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ECEY5005_BIRM

Awe and wonder – science, mathematics and the outdoors

Part 1: The Stream



Source: Oates (2024)

Within this module I will discuss some of the affordances of the environment captured in the above image in relation to mathematical and scientific concepts in the early years and the EYFS with a focus on how children could explore the water and the connections children might make. There will be a risk benefit assessment analysis of this same environment, which will demonstrate an understanding of possible benefits, risks and

guidance for the safe exploration and working practice of this outdoor space. Finally, I shall be reflecting on theories linked to outdoor learning, possible barriers and challenges and how practitioners can communicate and interact to the benefit of the children to inspire a sense awe and wonder.

Part 2: Exploring science and mathematical concepts

The cover photograph (Oates, 2024) is a natural environment, a space of constant change and full of an endless supply of mathematical and science experiences, being outside can enable children to make connections between hands, head and heart and build a foundation for lifelong learning (Robertson, 2020). The outdoors can be a place where children are free to be creative, challenge themselves, their thoughts and ideas through the exploration of their curiosities and the wonders of the environment that surrounds them (Johnson and Watts, 2019).

Scenario: The Structure

Based on the cover photograph in Part 1 (Oates, 2024) a small group of nursery children aged 4 years with adult practitioners visit local parkland for a morning. After a debrief about how to keep safe in the environment, including when climbing and exploring the water, the children explore. A few resources are at hand for children, paper cups, nets and magnifying pots/glasses, pencils and paper. However, the children are challenged to explore with environment and use the resources they find to expand their play.

Some children start to climb boulders and trees, while others look at plants, search for bugs. A few children are heard singing 'five little speckled frogs' and pretending to be frogs hopping and eating bugs. Others are making daisy chains and pretending to be princesses.



Source: Creating Green Living (2024)



Source: Shutterstock (2024)

“I want to build a bridge to the island” Saron called out to her friend. “What could we use?” replies Eric. Saron starts to collect rocks and tells Eric that they need some wood for the top of the bridge.

It is not long before the other children of the group become interested in the project and begin to collect rocks from the water edge and gather twigs and fallen branches. One child even suggests that they could mix water from the stream with mud to stick the rocks together and make the bridge stronger like the builders do.



Source: Kids Go Gardening (No Date)



Source: Mama Teaches (2024)

The children talk to one another about which rocks to use and where and how to balance twigs and branches. Another child tells the group to be careful because it is slippery where they are stood.

There is success as the children manage to build a structure that spans to width between to path and the island in the stream ‘We did it, we crossed the river!’, ‘Our bridge is huge’ and ‘Miss, look! Look! We finished our bridge’. Saron observes that the water is moving differently than before and seems deeper where she is stood.



Source: Forest Schooled (2018)

The practitioner asks the children to look carefully at the structure that they have made to see if any of them can work out why the water is getting deeper before giving them the answer. "Its because we are blocking the way with our bridge." Answered one of the children. The practitioner explains that they had constructed a dam and suggests that they revisit the structure after snack time to investigate how they might adapt their creation.

Some time passes and when the children returned to their structure, they notice that the water looks even deeper. The practitioner asked what would happen to the life in the stream if all the water were to dry up. Children gave various answers, "the frogs would move away" to "the fish would die".



Source: Fagley Forest School (2016)



Source: Fagley Forest School (2016)

The group came together again to adapt the construction, they managed to create a small opening under the branches by removing some rocks, a gush of water comes through the opening and twigs and branches fall and float away dismantling the structure.

Although sad at the demise of the bridge, the children commented 'next time our next bridge will be bigger and better!'.



Source: Fagley Forest School (2016)

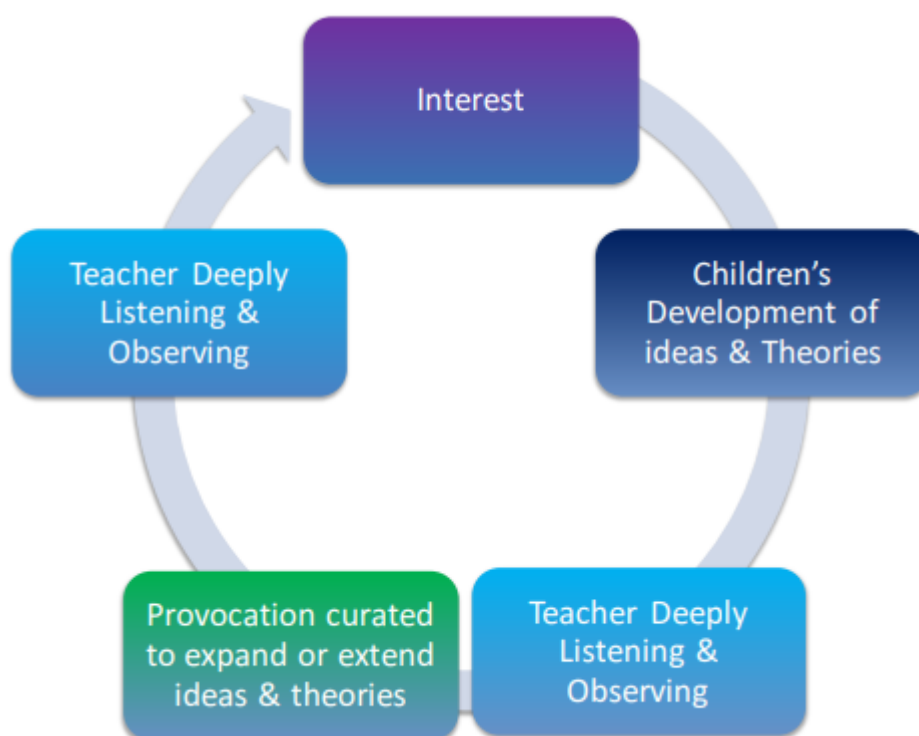
Although this is a scene where children are playing and exploring in an outdoor space freely a practitioner could still link the children's experiences to many different learning and development outcomes. The main thread of this scenario the children were afforded the opportunity to build a large structure across the width of a stream. Giving them the real-life experience of engineering, through trial and error, problem solving and the sharing different ideas the children attempted to construct a bridge. The children are playing and exploring, fully engrossed in the building of the structure and actively learning and they are thinking critically, developing their own ideas, making links and developing strategies, all parts of the characteristics of effective learning.

The hands-on exploration within this scenario is key to 'understanding the world' and for the children to begin to make scientific links, they talk about the similarities, differences and features of the natural materials and environment around them, for example when they are discussing which stones to build with. One child says that they want to make mud, acknowledging that they can change the state of the earth by adding water to it. Saron notices that the force of the water has changed as the bridge is nearing completion. Other children looking for insects and bugs might discover different stages of lifecycles and make connections between these stages linking of both science and mathematical concepts. Further mathematical exploration might be observed, as children use spatial vocabulary when building, 'on, under, up, down' and spatial reasoning as they build layering the stones. The children might also make comparisons of length, weight and size of the stones and branches. Some children may have noticed patterns in the environment, observing the shapes and sizes of pebbles, leaves, fir cones or symmetry in flowers or butterflies and in identifying these patterns they are beginning to identify different mathematical relationships. The children singing number rhymes are using their understanding of cardinality 'how many' and counting and possibly subitising.

We can also see, listening and communication between the group and age-appropriate language, with the children singing about 'speckled' frogs and a child saying the ground is 'slippery', children are using a wide range of vocabulary, and the children are expressing themselves and listening to their friends' ideas. From these back-and-forth interactions we can also observe the personal, social and emotional development of the group being enhanced. The children are looking out for their friends physical and emotional wellbeing and are proud of their achievements and celebrate their friend achievements 'We did it!, we crossed the river'. Child's gross and fine motor skills are being challenged during this activity, as they move large stones, climb trees or mix mud, developing their physical development. Finally, we can see that the children are engaged in expressive arts and design not only are they using and manipulating a whole range of natural materials for their construction, but there are also other children involved in pretend play and singing.

Leading on from these experiences the children may want to take their learning further and explore more about the construction of different types of bridges and dams natural and manmade, once back in the classroom they could use technology and use Google or the BBC or other STEM related web pages to find this information. This might lead to learning about the causes of flooding, the weather or man's impact on ecological systems. A 'Children's People and Nature Survey' stated that over 80% of children wanted to do more to look after the environment and over 70% agreed looking after the environment was important to them (Natural England, 2021) although the survey carried out was with children aged 8 to 15 years. However, the foundations for nature connection can start in the early years.

A child's sense of wonder and intrinsic motivation to explore are attributes for absorbing information and exploration of the natural world and come from schemas and play, for example discovery play similar to schemas discovery play builds upon a child's exciting knowledge through observations and exploration of the natural world according to Atherton and Nutbrown, 2013 and Hamlin and Wisneski, 2012. Children can begin to make scientific and mathematical links to weather changes and seasons, the life cycles of animals and plants, Gino (2019) explains that this is in part because patterns in play have been directly linked to strengthening cognitive structures in the brain and the step-by-step processes in play have also been connected to mathematical and scientific methodology and reasoning (Siraj-Blatchford, 2015).



Source: Haughey and Hill (2017) A possible cycle of provocations.

As early years practitioners it is for us to ignite children's imaginations and realize their ambitions by tapping into this awe and wonder of their environments, whether it be a puddle or stream, a weed in the pavement or meadow. We need to be following the child's interests and providing them with what Haughey and Hill (2017) coined as provocations or resources these provocations also inform our pedagogy and should spark a child's sense of wonder to explore, test and expand their ideas.

Part 3: RISK BENEFIT ASSESSMENT

Location / Activity:	Bradgate Park : Stream exploration – maths and science	Date:	25/06/24
Assessor:	Pandora Oates	Review date:	25/06/25

Hazard = something with the potential to cause harm.
Risk = the likelihood to a hazard causing harm and its associated severity.
‘Concentrate on the significant, ignore the trivial’ (Oxford Council, No Date)

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk after precautions RATING: L/M/H
Free play, children allowed to play around the waters edge and paddle in the stream. (under 20cm depth).	- Emotional wellbeing, being outside and in nature. - Begin to learn how to assess risk linked to physical capabilities when navigating loose rocks, mud and water. - Observe natural environment, make links to previous learning, inspire creativity, problem solving. - Listening, attention and communication skills enhanced when sharing ideas with peers.	- Drowning. - Uneven ground around water and in stream, slippery with sharp rocks, mud or spiky ground topography. (Slips trip/falls, possible cuts/bruising) - Wet persons are more susceptible to cold injury (hypothermia). - Reflection of the sun from water might increase sun exposure. - Insects/waterfowl possible bite or sting.	Staff/students	- Staff will set rules prior to visit and remind students on site of safety/behaviour expectations. - Wellies/all-weather suites. - Sun cream, extra clothing, shade/shelter will be provided where needed to prevent cold and heat injuries. - Supervised activity.	L/M

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk after precautions RATING: L/M/H
Mixing mud	• Fine/ gross motor skills. • Creativity and imagination. • Using the natural world for a purpose. • Messy play. • Teamwork and social skills. Multi-sensory, contact with nature.	• Eating mud • Mud in eye/s • Disease – micro-organisms	Students	• Through washing of hands after exploration. • Reminder - no picky no licky rule also applies to mud. • Wellies/all-weather suites.	L
Collecting/building with branches/twigs and large stones.	• Social wellbeing, Working collaboratively. • physical strength and coordination. • Critical thinking, problem solving • Creativity • Sense of achievement	• Cuts, grazes or bruises • Head/eye injury from twigs/branches. • Thorns, splinters or stings	Staff/Students	• Only natural materials used, no tools. • Model how to lift and carry twigs/branches and stones to keep themselves and peers safe.	L

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk after precautions RATING: L/M/H
Climbing trees and boulders (being off the ground)	- Physical wellbeing, strength, balance, coordination, dexterity, greater awareness of own physical abilities. - Understand perspective – literally – from a different height. - Spatial awareness - Self-confidence, critical thinking, risk negotiation. - Challenging themselves whilst having fun and exercise. - Vestibular and proprioception input. - Resiliency - Learn about tree structure and concept off living and dead wood.	- Slips/falls - head injuries/ strains. - Broken bones	Staff/students	- Only climb trees/boulders staff have chosen as areas to explore. - Students will be encouraged to only climb what they can down-climb from independently. - Students to only climb own height from ground, with the provision of suitable surface – soft ground without protruding objects. - Supervised activity. *Note of current/forecasted weather conditions will be considered and possible effects on site.	L/M
Catching insects or aquatic life, beetles or minnows	- Observe biodiversity of the environment and lifecycles. - Learn about topography - Nature connection through Multi-sensory experience sounds of water, wind, insects, scent of marginal plants, sticky mud. - Hand eye coordination - Balance	- Drowning - Water quality, poisonous plants. - Slips/trips/falls. - Stings/scratches from plants/insects. - Anaphylactic shock	Staff/students/wildlife	- Only use equipment (net/pot/brushes) prevent harm and release all creatures at end of visit. - Wellies/All-weather suits. - Hand washing - Staff will brief students about safety/behaviour expectations around water and identify possible hazardous plants and insects before/during visit. Supervised activity.	L/M

Risk assessed through pre-visit checks, continuous monitoring during visit including emergency procedures (emergency whistle will be blown if there is an emergency and all activities will stop immediately, children will wait future instructions) and plan for differentiation of individual children's needs, correct adult/student ratios will be followed. EPIPEN and any other medications required by students/ staff will be carried by designated first aider along with first aid kit, fully charged mobile phone with paediatric first aider will attend off-site visit.

Ensure site is left as found: model good practice throughout the only using dead wood for constructions and not damage trees, release any insects/minnows and no leave rubbish is to be left behind, staff will remind children of rules and boundaries, highlighting risks of the outdoor environment, **including not interacting with other visiting public or their pets.**

Part 4: The Adult's Role in Outdoor Learning

STEAM opportunities are without limit when explored through outdoor experiences, as children invent, explore and imagine, their curiosity drives their learning to discover more about their surrounding environment according to Solly (2022). Robinson (2020) agrees but adds that the actual magic happens when practitioners recognise the connection between children and their environment, the weather and loose parts, if the practitioner is fully flexible in how children discover, explore and manipulate loose parts, this alone has the potential to engage all children fully. Merrill (2024) affirms that a practitioner's pedagogy should be grounded in joy and confidence that experiences are a journey.

A key theorist associated with the constructivist theory and how practitioners understand outdoor learning takes place is Jean Piaget (1896-1980) he believed that children's play was important to their learning. Piaget inspired work, made connections between children's cognitive development and schematic play, linking their learning to their first-hand experiences (Pound 2014). Chris Athey, in the 1970 proposed that patterns of schema development are learners trying to 'fit' their experiences into schemas. (Athey, 2007).

Simon Nicholson, coined the term 'Loose Parts' he associated materials both manmade and naturel and have the capacity for open-ended possibilities which he called 'variables', similar to schemas 'loose parts' can be explored over and over texting concepts and ideas (Robinson, 2020). Daly and Beloglovsky (2014) ideas of loose parts are based on Eleanor Goldschmid's (1910-2009) work around treasure baskets and heuristic play (Froebel Trust, no date) they suggest that loose parts should be available for children to move, manipulate, control and change purpose as children's ideas develop in play. The term heuristic comes from the Greek word 'heuriskein', meaning 'to discover' a main element of hands-on activity that practitioners can see as children explore loose parts in the outdoor environment (Better start, 2021), Keyte-Hartland (2022) asserts it is easy to see the affordances and flexibility of loose parts in the EYFS to support all areas of learning and development, adding that loose parts might encourage children to explore ideas related to mathematics and science

Vygotsky thought that children learned not only from the values and beliefs of adults but from one another and through personal and social experiences, Vygotsky states that children use language constantly not just verbally but through their facial expressions and mannerisms and have internal dialogues to regulate and guild their learning, Vygotsky believed that language is essential to development and along with social interactions both contribute to the construction and consolidation of a child's knowledge and understanding of the world(Pound, 2014). John Dewey also thought that children learned through social interactions and believed learning by doing so

practitioner's pedagogy should be based on a child's interests, knowledge and experience to support the development of new skills (Pound, 2014).

From these theorists, many types of approaches to pedagogy have evolved including the New Zealand approach. However I will be looking at three types of alternative pedagogical environments and approaches, these include Steiner, Montessori and Forest schools. Steiner environments place emphasis on natural cycles and the arts and encourage empathy and self-awareness, Waldorf Steiner believed in a holistic approach to a child's development and used the terminology 'body, soul and spirit' (Kim, 2011). Montessori environments seem to place a greater emphasis on science than Steiner schools and encourage students to create their own experiments to test ideas and theories, believing that science concepts are no different from other strands of learning. Montessori is based on the idea that children are capable of self-directed their learning and absorb knowledge from their environment. The Montessori environment has a distinct design to nurture exploration, choice and independent learning. (Marshall, 2017 and Gentaz and Richard, 2022). Forest Schools has seen an explosion in popularity in the UK in recent years with schools adapting outdoor areas and training staff in the model of pedagogy, which was developed in Denmark, less formal than the other approaches already discussed, its pedagogical focus is on physical and mental wellbeing (Garden, 2022). Children are enabled to concurrently learn, play and connect with nature (Barrable and Arvanitis, 2019). These pedagogies all differ slightly in their approach, however, Gentaz and Richard (2022) states that these alternative pedagogies are all based upon social-constructivism putting the child at the centre of learning, their needs and abilities, children are free to follow their own interests and learn a bottom-up vision of knowledge and learning rather than the conventional top-down view of instruction lead pedagogy.

Gleeson (2021) states this is a possible disadvantage to constructivist learning environments, stating that students at forest school may have the opportunity to discover knowledge by making connections for themselves and from a young age, but this can potentially be a hindrance as they progress through the education system into learning environments that differ from constructivist environments drastically. Gleeson (2021) does counteract this disadvantage with a benefit to constructivist pedagogical environments, stating that children learn to be active learners within a constructivist environment, and this enables them to work out their own solutions which is an invaluable skill to lifelong learning.

According to Patchen et al (2024) despite a shift of school goals regarding the outdoor environment as a space for learning and an understanding of the benefits of nature connection, implementing regular outdoor learning can be a challenge. Another challenge is the poor integration of environmental topics across the curriculum and educational standards states Salazar et al. (2019) and Kunkle and Monroe (2019) further

suggests that there is politicization of scientific findings for example climate change that affects the confidence as practitioners to explore outdoor learning opportunities and ability to teach STEM subjects connected to nature where findings have potentially been compromised. Patchen et al (2024) asserts it is concerns around health and safety, teachers lack belief in their own pedagogy in the outdoor environment, learning timetables and as well as wider changes including the student-staff ratios and a focus on assessed learning outcomes are also barriers and limit outdoor learning.

Learning through landscapes (no date) asked teachers to give them feedback on what they felt were the challenges and barriers to outdoor learning, some of which as you will see crossover with concerns already discussed. Teachers shared five their ideas and came up with some advice for overcoming these obstacles. Firstly, a lack of suitable space and clothing – one teacher suggested that becoming partners of a community partner and asking each child to bring their own wellies, this could be a local allotment or another school that has a designated outdoor space for learning. Learning through landscapes (no date) suggest thinking outside of the box and rethink how to utilise vertical space and to create a wet weather policy which is communicated with parents so that parents are informed and can equip children. Teachers also voiced concerns around behaviour, setting boundaries and expectations, and learning through landscapes (no date) say it is important to involve the opinions of children and encourage them to take some responsibility for setting these expectations and boundaries, it is important to communicate with parents, who might be able to inform the practitioner of potential problems. Teachers again brought up a lack of confidence in the outdoor classroom, concerns about meeting the demands of the curriculum and fears around risk and the health and safety of the children. Learning through landscapes along with a wealth of bodies specialized want to encourage outdoor learning and can provide a wealth of training, prepared lesson materials and risk-benefit analysis assessments that can be adapted to fit the needs of the children, staff and available outdoor space some of these include Forest school training, BBC's grow your own 'meal barrow' (Gardeners world live, 2023), Institute for outdoor learning (2024) and The Woodland Trust (2024).

Solly (2022) posits that many practitioners want to incorporate more nature and outdoor learning but are reluctant too for the points already raised, she agrees that to be comfortable and confident in the outdoor environment, practitioners need guidance through CPD to enhance their pedagogy of outdoor learning but also a leadership team that value the affordances of the outdoor environment as a learning space.

Our role as practitioners is getting children to reach their full potential, this includes us providing stimulating spaces to learn in a holistic way, enabling outdoor environments to afford children time and space to understand and make connections with the world

through meaningful, authentic, rewarding, experiences and interactions we can support children to thrive (White, 2020)

Jackson (2023) suggests that practitioners can support learning could be through metacognitive talk and as is the theme of outdoor learning it should be organic and follow along with the child's interests and while they are exploring in play. By explicit modelling of thinking aloud and the teaching of vocabulary linked to particular a scenario that children are engrossed in, gives children the confidence to think aloud and use the language of possibility, 'I wonder if' Or 'what if we tried' and encourages children to take risks, test ideas and learn from mistakes according to Jackson (2023), it is the role of the practitioner is to facilitate opportunities for metacognitive interactions working in collaboration with the child to solve problems, reflect on prior knowledge and support future planning to explore children's fascinations in full. EEF (2021) recommends that practitioners should start metacognitive in the early years, and it can support children in self-regulated learning, key when we are wanting then to explore new possibilities and theories.

Sustained shared thinking is recognised as a valuable strategy for practitioners in the early years and can used to support children to think deeply about their ideas, thoughts and knowledge, it was first used in practice as part of the Effective Provision of Pre-School Education (EPPE) study and was found to have beneficial effects to the quality of early years practice within the program as it offers a way for practitioners to interact in child's play with minimum disruption and supported the practitioners to assess learning through anecdotal observation, Sylva et al (2004). Sustained shared thinking also links strongly with Vygotsky's 'zone of proximal development' (ZPD) the relationship between practitioner and child's in play, to extend the learning opportunities and take the child's learning further than would have been possible if the child only its own knowledge to call upon, children become more capable when actively learning and when learning with others, according to IPSP (2021).

Conclusion

Solly (2022) asserts that our outdoor spaces are whatever we want to make of them, but the most important thing is that we use them and as much as possible, the quantity of interactions between children and practitioners is without limit is these ever-changing landscapes bringing practitioner and child to learn together. Throughout this module we have seen the potential for of outdoor spaces to enrich and extend children's experiences and knowledge. Gill (2021) acknowledges that there will always be some adults that struggle with elements of risk in play, but practitioners need to keep in mind a balance approach to risk, the Care Inspectorate (2016) elaborates on this theme of risk and the benefits of outdoor play stating that it is essential that practitioners in early

years embrace outdoor play and its risks and adopt a holistic risk-benefit approach to learning environments for the benefit of children's experiences and development.

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