings (2022) by encouraging the child to investigate materials and natural phenomena through first hand experiences. They also link closely to the ECPLC (2024) Pathway of Exploration and Discovery, where children develop curiosity, use their senses to investigate their environment and begin making connections between cause and effect.



(Source: Canva stock image, 2026)

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Our learning Journey - Exploring large loose parts

The children were eager to explore the large loose parts construction that had been left by the 4-year-olds play earlier in the day.

T selected a large wooden log and carefully rolled it across the ground. Smiling, she exclaimed, 'Big log!' The Practitioner responded, 'It is a big log. I wonder if it is bigger or smaller than the tyre?'. T rolled the log over to the tyres, 'Its smaller', 'yes, it is, the tyre is the biggest' remarked the practitioner.

M attempted to stack a crate on top of another crate and proudly said, 'It's getting high!'. The practitioner replied, 'You've made your tower taller. How many crates do you think you can stack before it falls?'

As M added another crate, the structure became unsteady and toppled over. She laughed and shouted, 'Oh no, it fell down!' The practitioner responded, 'I wonder why it fell? What could we do to make it stronger?'

T moved several tyres into a line and announced, 'Train, choo choo!' The practitioner extended her thinking by asking, 'Wow, how many tyres have you used to make your train? Shall we count them together?'

T responded, 'one, two, three, four'. P noticed that a crate would also make a good seat, 'one more' he exclaimed as he added the crate to the line. 'And another one' T responded as he struggled to roll the log to add it to the end. T noticed that P was struggling and helped to move the log into position. The practitioner said, 'You worked together to move the log. Teamwork helped you move something heavy, well done!'. 'It was heavy' huffed P dramatically, dusting his hands off on his trousers.

(Source: Homestead, 2025)



(Source: James, 2026)

Through their exploration of large loose parts, the children demonstrated curiosity and emerging problem solving skills as they investigated mathematical concepts including size, weight, height, quantity, balance and stability. Practitioner interactions enriched the experience through sustained shared thinking, introducing mathematical language and encouraging counting, comparison and measurement, whilst supporting scientific enquiry as children predicted outcomes, tested ideas and explored cause and effect. Through rolling, stacking, balancing and constructing, the children developed an understanding of forces, movement and stability. This child-led experience supported the CFNMS (2022) areas of exploration, communication and wellbeing by enabling children to investigate, experiment, share ideas and develop confidence through first-hand experiences. It also reflected the ECPLC (2024) strands of exploration and play, communication and physical development, as children used their curiosity, language and physical skills to explore mathematical relationships and scientific concepts through active play.

Site Risk / Benefit Assessment

Site name and Location	Twinkle Tots Garnlydan Flying Start Hub School Way Garnlydan Ebbw Vale Nearest Post Code: NP23 5ER	
Site location mobile phone number	074900884345	
Grid Reference for Air Ambulance: What 3 Words	Unhappily/prude/apples	
Age group of children attending	2-4 years	
Number of children to adult ratio	A ratio of 1 adult to 3 children will be maintained when using the site Additional staff who do not routinely work in ratio will support the sessions to ensure there are appropriate number of adults.	
Any required adaption to site or activities?	Consideration for child D who will be using her walking frame	
Responsible Staff allocated	Laura James Rebecca Williams Sarah Evans Ryan Morgan	Support staff Demi Lewis Georgia Owens Elis Rees
Person/s on site responsible for First Aid	Laura James Rebecca Williams Certificate: Paediatric First Aid / Allergy response certificate: Date of cert: 28/10/2025 LJ / Date of cert: 11/08/2025 RW	

Session control measures Staff sign box to acknowledge all measures have been actioned prior to session	• Setting mobile phone charged and present • Child and staff emergency contacts available • Stocked first aid kit available • Grab bag – Gloves/ wipes/ paper towels/ nappy sacks/ black bag/ Set of spare clothes / bottled water • Fire / Burns kit present when fire pit and kelly kettle is in use • Emergency allergy medication present • Travel sinks filled with warm water and soap	Responsible Staff Signature
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The natural site

The site provides children with opportunities to develop physical competence, resilience, independence, confidence, communication skills, problem-solving abilities and a connection with the natural environment. Through carefully managed risk-taking, children learn to assess hazards, make decisions, build self-esteem and develop an understanding of personal safety whilst engaging in meaningful outdoor play and exploration.

A daily dynamic risk assessment will be completed before each session to sit alongside this risk benefit assessment. Staff will inspect the site for hazards and any identified will be considered, removed, controlled or the area taken out of use before children access the site.

The Hazard	Who could be harmed	How could they be harmed?	Level of Risk with no control measures in place	Benefit	Control	Who will carry out the control measure and when?	Level of Risk with measures in place
Uneven ground, grass, pathways and natural terrain	Staff Children Visitors Children using wheelchairs, walking frames or mobility aids	Trips, slips, falls resulting in minor cuts, bruises or sprains, Tips in wheelchairs and on walking frames, becoming stuck, difficulty accessing activities	Medium	Develops balance, coordination, confidence and physical skills through exploration of natural environments, Enables inclusive participation, independence and access to outdoor experiences for all children	• Daily site check. • Children encouraged to walk carefully. • Appropriate footwear worn. • Staff positioned throughout site and supervise higher-risk areas. • Site assessed for accessibility before use. • Identified accessible routes used where possible. • Additional adult support provided. • Staff remain close by when navigating uneven surfaces. • Individual risk assessments completed where required. • Activities adapted to ensure full participation.	All staff prior to each session and throughout activities.	Low

Logs, stumps, low platforms and natural play structures	Staff Children Visitors	Falls, bumps, splinters, trapped fingers	Medium	Builds physical confidence, risk assessment skills, climbing ability and resilience	- Structures checked before use. - Children supported to climb safely according to individual ability. - Splinter checks completed.	All staff prior to each session and throughout activities.	Low
Trees, shrubs and planted vegetation	Children Staff Visitors	Scratches, stings, ingestion of unsuitable plants, eye injuries from branches	Medium	Encourages curiosity about nature, biodiversity and environmental awareness	- Regular inspection of planting areas. - Staff educated on identifying hazardous plants - Hazardous plants removed. - Children taught not to put plants in mouths. - Close supervision in wooded and planted areas.	Staff at site inspection and throughout session.	Low
Mud and wet grass	Children Staff Visitors	Slips, trips, Infection, Exposure to harmful Microorganisms and bacteria- could contain parasites, Injury from Sharp objects like glass, rocks, or debris that might be hidden in the mud	Medium	Opportunities for sensory play and exploration, boosts immune system, fosters a love of nature, supports emotional wellbeing	- Suitable outdoor clothing requested. - Activities adapted or moved under shelter when necessary. - Children and staff with open wounds on hands will be given gardening gloves to wear during mud play - Children educated on not putting hands in mouth - Hand wash facilities on site - Mud is checked before session	Session leader supported by all staff before activities begin.	Low
Falling branches and deadwood	Head injuries or cuts	Head injuries and cuts	Medium	Allows access to a natural woodland environment	- Regular tree inspections. - Hazardous branches removed. - Areas closed during severe weather.	All staff continuously before and throughout session.	Low

Open outdoor environment and large site area	Children	Child becoming separated from group Child lost from sight of adults	High	Allows freedom of movement, independence and wider exploration opportunities, fosters a love of being outdoors, develops holistic wellbeing	• Head counts conducted regularly. • Clear boundaries identified with children. • High staff-to-child ratio maintained. • Staff positioned at key points around the site. • Children allocated to staff through a keyworker system	All staff continuously throughout session.	Low
Natural materials including sticks, stones, leaves, acorns, pinecones, seeds and loose parts	Children, particularly under 3s	Injuries from throwing objects, impalement, cuts or bumps, choking, ingestion, splinters	Medium	Supports imaginative play, creativity, problem solving and investigation skills	• Children reminded of safe use. • Staff intervene where behaviour presents a risk. • Resources checked for suitability. • Staff regularly scan play areas and remove unsuitable items.	All staff during activities.	Low
Insects, bees, wasps and other wildlife	Children Staff Visitors	Stings, bites, allergic reactions	Medium	Encourages understanding and appreciation of the natural environment	• Check for nests before sessions. • Staff aware of allergies and emergency procedures. • Children taught to observe wildlife appropriately.	All staff throughout session.	Low
Allergies (plants, pollen, insect stings, food allergens)	Children Staff Visitors	Allergic reaction ranging from mild irritation to anaphylaxis	High	Exposure to nature supports environmental awareness and sensory experiences	• Allergy information obtained before attendance. • Care plans and medication (EpiPens, inhalers) available on site. • Staff aware of allergies. • Avoid known allergen areas where possible.	All staff before and during every session	Low

					• Emergency procedures shared with staff.		
Standing water, water trays, puddles, ponds, streams or water features	Children	Slips, falls, drowning risk, ingestion of contaminated water	High	Supports scientific enquiry, sensory play and understanding of nature	• Constant supervision around water. • Children never left unattended. • Water sources checked before sessions. • Clear boundaries around any deep water. • Water activities risk assessed separately.	All staff during every session	Low
Extreme / Adverse weather (sun, heat, cold, heavy rain, frost, snow, ice)	Children Staff Visitors	Sunburn, Prolonged exposure to sunlight, dehydration, hypothermia, slips or reduced visibility, Headaches, fatigue, illness	Low	Supports learning about seasons and weather conditions and encourages independence through self-care routines	• Weather forecast checked daily. • Activities adapted according to conditions. • Shelter available. • Sun cream applied by parents/carers where required. • Always have drinking water accessible and available. • Sessions shortened or cancelled during extreme weather. • Regular water breaks encouraged. • Staff monitor fluid intake during warm weather. • Children wear hats and appropriate clothing.	All staff during every session Parents to supply appropriate clothing and suncream	Low

					Parents asked to apply sun cream before attendance with staff reapplying where consent allows.		
High winds	Children Staff Visitors	Falling branches, unstable shelter structures, flying debris	High	Provides opportunities to observe weather safely	- Site inspection before use. - Shelter structures checked. - Woodland areas avoided during severe winds. - Session cancelled if site becomes unsafe.	Setting leader before session	Low
Bird droppings and animal faeces	Children Staff Visitors	Illness through contact with bacteria or parasites	Medium	Learning about wildlife and habitats	- Site checked before sessions. - Any contaminated areas cordoned off or removed safely. - Strict handwashing procedures followed. - All eating areas checked before use	All staff before session	Low
Poisonous berries, fungi or plants	Children	Illness if touched or ingested	High	Opportunities for learning about plant identification and safety	- Regular site inspections. - Hazardous species removed where possible. - Children closely supervised and taught not to eat anything found outdoors.	Staff before and during sessions	Low
Brambles, thorns and sharp vegetation	Children Staff Visitors	Scratches, cuts and eye injuries	Medium	Supports understanding of natural environments	- Hazardous growth managed regularly. - Children encouraged to move carefully. - Staff supervise exploration.	Staff during routine site management maintenance	Low
Contact with wildlife (birds,	Children Staff Visitors	Bites, scratches or disease transmission	Medium	Encourages respect for	- Observe wildlife without handling - Handwashing after activities.	All staff throughout session	Low

insects, small mammals)				wildlife and biodiversity	Staff monitor interactions.		
Exposure to ticks	Children Staff Visitors	Tick bites and potential transmission of disease	Medium	Access to woodland and long grass areas enhances exploration	- Long trousers recommended where appropriate. - Tick checks carried out following sessions. - Parents informed of procedure.	Staff and parents after sessions	Low
Animal remains, bones, feathers or nests found on site	Children Staff Visitors	Infection, cuts, emotional distress, inappropriate handling	Medium	Provides supervised learning opportunities about the natural world	- Children instructed not to touch found animal remains. - Staff assess and safely remove items where required. - Educational discussions take place only under direct supervision.	Staff when identified	Low
People / Actions and Resources							
The Hazard	Who could be harmed	How could they be harmed?	Level of Risk with no control measures in place	Benefit	Control	Who will carry out the control measure and when?	Level of Risk with measures in place
Nappy changing and toileting on site	Children Staff Visitors	Infection spread and cross-contamination	Medium	Enables children to remain comfortable and participate fully in activities	- Portable toilet/ potty tent available on site - Portable sink available with soap and hand towels - Gloves and changing supplies available. - Waste taken back to setting and disposed of appropriately. - Hands washed after all personal care tasks.	Designated staff as required	Low

					• Privacy protected		
Developmentally inappropriate risks for younger children	Children under 3	Falls, choking, ingestion of natural materials, inability to recognise hazards	High	Supports sensory exploration, language development and physical development	• Increased supervision maintained. • Age-appropriate activities planned. • Small objects removed where possible. • Higher-risk areas monitored closely. • Children always remain within sight and hearing of staff. • Individual developmental needs considered during activities.	All staff continuously	Low
Lost child	Children	Separation from the group causing distress and potential harm	High	Supports independence and exploration in a managed environment	• Regular head counts. • Defined boundaries. • High staff ratio maintained. • Emergency lost child procedure followed.	All staff continuously	Low
Delayed emergency response	Children Staff Visitors	Increased severity of injury or illness	High	Enables use of remote outdoor environments	• Staff carry mobile phones. • Emergency contact details readily available. • Staff aware of site's What3Words location and emergency procedures. • First aiders always present.	Session leader and first aiders	Low
Site access and unauthorised visitors	Children Staff Visitors	Child leaving site or contact with unknown adults, Safeguarding risk, distress, potential abduction or	High	Open site allows children to explore larger spaces safely	• Clear site boundaries identified and explained to children and staff. • Appropriate site security in place	Designated safeguarding lead and all staff during session	Low

		inappropriate contact			• Visitors challenged politely and identification requested where appropriate • Staff positioned at access points. • Visitor procedures followed. • Regular headcounts undertaken. • Children gathered immediately if an unknown person enters the area using emergency safe word. • Staff follow safeguarding procedures and contact emergency services if required. • Mobile phones available.		
Loose clothing, drawstrings or scarves catching on equipment	Children Staff Visitors	Entrapment or strangulation risk	High	Allows comfortable outdoor participation	• Staff visually check clothing at start of session. • Remove hazards where possible. • Children supervised when climbing or exploring.	Staff on arrival and throughout session	Low
Manual tools used for gardening or site maintenance	Children Staff	Cuts, puncture wounds, trapped fingers	High	Supports responsibility, fine motor skills and practical learning	• Children only access age-appropriate tools. • Adult supervision always. • Tools counted before and after use and stored securely.	Responsible staff with tool training during activity	Low
Infection and poor hygiene outdoors	Children Staff Visitors	Spread of illness through soil,	Medium	Children experience	• Handwashing facilities or sanitiser available. • Gloves used where required.	All staff throughout session	Low

		animal contact or bodily fluids		outdoor learning safely	• First aid procedures followed. • Contaminated waste disposed of appropriately.		
Manual handling of resources and equipment	Children Staff Visitors	Musculoskeletal injury, trapped fingers	Medium	Encourages responsibility and teamwork	• Use correct lifting techniques. • Staff move heavy equipment. • Children assisted with suitable resources only.	Staff when setting up and clearing away.	Low
Shelter structures, ropes and tent support	Children Staff Visitors	Collision with poles, tripping on ropes, instability during severe weather	Medium	Provides outdoor learning space and protection from sun/rain	• Daily inspection of structures to check for stability or issues • Ensure guy ropes are visible. • Cease use during high winds or unsafe weather conditions.	Staff before use and during changing weather conditions.	Low
Fire circle or campfire area (if used on site)	Children Staff Visitors	Burns, smoke inhalation, contact with hot materials	High	Supports learning about fire safety, cooking, teamwork and outdoor skills	• Separate fire risk assessment. • Strict supervision. • Defined safety boundary. • Fire safety equipment available. • Staff responsible have fire pit safety training	Designated trained staff only	Low
Fire pit / Kelly kettle outdoor cooking activities	Children Staff Visitors	Burns, smoke inhalation, fire spread, burns to mouth / hands, scalds, food poisoning	High	Teaches fire safety, teamwork and outdoor cooking skills	• Separate fire risk assessment. • Fire circle established. • Safety boundary maintained. • Water/fire blanket available. • Fire safety equipment available. • Food hygiene training in place • Only trained staff light and manage fires. • Food is stored in appropriate sealed cold box • All allergy and intolerance information is stored	Designated trained staff only	Low

Eating and drinking outdoors	Children Staff Visitors	Cross-contamination, food poisoning, spread of illness, choking	High	Supports social skills, independence, healthy eating and outdoor learning experiences	• Tables and surfaces cleaned before use. • Children seated while eating. • Staff supervise continuously. • Food stored appropriately. • Allergies checked before food is offered. • Waste disposed of safely to avoid attracting insects and animals.	Designated trained staff only	Low
Wild animals, livestock, birds and wildlife (including foxes, rodents, squirrels, rabbits, birds, insects and dogs entering the site)	Children Staff Visitors	Bites, scratches, disease transmission, distress, contamination from urine or faeces, children chasing or approaching animals	Medium	Encourages respect for nature, understanding of habitats, biodiversity and wildlife conservation	• Daily site inspection for evidence of animal activity, faeces, nests, burrows or carcasses. • Children taught to observe wildlife from a distance and not touch, feed or chase animals. • Any animal faeces removed or area cordoned off. • Handwashing completed after outdoor play and before eating. • Staff supervise children closely during wildlife encounters. • Any sick, injured or aggressive animals reported and children moved away immediately. • Parents informed of any bites, scratches or unusual incidents.	All staff before and throughout each session	Low

Part 4: How adults working with early years children support and encourage children engage with mathematical and scientific concepts in an outdoor environment

From an early age, children explore concepts of mathematics and science (Gopnik, Meltzoff and Kuhl, 1999). They naturally notice patterns, compare quantities, explore relationships and solve problems as they learn to make sense of the world (NAEYC and NCTM, 2010). Furthermore, Isaacs (1930) argued that children develop understanding through investigation, experimentation and first-hand experiences. Her observations highlighted children's natural tendency to question, explore and develop theories about the world around them. This is particularly evident within outdoor environments, where children are afforded authentic opportunities to observe change, make comparisons and solve problems using real materials and experiences (Maynard and Waters, 2007).

Historically, outdoor learning has been recognised as an important setting for children's development, particularly through the lens of science and mathematics. It provides opportunities for exploration, investigation and problem-solving through authentic experiences (Dewey, 1938; Bilton, 2010; Maynard and Waters, 2007). This reflects Froebel's (1887) belief that nature is a powerful teacher, offering children opportunities to observe, enquire and make sense of the world around them. Pecaski McLennan (2017) similarly suggests that these experiences can support the development of mathematical and scientific concepts, including measurement, pattern, number, change and enquiry, through meaningful engagement with natural materials and opportunities for awe and wonder. Likewise, Piaget (1952) argued that children actively construct knowledge through exploration and experimentation, developing understanding through direct interaction with their environment. This perspective is reflected in Tinney's (2023) view that natural environments provide rich opportunities for children to learn through exploration, discovery and enquiry, supporting the development of curiosity, problem-solving and higher-order thinking skills.

Enabling adults play a pivotal role in transforming outdoor experiences into meaningful opportunities for mathematical and scientific learning (Welsh Government, 2024). Through observation, responsive interactions and sustained shared thinking, practitioners support children to extend their knowledge, develop higher-order thinking skills and engage more deeply with mathematical and scientific concepts (Welsh Government, 2022). This reflects

Vygotsky's (1978) theory of social constructivism, which suggests that children's learning happens within the Zone of Proximal Development (ZPD), where children can achieve a higher level of understanding with the support of a 'more knowledgeable other.' Building on this, Bruner (1983) suggested that adults scaffold children's learning by providing appropriate support and gradually withdrawing it as their competence develops.

However, role of the enabling adult extends beyond simply supporting learning. Effective practitioners create environments that provoke curiosity, encourage risk-taking and promote enquiry. Rather than directing learning, they observe children's interests, recognise learning potential and respond in ways that deepen thinking (Welsh Government, 2024). This aligns with the ECPLC framework, which identifies enabling adults as a key component of high-quality early years provision. By carefully balancing support and independence, practitioners help children to become confident problem-solvers and independent learners (Welsh Government, 2024).

Within outdoor environments, practitioners can extend children's mathematical and scientific thinking through questioning, discussion and shared problem-solving (Vygotsky, 1978; Bruner, 1983). For example, when children discover slugs after rainfall, an adult might ask, 'Why do you think the slugs came out today?' or 'How could we find out where they live?'. These interactions encourage children to observe, predict, investigate and draw conclusions, supporting the development of scientific enquiry skills. Similarly, when children explore puddles, adults can introduce mathematical concepts such as measurement, capacity and comparison through questions including, 'Which puddle is bigger?' or 'How could we find out which holds more water?'. Through these connections, children move beyond simple exploration to develop increasingly sophisticated mathematical and scientific understanding. Similarly, when children transport water between containers, practitioners can encourage mathematical thinking by asking children to estimate which container will hold the most water, compare quantities and discuss concepts such as full, empty, more and less. Scientific enquiry can be extended through questions such as, 'What happens when we pour the water into a smaller container?' or 'Why do you think the water level changed?'. Through observation and experimentation, children develop an understanding of capacity, volume and conservation while testing their own theories about how water behaves.

As they compare capacity, make predictions and test their ideas, children develop the characteristics of 'ambitious, capable learners who are curious', questioning and able to apply knowledge in different contexts (Welsh Government, 2022). Through investigating solutions, solving problems and evaluating outcomes, they also demonstrate the attributes of 'enterprising, creative contributors' using creativity and critical thinking to make sense of their experiences (Welsh Government, 2022).

This approach aligns closely with sustained shared thinking, identified by Siraj-Blatchford et al. (2002) as a defining characteristic of effective early years practice. Research suggests that children are more likely to develop reasoning, problem solving and enquiry skills when adults engage alongside them, model language and encourage them to explain their thinking rather than simply providing answers (French, 2004). Consequently, whilst outdoor environments naturally provide opportunities for exploration, their educational value is enhanced when practitioners actively extend children's thinking through purposeful interaction.

In addition to extending children's understanding, practitioner interactions can influence children's motivation and attitude towards mathematics and science. Positive encouragement, shared enthusiasm and genuine curiosity help to create a learning culture in which children feel confident to ask questions, test ideas and learn from mistakes. Consequently, adults support not only the development of knowledge and skills, but also the attitudes associated with lifelong learning in STEM related subjects (White, 2014).

This highlights that the educational value of outdoor learning depends largely on the skill of the practitioner. Siraj-Blatchford et al. (2002) argue that sustained shared thinking occurs when adults and children work together in an intellectual way to solve a problem, clarify a concept, evaluate activities or extend a narrative. Within outdoor environments, this may involve adults and children jointly investigating why leaves float on water, discussing how to build a stronger den or exploring why some objects roll further than others. These interactions encourage children to articulate their thinking, consider alternative explanations and engage in deeper reasoning, all of which support mathematical and scientific understanding.

However, some researchers caution against excessive adult intervention (Moyles, 2015; Anning and Edwards, 2006). Child-led approaches influenced by Reggio Emilia highlight the importance of children's agency and capability as learners, recognising that knowledge is developed through exploration, enquiry and collaboration (Edwards, Gandini and Forman, 2012). Similarly, Bruce (2021) argues that children benefit from opportunities to pursue their own interests through self-initiated play. This suggests that practitioners need to make careful professional judgements about when to intervene and when to step back, ensuring that adult support extends children's thinking without reducing opportunities for independent exploration and discovery (Moyles, 2015).

Piaget (1952) also emphasised the importance of independent discovery, yet Vygotsky (1978) argued that children benefit from guidance from 'more knowledgeable others. This suggests that neither unrestricted play nor direct support alone is enough. Effective outdoor pedagogy requires a balance between child led exploration and sensitive, responsive adult support that enables children to construct and deepen their understanding.

Additionally, evidence from Estyn (2024) suggests that practitioners require well developed observational skills to effectively notice, analyse and respond to children's interests, experiences and emerging learning. Developing these skills is an important aspect of professional practice, enabling practitioners to identify teachable moments and extend children's learning through purposeful interactions. Consequently, opportunities for sustained shared thinking and the extension of children's mathematical and scientific ideas may be missed when practitioners lack the confidence, subject knowledge or pedagogical skills required to identify and take advantage of teachable moments, particularly within outdoor and natural environments (Ephgrave, 2018).

The EPPE (Effective Provision of Pre-School Education) study found that high-quality early year's settings show evidence of frequent sustained shared thinking between adults and children, with practitioners combining child-initiated activities with intentional teaching to extend learning (Sylva et al., 2004). This suggests that mathematical and scientific understanding develops most effectively when children are provided with opportunities for independent exploration alongside responsive adult support. Open ended resources and natural materials, such as stones, sticks, mud and water, enable children to investigate ideas, solve problems and test theories through meaningful first-hand experiences (Bruce, 2021).

For instance, children exploring large stones may investigate weight, size and balance by comparing and arranging them in different ways. Adults can extend this learning by introducing mathematical vocabulary such as heavier, lighter, taller and shorter, whilst encouraging scientific thinking through questions including, 'Why do you think this stone stayed balanced?' or 'What might happen if we add another stone on top?'. This suggests that high-quality outdoor learning is not achieved through access to outdoor spaces alone but through practitioners' ability to combine child led exploration with intentional enabling strategies (Welsh Government, 2022).

However, the learning potential of outdoor environments in early years settings is not always fully realised. Contemporary Welsh guidance highlights that high-quality provision depends upon the interaction between enabling adults, engaging experiences and effective environments (Welsh Government, 2024). Similarly, Estyn (2024) emphasises the importance of practitioners being able to notice, analyse and respond to children's interests, while NDNA (2025) argues that effective STEM learning develops when enabling adults nurture children's curiosity and enquiry within authentic contexts. Subsequently the educational value of outdoor experiences is not simply shaped by the environment itself, but also by the ability of practitioners to recognise and extend learning opportunities through purposeful interactions.

Despite the recognised benefits of outdoor learning, several challenges can affect its effectiveness. One significant barrier is practitioner confidence. Research suggests that some adults feel more secure supporting literacy than mathematics or science, which can limit the depth and quality of interactions that promote learning in these areas (Johnston, 2014). For example, practitioners who lack confidence in mathematics may overlook opportunities to introduce concepts such as measurement, capacity or pattern during water play, while limited scientific knowledge may restrict discussions about forces, weather or life cycles. As a result, rich learning opportunities may remain unexplored despite the potential offered by the outdoor environment itself (MacDonald, Danaia, Sikder and Huser, 2021).

Similarly, risk averse cultures may restrict opportunities for exploration and investigation. As scientific investigation often involves experimentation, unpredictability and manageable risk, concerns about safety can reduce opportunities for meaningful experiences with water, natural materials and loose parts especially in the early years. This is particularly significant

in relation to STEM learning, where practitioners may lack confidence in their own mathematical or scientific knowledge. As a result, opportunities to extend children's thinking through meaningful questioning or explanation may be missed. Therefore, professional learning and ongoing development are important in ensuring practitioners can maximise the potential of outdoor environments for children's learning (Johnston, 2014).

Environmental factors, including adverse weather conditions, limited outdoor space and restricted resources, may also influence provision. However, evidence suggests that successful outdoor learning is determined less by the availability of expensive resources or quality spaces and more by practitioners' attitudes, knowledge and pedagogical approaches (Maynard and Waters, 2007; Waite, 2017). Time pressures and curriculum demands can present further challenges. Ultimately, opportunities for learning may be missed when adults focus primarily on supervision rather than observation, interaction and the extension of thinking. Therefore, the quality of adult engagement remains one of the most influential factors in determining whether outdoor experiences lead to meaningful learning (Purdon, 2024).

Conclusion

Outdoor environments provide powerful opportunities for young children to develop mathematical and scientific understanding through exploration, enquiry and play. However, theory and research consistently suggest that these opportunities do not automatically lead to meaningful learning. Rather, the quality of adult interactions is a key factor in determining the depth of children's understanding. Through observation, questioning, scaffolding and sustained shared thinking, practitioners encourage children to investigate, reason, solve problems and test theories within authentic contexts. Whilst barriers such as practitioner confidence, resource limitations and risk-averse cultures can restrict learning opportunities, effective enabling adults are able to recognise and extend teachable moments. Therefore, it is not the outdoor environment alone that supports mathematical and scientific learning; rather, it is the skilled practitioner who acts as the 'golden thread', connecting children's interests, experiences and emerging understanding through purposeful interactions and sustained shared thinking.

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