

Early childhood education has significantly changed in recent years, focusing on hands-on learning experiences that incorporate mathematical and scientific concepts. Educators and researchers recognize the benefits of outdoor environments as natural settings for fostering children's curiosity, exploration, and understanding of these concepts. Adults play a vital role in guiding the minds of young children by enabling environments, utilising loose parts, and igniting curiosity. Adults have a responsibility to support and encourage children's engagement with mathematical and scientific concepts in the natural world.

Vygotsky and Piaget, two influential theorists, have contributed to our understanding of how children learn. Vygotsky highlighted the significant role of adults in shaping children's mental development, while Piaget emphasised children as independent intellectual explorers who construct knowledge through their discoveries. Many educators advocate for a balanced approach that combines Piaget's and Vygotsky's perspectives, allowing children to follow their interests and enthusiasm while receiving intellectual challenges. Bruner, another influential theorist, was influenced by both Piaget and Vygotsky. He, too, believed that learning is an active process in which children build new knowledge upon their existing understanding (Charlesworth, 2015). Adults have a role in providing stimulating play environments that encourage curiosity, discovery, experimentation, and hypothesis. According to Jirout (2020), through curiosity, children can enhance their growth of scientific thinking. Curiosity can drive the search for information. This leads to asking questions and engaging in other information-seeking activities. This will then trigger the activation of relevant prior knowledge, which sustains deeper learning. Outdoor environments especially spark children's curiosity. Waite (2010) states that the unpredictability of the outdoors gives children the opportunity to be curious. The natural world provides an experimental foundation for curriculum growth as well as environmental values. However, Zamani (2016) highlighted a challenge that is, some outdoor environments will not have been as effective and beneficial for children's development. Children need to be exposed to natural outdoor environments, as opposed to traditional typical playgrounds. Natural areas that include natural elements such as plants, trees, and sand provide the opportunity for hands-on learning, explorative and manipulative experiences. Waite (2010 cited in Zamani, 2016) goes on to state that natural environments allow children to connect with nature, providing them with open-ended play options that stimulate creativity. This is supported by theorist Froebel, who emphasised the importance of children learning through nature. Froebel saw the significance in the environment in which children learn (Macblain, 2018). White (No date) also states that it is important for young children to have access to the outdoors as frequently as they do indoors. Children benefit from a planned, organised indoor-outdoor environment. To contrast, Austin (2007) contradicts these beliefs and claims that simply moving children outdoors will not enhance learning.

Sargent (2015) believes that the outdoor area is ideal for planning maths activities. Children develop mathematical skills by trial and error and playing with ideas. Children explore size, shape, and space and are less restricted, having the freedom to sing, talk, and shout. This encourages conversations, questions, and debates. Ultimately, the outdoor environment encourages active social learning. The significance of active social learning is emphasised by Vygotsky who believed that children's cognitive development is encouraged by social

interactions and guided learning experiences facilitated by those who are knowledgeable (Macblain, 2018).

Moreover, the outdoor environment also encourages scientific engagement and thinking. According to Gove (2014), the outdoor environment provides more scientific learning opportunities than indoors. The outdoor environment encourages science-based observations. Children can witness the habitats of insects and animals, the life cycle of flowers, and weather changes. Just a fraction of examples of outdoor science learning opportunities. It is also notable that the outdoors provides sensory experiences. Using different senses is a basic skill in science. Although children can learn in natural environments, it is also important for adults to provide a well-planned environment. An enabling environment provides space, resources, and accessibility. According to Hodgman (2012), the environment plays a key role in encouraging children's learning and development. This is supported by theorist Burner, who believed that the environment plays a role in facilitating learning. Bruners 'scaffolding' theory states that adults or more knowledgeable individuals should create environments and provide support that enables learners to reach higher levels of understanding and competence. Ultimately, Bruner encouraged educators to create environments that are conducive to learning and provide the necessary tools, resources, and guidance to help children succeed (Main, 2023). However, Patchen et al (2022), highlighted some challenges and barriers that adults have encountered when attempting to indulge in outdoor play and learning. These barriers include time, student to staff ratios, physical location safety concerns and weather.

Outdoor learning has gained recognition worldwide for its positive impact on children's development and educational experiences. The Scottish Curriculum for excellence places a strong emphasis on outdoor learning throughout a student's educational journey. From early years to secondary education, students are encouraged to engage with the natural environment (Scottish Education Government, No date) . This differs from the common Core state standards in the United States as the Common Core does not specifically address outdoor learning (The Common Core Standards, No date).

Furthermore, The environment could include loose parts. The loose parts theory has gained recognition for its impact on children's development and learning experiences. The concept was initially introduced by Simon Nicholson and is now a widely accepted approach in early years settings. Loose parts refer to materials or objects that have no predetermined purpose (Casey and Robertson, 2019). These materials can be moved, combined, manipulated, and adapted in various ways by children to create their unique play experiences. Examples of loose parts include natural materials like sticks, stones, and leaves, as well as man-made items like wooden blocks, fabric scraps, and assorted containers. The defining characteristic of loose parts is their open-ended nature, which allows children to use them in imaginative and creative ways (Daly and Beloglovsky, 2015). According to Flannigan and Dietze (2018), the utilisation of loose parts in early childhood education has extensive benefits. They foster creativity and imagination as children explore these materials without predefined rules. Loose parts also nurture problem-solving skills and critical thinking, as children encounter challenges and obstacles in their play. Moreover, handling various materials enhances both fine and gross motor skills,

promoting physical development. This is supported by Spencer et al (2019), who found that loose parts play promotes cognitive development such as planning, problem-solving, communication and imagination. However Spencer et al (2019), later stated that there are challenges regarding loose parts play. Participating educators in the study revealed how the introduction of loose parts led children feeling overwhelmed and intimidated. Educators in the study also stated that they believed when these materials were introduced, the novelty would wear off, children would get bored and there would be a decrease in engagement. To contrast, theorist Montessori encourages loose parts play as Montessori's education principles align with the concept, emphasising hands-on, self-directed learning and the use of natural materials (Montessori Apprentice, no date).

Moreover, Casey and Robertson (2019), states that loose parts play a pivotal role in children's holistic development, stimulating cognitive, physical, social, and emotional growth. They provide opportunities for children to explore, experiment, and express themselves freely, fostering independence, resilience, and a love for learning. This aligns with the goals of the Curriculum for Wales (2022), which emphasise holistic development, individualised learning, and the promotion of critical thinking and creativity. Loose parts are especially ideal for children when engaging in mathematical and scientific concepts. As stated by Joe (No Date), engaging in loose parts play nurtures several essential scientific skills in children. These skills encompass activities such as investigation, exploration, the formulation and testing of hypotheses, the construction and deconstruction of ideas, and active engagement with their environment. Loose parts play naturally fosters these skills, encouraging children to conduct a variety of experiments. While some experiments may occur spontaneously during play, others can be more structured, allowing children to gain valuable scientific insights using basic found objects. This is supported by Truce Teachers (No Date) who state that Loose parts engage children in basic mathematical and scientific concepts such as volume, measurement, cause and effect, friction and patterns. Truce Teachers (No date), also goes on to state that it is important for adults to model curiosity and analytical thinking. Adults can ask questions such as 'did you notice how..' or 'what do you think will happen when..'. These questions encourage children to think about future outcomes of events, making guesses and engaging in simple experiments to enhance their knowledge on these mathematical and scientific concepts.

This being said, Educators in early years settings can effectively utilise loose parts by providing a diverse range of materials, creating inviting play spaces, observing and encouraging children, and documenting their learning experiences. As previously stated, loose parts play is open-ended and through curiosity and discovery, children will ask questions and start conversations about the ideas they have (Rahardjo, 2019). This links to metacognitive talk. Metacognitive talk means talking about how you think, solve problems, and understand things on purpose. It is done by speaking thoughts out loud, asking questions, or talking with others about your thoughts (Cambridge Community, No date). According to Sword (2017), Metacognitive talk offers a range of advantages that significantly enhance the learning process and cognitive development. One key benefit is enhanced self-awareness; when individuals engage in metacognitive talk, they gain a deeper understanding of their cognitive processes by expressing their thoughts and strategies aloud. This heightened self-awareness becomes a

valuable tool for personal growth and development. Another notable advantage is the improvement in learning strategies; metacognitive talk encourages learners to assess the effectiveness of their strategies. Identifying successes and failures builds resilience. Finally, engaging in metacognitive talk, especially in group settings, fosters effective communication and collaboration skills.

The outdoor environment offers a rich and stimulating backdrop for children to explore mathematical and scientific concepts. As they engage with nature, the role of adults becomes crucial in guiding and supporting their learning experiences. Observations serve as a fundamental tool in facilitating children's engagement with mathematical and scientific concepts in outdoor settings. They involve actively watching, documenting, and reflecting on children's behaviours, interactions, and discoveries. According to Ward et al (2012), observing learners engaging in science concepts is vital, judgement can be made about children's ability to carry out investigations and their cooperation with others. Performing observations also supports adults when planning activities based on children's individual needs as learners. Adults can then create an environment that extends children's development and learning (Palaiologou, 2012). This is supported by Davies et al (2014), who states that observing and documenting children's learning are vital for several reasons. For instance, Observations help adults gain insights into children's interests and curiosities regarding the natural world. Additionally, Observations align with the principle of child-led learning. The Curriculum for Wales (2022) promotes child-centred learning experiences, where educators take into account children's interests, needs, and preferences. Teachers are encouraged to observe and respond to children's cues, allowing them to take the lead in their learning. This is further emphasised by Theorist Montessori. Montessori teachers are encouraged to observe from a distance, recording children quietly, allowing children to behave freely (Macblain, 2018). This is supported by Lamont (2021) who found that by guiding children through structured activities led by adults, we can introduce them to fresh concepts and create chances for them to enhance their abilities and acquire knowledge. Nevertheless, it becomes clear that children should subsequently have the chance to delve into their own thoughts, interact with diverse materials, explore their surroundings, and express their creativity. These encounters enable children to gain a more profound insight into the world that surrounds them.

To conclude, In the evolving landscape of early childhood education, the role of adults in facilitating children's engagement with mathematical and scientific concepts is paramount. Whether through outdoor exploration, loose parts play, or metacognitive talk, educators, inspired by theorists like Vygotsky and Piaget, guide young learners on a path of discovery and understanding. Through careful observations, adults can tailor their guidance to individual needs, adhering to child-centred principles promoted by curricula like the Curriculum for Wales and the Reggio Emilia approach.