

1. Activity Plan		
Activity: Walk along riverside cycle-track/footpath. Focus on concepts of shape/size and early numeracy skills.		
Number of children: 15	Age of children: 3 – 4 years	Number of adults: 3
Location: Cycle-track/footpath, including wide area of riverbank.	Preparation time: 15 minutes to complete/update risk assessment and gather resources.	Activity time: Approximately 1 hour.
Resources: • Travel first aid kit • Mobile telephone • I-pads • Clip-boards with pencils and paper • Basket/bag • Shape cards		
Aims of activity: To assess current levels of understanding around concepts of shape and size. To extend understanding using real examples of natural resources. To extend mathematical vocabulary by using correct terminology to express concepts. To allow children to explore mathematical concepts in a hands-on way in their local environment. The aim will either be to introduce, explore or consolidate understanding of these concepts, depending on the child's current level of understanding.		
Links to outcomes: To learn names of shapes– e.g. square, circle Features of shapes – corners, edges, round Grouping – same as, different, similar To learn concepts of size – small, medium, large/ big, bigger, biggest Counting up to 5 In line with area of learning skills and extended learning skills for nursery in Foundation Phase Framework (Welsh Government, 2015a).		
Differentiation: Children to be grouped based on their stage of development as informed by ongoing observations carried out in the setting. Area is accessible for those with mobility issues. Practitioners to tailor questioning based on level of understanding of each individual child.		
Health and safety: • All staff familiar with risk assessment for this route/activity • All staff have up to date first aid training • First aid kit and mobile telephone carried • Each practitioner to know number of children in their group and who they are • Regular head counts		

Role of adults:

To provide resources to extend the activity and which allow the concepts to be revisited at a later date. To act as more knowledgeable other, providing scaffolding to their learning. To ask appropriate questions to encourage problem solving. To provide vocabulary with which the children may not yet be familiar. To record observations of children's knowledge and progress in order to inform future planning. To risk assess and help children become aware of risks themselves.

The activity:

Staff to accompany children on the short walk to the riverside path. This is an opportunity to talk to the children and point out anything of interest, such as any signs of wildlife and features of their local area.

On arrival, staff will speak to the group, and explain the task of looking for different shapes, this will include an example to the children, such as "Look at this long wall, it is made up of many, small bricks. Each brick is a rectangle shape."

Children will be put into three groups, based on their level of mathematical understanding as defined by previous observations and activities. The walk leads to the wide riverbank area, where there are various size/shape stones, trees, grasses and bushes to provide adequate resources to stimulate conversations amongst the groups.

Children will be allowed to initiate their own activities and explorations. As the children explore, practitioners will question them and encourage them to record their findings by filming/photographing on the I-pad, drawing pictures or making rubbings on paper. Some may choose to use the resources around them to create shapes, for example, using sticks to form shapes. Practitioners may then challenge the children by asking "is that triangle big or small?" "How could you make a bigger triangle?"

Children may collect items of interest to them to take back to the setting. These can be kept as loose parts and revisited to consolidate learning.

As the activity is guided by the children, it may include other mathematical skills, such as building towers, and sequencing. These should be observed and recorded, but where possible the practitioner should try to introduce the concepts of shape, size and numeracy that are the aim of this activity.

The activity is to conclude after around an hour, in order that the children can return to the setting and attend to the daily routines, such as circle-time and snack before the end of the session.

2. Evaluation of activity plan.

Just as settings aim to encourage children to take time to look back at their learning and question what they have done, it is also necessary that practitioners reflect upon their practice, to evaluate activities and learn from them in order to become more effective practitioners (Dowling, 2013; Lindon and Brodie, 2016; McLeod-Brudenell, 2004). Each activity will have elements that work well and areas which can be improved, evaluation helps to identify these.

This activity is based outdoors, in an area with forestry, grassland and a river with a stony bank. McGrath (2010) states that the benefits of forest schools for multi-sensory mathematical learning are accepted, and are particularly helpful for children with traits of dyslexia and dyscalculia. Getting outdoors is a good way of creating memorable days, which in turn become memorable learning, particularly important for mathematics which relies greatly on memory and recall. Education in the outdoors was advocated by Pestalozzi (1746-1827), Froebel (1782-1852) and McMillan (1860-1931), with Ouvry (2003) suggesting particular benefit for boys. Working outdoors also has the benefit of true scale, allows children to experience spatial concepts such as far away and next to, changes with the seasons, which may lead to discussion on patterns such as seasons and time (Taylor and Harris, 2014).

The activity uses natural materials, which keeps costs down and has little environmental impact. There is opportunity to record the learning and take some items back to the setting. This encourages children to revisit and consolidate their learning, by creating a display and keeping the resources accessible. The activity is multi-sensory, allowing children to handle and move items. This is effective for children sorting, comparing and matching common features. Taylor and Harris (2014) point to play as being an introduction to concepts such as height, speed, direction and space and of play having the power to motivate and inspire young learners. This activity should, therefore, engage children, as it is open and adaptable to suit individuals.

Practitioners are depending on children being suitably attired for the weather. Settings may not supply waterproofs; proper consent must be obtained before applying sunscreen and practitioners may be reliant on parents/carers supplying hats and gloves. A good relationship with the home may reduce problems, but for various reasons children may not be prepared and practitioners have a duty of care to look after their health and wellbeing. The ratio of staff to children may also prove problematic with mathematical learning in the outdoors. McGrath (2010) advises small working groups, preferably pairs, to encourage deep engagement, however CIW require one adult for eight children over the age of three (Mudiad Meithrin, No date). The activity plan therefore assumes that the setting is overstaffed, and there would be no requirement for there to be more than two members of staff for the fifteen children stated, which would impact upon the quality of the experience.

Tucker (2014) states the need to consider resources, space and time to explore when planning, and Bruce (2012) believes there must be time and space for children to be adventurous outdoors. However, there are a number of things that have to be fitted in to each session in nursery settings, a list of daily activities which must be completed to satisfy the education authority and inspectors, such as registration and snack time.

With some sessions lasting less than three hours, it is rarely possible that activities can be left to run, and most have to fit in to a busy schedule. The one hour allotted to the activity may mean that children are interrupted when engrossed in their learning and the full benefits of the session not experienced.

Outdoor learning and play promote holistic development. Alongside mathematical learning, there are elements of physical development, working with peers and practitioners involves personal and social development and being outdoors teaches knowledge and understanding of the world. Mathematical tasks extend language and communication skills, alongside the use of Welsh. Children may create shapes and structures, take photographs, film and draw pictures, all of which cover creative development (Welsh Government, 2015a). It is central to Froebelian principles to make observations of children when they are engrossed in play as it gives a holistic view of development (Bruce, 2012). It is central to this activity that children are observed to gauge their understanding. However, outdoors it may be harder to note observations in the traditional way, using pen and paper. Practitioners must think creatively, perhaps using recording devices, and the pictures and recordings made by the children.

The activity is reliant on practitioners providing a positive role model and being confident in their own mathematical abilities. McGrath (2010) believes that the emotions and attitudes of educators can transfer to children, and that early experiences impact upon all future connections to mathematics. It is therefore important that practitioners are well-trained and confident in what they are delivering. The role of the practitioner is to observe the child in order to identify what Vgotsky termed the 'zone of proximal development', or what the child can achieve with some help and to sometimes act as the 'more knowledgeable other'. They should use careful intervention to 'scaffold' the child's learning (Bruner et al, 1976, cited in Wood, 2013, p.82). This could involve providing the child with new vocabulary, describing, modelling correct language, not using too many words and using the correct type of open question to foster quality adult-child interactions (McGrath, 2010; Smidt, 2015; Yelland, 2014).

The activity is child-led and play based. Piaget, Vgotsky and Bruner all believed in play as the most effective mode of learning and that children are active learners (Smidt, 2015). Yelland (2014) states that self-directed activities such as this promote learning, in common with social constructive theories such as that of Vgotsky (1978). Intentional teaching, a pedagogical practice whereby teaching which is purposeful and deliberate, but within play-based activities, can be used to broaden the scope of activities, and has demonstrated efficacy in numerical learning (Chigeza and Sorin, 2016).

The activity plan groups children according to ability. However, the Vgotskian theory of children being motivated to learn from more knowledgeable others, would suggest that groups of mixed ability may be more beneficial, as children learn from each other (Smidt, 2015; Boaler, 2009 cited in McGrath, 2010, p.21). This also allows children with higher levels of understanding to revisit and consolidate their learning. Regarding gender, a study of seven million US students found that boys and girls perform equally

in mathematics assessments, but that old-fashioned stereotypes and cultural beliefs have led to a belief that boys are more able in the subject than girls (Hyde et al, 2008, cited in Palmer, 2010, p.132). Each child should be treated as an individual, regardless of their gender. Children with additional learning needs can also benefit from alternative classroom environments. As the activity is accessible and based around play and discovery, it is child-led and suitable for those with different needs, but may require additional staff members and some adaptations.

To conclude, positive elements of the activity are that it is multi-sensory, child-led and takes part in the outdoor classroom. It provides opportunities for mathematical and holistic development in a way that can be tailored to individual needs and preferences. The use of recording devices and the ability to collect things and take them back to the setting could lead to further learning opportunities and revisiting of concepts learnt. The activity is limited by the fact that it works under time constraints and offers freedom which poses a risk of the aims not being achieved. The activity also relies on the expertise and positive attitude of practitioners, which may vary between and within settings. There is a need for the way groups are selected to be changed to provide broader learning opportunities.

3. Discussion on the range and diversity of resources.

A range of resources are available to for settings to purchase for the delivery of early mathematics and numeracy, with the Early Years Resources (2020) website alone offering over 70 items in this area, with prices up to £400. Items are primarily mass-produced from plastic with many designed to be used purely for provision of mathematics and numeracy education, such as counters, sorting/sequencing sets, peg boards and measuring apparatus. Many items have just one purpose, such as flash cards to teach number recognition. Settings may not offer these as part of continuous provision, bringing them out for focused tasks, rather than in child-led play activities.

This contrasts sharply with resources seen in Montessori settings, which are simple, usually made from natural materials and are functional or constructive, such as wooden blocks. They share many attributes with Froebel's gifts, which drew on his own knowledge of science and mathematics, were also well-made, high-quality, and of natural materials. Froebel also advocated the use of naturally occurring and malleable materials like clay and sand alongside sticks, stones and shells. Montessori and Froebelian settings focus on the quality and versatility of the resources provided, quality over quantity (Hogan, 2010; Early Education, No date).

It is notable that the resources advocated by Montessori and Froebel do not limit choice, they are open-ended, to be played with however the child chooses or however the adult models. Many settings set out specific areas, such as a reading corner, a mark making area and a mathematics area. Often children are expected to keep the resources within the specified areas and not to mix the resources up. Although Tucker (2014) recommends the use of 'zones' in early years settings, where space is allocated for different types of learning, it is also stated that there must be evidence of mathematical activity happening throughout the environment. This ties in with the idea of making mathematics and numeracy part of continuous provision, where children have open access to resources that they can use as they choose, to support child-initiated learning. Items added to existing play areas can increase learning opportunities, for example a variety of patterned socks in the home corner, to be matched and sorted or calendar and clock in role-play doctors/veterinary surgery (Pound, 2008).

Mud kitchens have become a popular feature in many Foundation Phase settings, and alongside sand pits and water troughs form provision in the outdoor learning area. They are open-ended resources using natural materials. There are opportunities to weigh, measure, shape and explore properties of materials. With a view to cost and the pressure to keep settings clean and sessions running to time, practitioners may stop children from combining the materials or transporting them between stations. This limits their learning and their freedom within play.

Although plastic resources are easy to clean, quick to buy and can last a long time, there is concern in the light of the climate crisis around the sustainability of using plastic, particularly types which cannot easily be recycled. By making gradual changes and reflecting upon their choices, settings can become plastic-free (Nursery World, 2019). Setting this example is in line with the new Curriculum for Wales 2022 and its

purpose of creating “ethical, informed citizens who show their commitment to the sustainability of the planet” (Welsh Government, 2015b, p.1).

There are benefits to using natural resources, which are tactile and multi-sensory. They are accessible, often within the grounds of the setting or in children’s own gardens, this in itself can stimulate interest in the environment. They are free, which can help settings to keep costs, and as a result, fees, down. They are renewable, but thought should always be given to nature, the environment and where things come from and if in doubt, items should not be removed. These items can become what Simon Nicholson first termed in 1972 ‘loose-parts’, for which there are numerous uses, including learning about shapes, colours, size, weight and counting (Rogers, 2014).

Practitioners can look for opportunities to introduce mathematical and numerical concepts in all areas and activities within a setting. Books and rhymes are full of such opportunities and can provide a theme for activities. Growing and gardening introduce concepts of time and size, simple activities with food introduce pattern, sharing and size, while cooking extends this to temperature, measurement and volume. Many of the resources brought out for such activities could be accessible all of the time for imaginative play. As part of continuous provision, a sensory table containing any of the natural items previously mentioned provides holistic development opportunities through children’s natural inclination towards social play, including mathematical learning opportunities (Hunter, 2008, p.78).

4. How the adult monitors and plans for children's mathematical development.

Currently in Wales, practitioners work within the Early Years Foundation Phase, and the profile handbook states the requirement that observations are carried out both indoors and outdoors, across continuous, enhanced and focused provision and during a mix of adult-led and child-led activities. It requires practitioners to seek feedback from children and to engage with parents/carers to gather evidence of where the child is developmentally. This information should be used to plan appropriate activities and to provide appropriate resources to scaffold the child's learning (Welsh Government, 2017). Bruce (2012) also states the importance of observation-based assessment, and the role of the adult being to provide resources and joint activities. However, the framework additionally requires formative assessment focused on achievement against prescribed skills.

There are questions surrounding how effective this has been, as the Successful Futures report calls for "assessment for learning", where regular feedback informs teaching-practice and learning in order that adaptations are made to tailor education to individual needs (Donaldson, 2015, p.67). Following this advice, the New Curriculum for Wales 2022 places learner progression on a continuum from the age of 3-16, with the learner at the centre of all assessments, and assessment forming part of the process of teaching and learning, thus being indistinguishable from it (Welsh Government, 2020). Specific to mathematics and numeracy provision, the new curriculum calls for experiences that are engaging and enjoyable for the children, which provide a challenge in order to teach resilience and which have relevance through real-life contexts. It presents the view that mathematical proficiencies are all interconnected rather than hierarchical and of the need for children to develop metacognitive skills in order to transfer these skills to other areas of learning (Welsh Government, 2019).

Bruce (2012) outlines the role of the adult as being to support the children through providing stimulating resources, devising activities which develop co-operative working and by stepping back to allow children time and space to develop their own learning. This approach also advocates observation-based assessment. Tucker (2014) also views the role of the adult as being primarily in the provision of resources and creative activities that are cross-curricula, and creating displays of current investigations, which allow children to revisit and discuss their learning.

The Organisation for Economic Co-operation and Development (OECD) measures the skills and knowledge of children around the world in annual Programme for International Student Assessment (PISA) tests. Although the UK is rising up the rankings, it continues to fall outside the top 10 countries in reading, science and mathematics, with Wales being the lowest ranking country within the UK. Asian countries perform particularly well, with China coming top and proving effective at ensuring that even pupils from deprived backgrounds achieve high levels, with those falling in the most deprived 10% attaining higher results than the UK average (Coughlan, 2019).

The highest performing European country as of 2019 was Estonia. Notable regarding their education system is the Nordic model of learning through play in a kindergarten

setting from the age of three or younger, with a gradual introduction to more formal learning before commencement in school at age seven. There is an emphasis on children being emotionally and physically ready to learn. Classes are not streamed according to ability, and though children engage in long hours of learning, much of this online, there is freedom for schools who are not held to account for assessment results in the same way as the UK (Jeffreys, 2019).

Such models have informed the new Curriculum for Wales 2022, where future assessment should be used to build a holistic picture of the child, setting out where the learner is, where they need to reach and how practitioners and other professionals will get them there. This will require practitioners to be clear about the intended learning of each task, evaluate the learning throughout, seek and offer feedback. Practitioners will be expected to engage fully with learners and their parents/carers to identify aims. There should be opportunity for professional dialogue within schools, between schools and other settings and with the Local Education authority and regional consortia to ensure that Welsh learners have equal opportunities (Welsh Government, 2020).

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