

Awe and Wonder – Science, Mathematics, and the outdoors

I acknowledge the use of 'Gemini' to spell check my work.

I used prompts such as 'Please check my work for grammar mistakes'

Part 1 -

(Picture source – Hardwick, 2026)

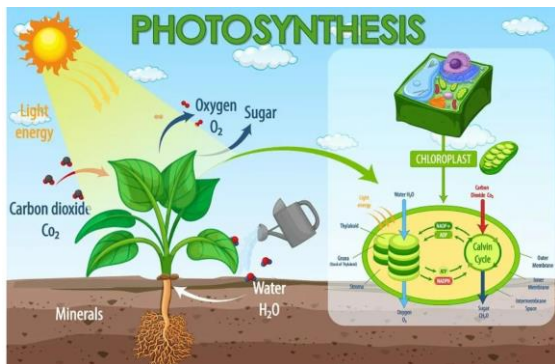
Part 2 -**Learning Journey****The Secret Pathway**

The photograph above captures the benefits of outdoor learning which shows the landscape where children can use their imagination, where different conversations can be had about what they can see and use, and where the children's natural curiosity comes into play, where it ignites child-led investigations. These diverse outdoor areas offer opportunities for child-led Science, Technology, Engineering, and Mathematics (STEM). According to the Welsh Government (2020), the Science and Technology area of learning and experience encourages children and young people to act as explorers in the outdoors, to explore the biological chemical and physical aspects of learning in their own world. Furthermore, the Welsh Government (2020) mathematics enables learners to problem solve, explore, create connections and develop that mathematical resilience, through practical, real-world problem solving and authentic exploration. As an educator, my role in this environment is to help scaffold learning through open-ended questions while allowing the children to self-direct their own play.

We arrived at the woodland site for 9:30am. As the children climbed off the bus; we began navigating through the forest and found ourselves on a woodland path. The children slowed their pace and gazed up mesmerized by the natural archway that has been formed by trees and the different colour leaves in multiple colours such as brown, yellow and green. "What is that?" Child B whispered. The children looked up curiously at the archway. "I know, I know!" Child A shouted. "It is a Secret Pathway!" Child A said excitedly. They began looking around curiously with a sense of wonder. "Miss, why is there a puddle over there, but under these leaves and trees the ground is dry?" Child B asks curiously looking down under the archway.

I stepped alongside them under the archway. "That's a brilliant observation, you are thinking like a scientist!" I replied. "Why do you think the rain hasn't reached this spot?" I say encouraging them to look up. "Because the leaves are touching!" Child B noted. "Exactly", I explained. "The branches are overlapping each other, and the thick leaves are acting like an umbrella." The children looked at each other "An umbrella?" they laugh. "When the rain falls, the leaves end up catching the rain first, so it gives them a chance to dry up into the air or fall slowly down the tree, rather than hitting the floor." I explain. "So, the leaves are protecting the ground from getting wet!" Child A reaches up and touches the curved branch. "But why do the

branches bend over like this? Are they trying to reach for something?” Child A asks curiously, touching the tree. I smiled and pointed up towards the gaps on the archway above us. “Trees need the sun and energy to make their food. Plants make their own food through something called photosynthesis. Like the life cycle of a plant.” I explained. “Photosynthesis, that’s a big word!” Child A shouted. “They are bending to the sun in! Everyone look where the light comes through the gaps!” all the children gather to look up at the sun shining through the branches, looking up in awe at the sun.



Picture source: EuroSchool (2024)



Whilst walking further along the ‘Secret Pathway’ the children notice the fallen leaves on the floor. The children are kneeled ready to investigate with their magnifying glasses. I say “Look at all these different leaves that have fallen on the floor under the branches! What colours can you spot?” Child A observes “I see brown ones, yellow ones, and some dark red ones!”, Child B quickly adds “I see some green ones too but some of them are really old and crunchy!”, demonstrating the awareness of the (Picture source: English, 2025) different textures of the

leaves.

Child A and B gathered a large pile of leaves and started to sort the leaves onto the green grass to see what colour had the most: brown, green, yellow, dark red. “Look Miss, green has the most leaves!” Child A shouts excitedly, demonstrating visual graph data. Using these sorted materials, Child A begins to make a smiley face out of leaves. I add “What other patterns can we make with leaves?” Child B went off and made different shapes out of the leaves they found, whilst Child A inspired by

the natural wildlife went and made animal mosaics such as leaf-embodied hedgehog and an owl out of the natural resources that was found, showing the mathematical concepts of scale, symmetry and different kind of shapes.



By 10:00am the children begin to explore the forest deeper. Until they discover several wooden stick dens. The children see, long and fallen branches leaned against some tree trunks to form teepee like shelters. "Look! Someone built a secret house out of giant sticks!" Child A shouted, as they all run over to inspect them. "If I pull a stick from the house, will it all crash down?" Child B asks curiously. "Shall we test it, and see?" I ask them, introducing a practical experiment, testing the gravity and the balance they pull a stick curiously to see if it falls. "What do you think is

holding the (Picture source: Hardwick, 2026) sticks together if there's no glue or rope? "I ask, watching them look at the teepees. Child B gently nudged the stick. "Look Miss! It isn't falling because all the sticks are pushing together and leaning against each other! "

As the children began to realise this, the children decided to add to these shelters. Collecting more branches from the forest, they worked together to balance the extra branches found against the frame to close any gaps that were showing. They noticed as the walls grew thicker, the inside became darker.

10:30am

By 10:30 Child A and B begin shifted their focus to collect different sticks and twigs. "We need to find a ton of sticks" Child A stated. "What if I find the small ones and you find the big ones?" Child A and B begin to search for them. Once found they suggested "We need to put them biggest to smallest". They laid all the sticks out on the floor and began ordering the different sizes of sticks and twigs they have

collected, arranging them in order of length. "This tiny one goes first!" Child A shouts. "Then this one... No, wait!" Child B interjects, placing a stick next to it measuring if it is bigger or smaller than the one that has been put down already. "This one's longer than yours" Child B points at the stick on the floor. "Miss, look how big this one is" Child A holds it up in the air.



After organising them Child B proposed a challenge "How many sticks do you think it will take to measure me?". I intervened and said "Let's find out who the tallest and who the shortest is." They

clapped excitedly and Child B [Picture source: Play of the wild (2019)] laid on the floor first and Child A began to lay the sticks down on the floor next to them. "One, Two, Three..." I stood back and observed them counting together. "You are 20 sticks tall!" Child A shouted. "My turn, my turn!" Child A said excitedly. Child A laid on the floor and child B started to place sticks next to them, counting as they go along. "You are 16 sticks tall!" Child B yells. I intervened and asked "Who is the tallest?", Child B yells "I am, I am!". The curriculum framework emphasises the importance of how mathematical understanding is developed through real-world problem solving and practical exploration (Welsh Government, 2020).



(Picture source: Hardwick, 2026)

Following the measuring game the children ran out into the big grassy field. They begin to run, roll and jump on the field. They pause; Child A kneels on the damp grass. “Hey guys look! There’s something moving in the mud!” Child A called out. Child B runs over to investigate. They ask for the magnifying glass we brought with us. “Look, it is a black shiny beetle!” Child B exclaims, carefully using the magnifying glass to inspect it. “Let’s see what else is hiding in the mud” I suggest. They begin to look closely through their magnifying glasses to

find more animals and bugs. “I have found a worm, it’s wriggling through the mud” Child A laughs and begins to imitate how the worm is moving to the rest of the group.

As reflected in the Curriculum for Wales Framework (Welsh Government, 2020), the outdoors helps them develop scientific curiosity, mathematical resilience and the engagement with the natural world that surrounds them.

Part 3 – Risk Benefit Assessment**Location: Woodland Path and open field****Target group: Early years / 6 & 7 year olds**

Activity	How will children benefit from this activity?	Hazards and Risks	Who is at risk?	Precautions/Control measures	Overall risk rating (L/M/H)
Children walking along a woodland path under an archway which is formed by overlapping branches, examining wet floor and dry floor, looking up at the sunlight and understanding how it is coming through.	They develop a scientific understanding of light interception and shadow mapping, the understanding of photosynthesis and how it helps trees and plants. It helps their curiosity and engagement by looking up at the different structures, inspiring child-led scientific questioning. Helps the children's sensory and visual awareness, as they are observing the leaves colour changes, the lighting shifts in the real-world setting.	Branches could possibly fall; low twigs and branches could cause head or eye injuries. Muddy ground, wet floor and leaves could cause trip and slip hazards.	Children Early years staff Volunteers	Staff to do a quick visual sweep for hazards, low branches etc. Ensure that there are clear walking paths for children and encourage children to keep a look out on the floor for any rocks, uneven paths. Ensure that children have the correct footwear on (Walking boots or wellies)	Low

Children kneeling on the grass using magnifying glasses to examine the leaves on the floor. Sorting them by colour, using them to make different patterns and animal mosaics	Develop fine motor skills, as they are handling and feeling dry, crunchy, wet leaves. Develops hand-eye coordination and helps their sensory processing. Develops their creativity and STEM as it blends their mathematical symmetry and the patternmaking with the children's imaginative nature art. Helps develop the children's mathematical reasoning, helps them promote spatial awareness, shape recognition, helps them compare the different shapes and sizes.	The ground could possibly contain animal faeces hidden in the grass or the leaves. Sharp objects such as glass or thorns hiding under a pile of leaves or the grass.	Children and staff who are handling the materials.	Ensure that the staff do a quick pre-inspect of the leaves and grass for any sort of litter, sharp items or animal faeces prior to the children going to collect the leaves. Ensure that the children wash their hands immediately after handling any of the leaves and the natural materials they gather throughout the day	Low
Children inspecting the sticks that are holding the teepee structure up, test the balance of the structure by adding branches to support the structure, work together to collect and lean the different branches and	The children will develop engineering principles, as they will build the practical understanding of balance, gravity, friction, and structural stability. They develop gross motor skills, and they use heavy work by lifting, carrying and	The structure of the teepee could collapse. Heavy sticks falling could fall and hurt children. Splinter injuries with the branches such as sharp branches	Children who are handling the branches and twigs. Children who are standing beneath the teepee structure.	Staff to inspect the teepees for the stability before the children approach or enter it. Staff to implement clear boundaries to ensure the children's safety. For example. No running whilst carrying the sticks and branches, walk. Ensure adult supervision, early years educators to position themselves close to help the children carry	Medium

twigs to lean against each other to fill in the gaps to make it darker.	taking the timber from different places, this is helping their core physical strength, physical and hand eye coordination and their spatial awareness. They will begin to work in a team and develop communication skills, this encourages negotiation skills, problem-solving and taking risks together.	and twigs, rough bark splinters or accidental collisions whilst carrying large sticks to different places.		the heavy sticks if help us needed or to stop the children pulling branches down.	
Children to lay sticks on the floor to measure them by length, to measure their heights, explore the different minibeasts and animals with their magnifying glasses.	Children will develop their mathematical skills, use comparisons to see what sticks are bigger and smaller, develop mathematical resilience. Children will become scientists and develop their scientific abilities, investigating the minibeasts and animals around them, the different textures on the floor. Using their imaginative skills and exploring the open field around them, building their	Possible animal faeces in the grass and around the field. Again, the ground may contain glass or sharp objects that are hiding in the grass or the mud. Possible surface hazards on the field, such as concealed holes, wet grass which could be a slip hazard, hidden rocks which could become a trip hazard.	Children who are running, rolling and exploring the field.	Ensure that the staff do a visual inspection of the field for any animal faeces, sharp items prior to any games on the field. Ensure that the children and staff wash their hands after exploring the minibeast and the mud. Ensure that the staff always supervise the children and the staff involved supervise their 1:1's always.	Medium

	gross motor skills and confidence through crawling, running and kneeling to investigate.	Some children may run away, whilst considering that some children may have additional needs (ALN).			
--	--	--	--	--	--

Part 4 -

In this section it will explore why the outdoors plays such a vital role in the overall development of children and young people, whilst focusing on how adult support and teaching enhance the children's understanding in the curriculum for Wales such as Mathematics and Numeracy and Science and Technology. While outdoor learning offers many benefits, I will also critically evaluate the difficulties and barriers that practitioners and children and young people may face.

Watts (2020), states that outdoor learning and different play experiences are a vital part of children and young people's development. He believes that offering children first-hand experiences in the natural outdoors benefit the children physically and emotionally as they start to engage with nature and the outdoors daily. Similarly, Sedgwick (2012) argues that children who experience outdoor learning and adventures are more than likely to develop emotionally, intellectually, spiritually and socially. UNICEF (2025) also highlights that spending time outdoors will help improve children's mental and emotional well-being, allowing them to grow in confidence and take risks. UNICEF (2025) highlight that research has found that children who take risks such as climbing trees or jumping from a height outdoors helps the children's physical activity that is needed to be strong and healthy, this promotes the children's creativity, resilience and their social skills.

The importance of the environment is further supported by Tucker (2014) who argues that the environment plays a crucial role in children and young people's development. A good learning environment encourages a child's self-esteem and confidence, encourages children to be independent and to take risks. However, Trina et al (2024) further identifies that an outdoor learning environment can influence Mathematics and Science. They believe that Early Childhood is a critical period for

children, this is where they develop their cognitive and social development and experiences adults give shapes future learning and interests within the 'STEM'.

The Well-being of Future Generations (Wales) Act (2015) embeds into outdoor learning within Mathematics and Science. This law requires schools to think about the long-term impact of their work on children and young people's futures. Teaching Mathematics and Science in the outdoors is one of the many goals of the Act. They believe that learning outdoors builds a strong personal connection to the environment (Cynefin), this is where the role of the adult comes into play as they are teaching children to care for the planet. The Well-Being of Future Generations Act (2015) believe that outdoor learning promotes a healthier Wales, such as children are getting fresh air, movement, hands-on play and they develop resilience where they begin to learn about different animals, plants, ecosystems and an understanding of the world around them.

The Welsh Government (2023) states that the outdoor environment needs to provide numerous natural resources and opportunities for mathematical learning, for example loose parts is a crucial part of children's outdoor learning experiences. Play Wales (2023) defines loose parts as materials with no specific set of directions and can be combined or used alone with other materials and resources, therefore children can use and manipulate them in many ways. Nicholson's (1971 cited by Robertson, 2017) theory states that environments much have lots of loose parts for children to experiment with. Loose parts can be natural or synthetic. They can be carried, moved, lined up, combined, taken apart and put back together again. Children can naturally use mathematical thinking to learn new skills as a part of their experiences outdoors. They can count, explore shapes, measure and develop their maths through creative and imaginative play (Early Years Maths Outdoors, 2020). Pentagon Play (2024) defines the role of the adult in Mathematical development as crucial. Adults can create opportunities for mathematical play, by creating fun activities for children to take part in. Pentagon Play (2024) believes that adults can also use the outdoor environment to introduce, reinforce, model mathematical concepts to make maths fun and engaging. For example, if children are collecting rocks, the adult could observe rather than taking over the activity completely. When

an opportunity arises, the adult could ask “How many have you collected?”, “Which group has more?” or “Can you find a rock that is heavier than that one?”, this is encouraging children to develop that mathematical language and begin to learn through what they are playing with. This approach can be used through Vygotsky’s (1978) sociocultural theory of what he calls the ‘Zone of Proximal Development (ZPD)’ where children’s learning can be extended through interactions with one another. Vygotsky (1978) believed that adults can scaffold a child’s understanding and development of spatial, numerical and geometric concepts. Vygotsky (1978) stressed that learning is social. Outdoor play encourages group play such as building dens, sorting piles of leaves and sticks, where children negotiate, shape, and count together which is crucial for a child’s holistic development (Teaching Cupboard, 2024). The Welsh Government (2019) emphasizes that Mathematics should not just be for producing correct answers, children must have the opportunities to justify, explain, make connections and problem solve. Robertson (2017) argues that mathematical proficiency does not come on its own, it needs careful scaffolding by adults that is relevant and meaningful. Robertson (2017) believes that adults must actively show an interest in Maths, otherwise the children will not either. Making sure that adults model the maths activities, show the children what to do with the different resources, use mathematical vocabulary such as ‘add’, ‘take away’ etc.

The adult also has an important role in supporting scientific learning outdoors. The Welsh Government (2020) encourages children and young people to use observations, logic, creativity and evidence to develop their learning within the Science Area of learning. Natural environments provide different opportunities for children to investigate and see different materials, explore living things such as bugs, notice the change in weather or how the seasons are changing (Welsh Government, 2020). The adult can support a child’s scientific thinking by encouraging children to observe carefully at their findings, test their ideas and discuss the evidence they have found. For example, the children could find a worm in the grass after it has been raining, the adult could ask, “Where has that worm come from?”, “Shall we use our magnifying glasses to find more?”, “What else can we find?”, rather than the adult immediately telling the child the answer, the adult is giving the child the opportunity to come up with their own theory and test their ideas. This reflects on Dewey’s (1938) experimental approach to education; he states that children learn by

doing. He believed that learning develops through meaningful experiences. Similarly to Dewey, Kolb (1984) developed an experiential learning cycle, where the child's experiences turn hands-on outdoor learning activities into deep, meaningful learning. Lamont (2024) believes that teaching science outdoors promotes children's problem solving, critical thinking and develops their creativity in the real world, it also provides hands-on learning experiences for children to help them develop a deeper understanding of science and technology. Furthermore, Sargent (2015) believes that the outdoor scientific environment promotes the children's social learning, which he believes is essential for developing scientific skills and developing that understanding of the scientific concepts. He believes that adults should provide flexible outdoor spaces where children can access stimulating resources that promote their exploration and play, whilst being supported by adults who can encourage them to ask questions and think "What kind of animals can we see?", "How many legs does a spider have?", or questions like "Why do plants need water?" etc, making the child think about the answers and come up with their own conclusions.

Although there are many benefits of adult supported outdoor learning, however we need to take into consideration the difficulties also. Waite (2010) highlights that outdoor learning can be affected by the weather, staffing, low funds, no access to suitable spaces, time or staff not having the correct training. Waite's (2010) research investigates the expectations of practitioners and how it can have a real impact on the learning of the children, as practitioners are expected to do everything and sometimes there is not enough time in the day for this to be successful and sometimes things get missed. Adults must require the knowledge and the training of the curriculum for Wales and the outdoor pedagogy to recognise the children's learning needs and to be able to respond effectively (Welsh Government, 2023). Another difficulty within the outdoors is 'risk', the outdoor environments can contain uncertainty, such as uneven surfaces, weather conditions or challenging situations. The current Welsh Government guidance recognises and supports the importance of risk and challenges, however Maynard and Waters (2007) research shows parental hesitation to let children play outside in the rain, common parental complains include children getting their shoes and socks wet, not having the appropriate clothes. To build on this, in recent research Armstrong et al (2025) points out the parent's

attitude towards risky play has completely changed. Studies showed that more than 40% of parents did not want their kids doing any sort of risky play. Another difficulty is adult to child ratios, managing large groups of children outdoors it requires high supervision which creates staffing issues. High supervision gives the children more attention, the children can ask questions freely, ask for help if needed.

To conclude, outdoor learning plays a vital role in supporting the holistic development of children and young people. It allows them to have opportunities for physical, emotional, social and cognitive development. This discussion has demonstrated how the outdoors can help the children and young people's development in the Mathematics and Science within the Curriculum for Wales. As stated above, natural resources such as loose parts can help encourage children to count, explore different shapes, measure, recognise patterns and solve problems, whilst the outdoor learning can support the scientific learning through, observation, experimentation and investigation. The role of the adult is very important as adults can extend the child's learning and thinking through scaffolding, modelling, mathematical and scientific language. Vygotsky's (1978) theory demonstrates how adults can support and extend children's learning, whilst Dewey (1938) and Kolb (1984) highlight the importance of learning through purposeful and meaningful, hands-on experiences. However, outdoor learning has some challenges, staff ratios, limited resources, weather, parental concerns and the management of risk can influence children's access to high-quality outdoor experiences. Overall, outdoor learning requires knowledge and responsible adults who recognises the learning opportunities whilst allowing the children to develop, explore and question their own ideas.

References

Afrin Trina, N., Monsur, M., Cosco, N., Shine, S., Loon, L. and Mastergeorge, A. (2024). *HowDo Nature-Based Outdoor Learning Environments Affect Preschoolers' STEAM Concept Formation? A Scoping Review*. [Accessed 25 September 2026]

Armstrong, F., Barrett, M. J., Gaul, D., & D'Arcy, L. (2025). Parental attitudes to risky play and children's independent mobility: Public health implications for children in Ireland. *International Journal of Environmental Research and Public Health*, 22(7), 1106–1106. <https://doi.org/10.3390/ijerph22071106> [Accessed 25 September 2026]

Cardiff Metropolitan University. (2020). *Library services: Learning at university: Experiential learning*. Cardiffmet.Ac.Uk. https://library.cardiffmet.ac.uk/learning/learning_theories/experiential [Accessed 22 September 2026]

Cloke, H. (2023). *John Dewey's learning theory: How we learn through experience*. Growth Engineering. <https://www.growthengineering.co.uk/john-dewey/> [Accessed 22 September 2026]

Early years maths outdoors. (2020). Meols Cop Research School. <https://researchschool.org.uk/meolscop/news/early-years-maths-outdoors> [Accessed 20 September 2026]

English, D. (2025). *Enquiry-based learning at Forest School: Nurturing curiosity and connection*. Danny English NBEC. <https://www.dannyenglish.co.uk/post/enquiry-based-learning-at-forest-school-nurturing-curiosity-and-connection> [Accessed 12 September 2026]

EuroSchool. (2024). *What is photosynthesis: How plants make food*. EuroSchool. <https://www.euroschoolindia.com/blogs/what-is-photosynthesis-how-plants-make-food/> [Accessed 12 September 2026]

Lamont, M. (2024). *How to teach STEM outdoors*. Learning Through Landscapes. <https://ltl.org.uk/stem-outdoors-how-to-teach/> [Accessed 25 September 2026]

My Teaching Cupboard. (2024). *Vygotsky's play theory: A guide for play based teachers*. My Teaching Cupboard. <https://www.myteachingcupboard.com/blog/vygotskys-play-theory-a-guide-for-play-based-teachers> [Accessed 20 September 2026]

Outdoor maths games & activities for EYFS! (2024, May). Pentagon Play.

<https://www.pentagonplay.co.uk/news-and-info/outdoor-maths-for-eyfs> [Accessed 20 September 2026]

Picture source - Hardwick, O (2026) Authors own

Robertson, J. (2017). *Messy Maths*. Google.Co.Uk.

https://www.google.co.uk/books/edition/Messy_Maths/epwuDwAAQBAJ?hl=en&gbpv=1&dq=adults+role+in+supporting+mathematical+concepts+outdoors&pg=PT8&printsec=frontcover [Accessed 22 September 2026]

Robertson, J. (2017b, December 8). *Simon Nicholson and the theory of loose parts – 1 million thanks*. Creative STAR Learning | I'm a Teacher, Get Me OUTSIDE Here!

<https://creativestarlarning.co.uk/early-years-outdoors/simon-nicholson-and-the-theory-of-loose-parts-1-million-thanks/> [Accessed 22 September 2026]

Sedgwick, F. (2012) *Learning outside the primary classroom*. 1st ed. Milton Park, Abingdon, Oxon: Routledge. Available at: <https://doi.org/10.4324/9780203120347>.

[Accessed 19 September 2026]

Tucker, K. (2014) *Mathematics through play in the early years*. 3rd ed. Edited by Kate Tucker. (London) : SAGE [Accessed 19 September 2026]

UNICEF. (2025). *The importance of outdoor play (and how to support it)*. Unicef.Org.

<https://www.unicef.org/eca/stories/importance-outdoor-play-and-how-support-it> [Accessed 19 September 2026]

Waite, S. (2010). Losing our way? The downward path for outdoor learning for children aged 2–11 years. *Journal of Adventure Education & Outdoor Learning*, 10(2), 111–126. [Accessed 25 September 2026]

Watts, A. (2020) *Outdoor learning through the seasons : an essential guide for the early years*. 2nd ed. London: Routledge. [Accessed 19 September 2026]

Welsh Government. (2015). *Well-being of Future Generations (Wales) Act 2015*.

Legislation.Gov.Uk. <https://www.legislation.gov.uk/anaw/2015/2/contents> [Accessed 19 September]

Welsh Government. (2020). *Mathematics and numeracy: Introduction - HWB*.

Hwb.Gov.Wales. <https://hwb.gov.wales/curriculum-for-wales/mathematics-and-numeracy/> [Accessed 13 September 2026]

Welsh Government. (2020). *Science and technology: Introduction - HWB*.

Hwb.Gov.Wales. <https://hwb.gov.wales/curriculum-for-wales/science-and-technology/> [Accessed 12 September 2026]

Welsh Government. (2023). *Enabling learning - HWB*. Hwb.Gov.Wales.

<https://hwb.gov.wales/curriculum-for-wales/designing-your-curriculum/enabling-learning> [Accessed 20 September 2026]