

Copyright Notice

Staff and students of this University are reminded that copyright subsists in this extract and the work from which it was taken. This Digital Copy has been made under the terms of a CLA Licence which allows you to:

- Access and download a copy
- Print out a copy

This Digital Copy and any digital or printed copy supplied to or made by you under the terms of this Licence are for use in connection with this module or course of study. You may retain such copies after the end of the course, but strictly for your own personal use.

All copies (including electronic copies) shall include this Copyright Notice and shall be destroyed and/or deleted if and when required by the University.

Except as provided for by copyright law, no further copying, storage or distribution (including by e-mail) is permitted without the consent of the copyright holder.

The author (which term includes artists and other visual creators) has moral rights in the work and neither staff nor students may cause, or permit, the distortion, mutilation or other modification of the work, or any other derogatory treatment of it, which would be prejudicial to the honour or reputation of the author.

Title of extract: **Creating and Using a Mathematical Environment**

Name of Author: **Tucker, K.**

Title/Author of book/edition (if applicable): **Mathematics Through Play in the Early Years. 3rd edition Tucker, K.**

Name of Visual Creator or other acknowledgement (if applicable):

Journal details –title/Vol/Year (if applicable):

Publisher: **Sage**

Pages scanned: **12 - 28**

Course of Study (Module name and number): **The Young Mathematician EAEE4005**

Name of Designated Person

authorising scanning: *E.L. Harris*

Date authorised: 10.11.16.

Moodle/Powerpoint

2

Creating and using a mathematical environment

This chapter covers:

- the features of an early years learning environment with examples of how they can promote mathematical development and provide links with other areas of learning
- creative materials and resources
- creating and using mathematical displays
- mathematical activity in the outdoor teaching and learning area and Forest School.



Ethos

The environment plays a crucial role in a child's ability to develop as a self-regulated learner. A learning environment that encourages the child's self-esteem, actively encourages independent learning and positively encourages risk taking will be more successful in supporting a child's agency and efficacy. A successful learning environment is one in which the psychological and physical aspects are afforded equal consideration (see Chapters 1 and 8).

The physical environment

When planning the physical environment, consideration must be given to:

- appropriate resources to inspire and motivate children
- space to enable interaction with peers and a natural flow from one activity to another
- time dedicated to exploring the opportunities they present.

If we wish mathematical activity to occur, we must show evidence of it happening throughout the environment by examining every aspect of continuous provision for mathematical potential and communicating this to the learning community.

Selecting mathematical resources

Natural materials

Often, the best resources tend to be those that are aesthetic, with potential for creative and cross-curricular opportunities such as conkers, acorns and shells. Offered in baskets or boxes, they can be used for many mathematical activities (see Chapters 4 and 5) and can provide meaningful links with other areas of learning:

- science (growth, materials)
- language (stimulating talk about similarities/differences, descriptive language)
- geography (places of origin, the local environment)
- history (will they always stay the same? What will happen if we plant them?)
- creative (using them for printing with, and as a stimulus for observational drawing and painting).

Numerals, number tracks and number lines

Numerals should be prominently and purposefully displayed. Displaying the sign 'Three people can work in the graphics area' alongside the corresponding numeral and array (see Glossary) reinforces the connection between the written word, symbol and array.

Number tracks (with numbered spaces representing natural counting numbers) and number lines (offering possibilities for representing numbers in between natural numbers – see Glossary) should be available to children and can be presented in a variety of playful ways (see Chapter 4).



Creative ideas for good practice

- Supply tactile numeral cards (made out of rough fabric, sandpaper, rope, etc.) and numeral marble runs.
- Provide areas in the environment where children can count interesting and aesthetic objects and label them with the corresponding numeral.
- Provide opportunities for children to see numerals alongside the written word and corresponding array.
- Display numerals in purposeful contexts (on drawers, pots of pencils, construction boxes, posters/signs, etc.).
- Ensure that number lines, both numbered and empty, are readily available for children to refer to and to write on independently.
- Display 'big' numbers, including a hundred square, prominently.
- Make number games readily available.
- Display books about number.

Other mathematical resources

Resources are most successful when they are theme-related and meaningful for the child, however there are a few essential resources that satisfy basic requirements:

- weighing apparatus – bucket balance, scales
- rulers and tape measures
- jugs and scoops of different sizes

- mathematical symbol cards/tiles
- construction kits, including sets of wooden blocks
- sets of 2D and 3D shapes
- calculators
- bead bars/strings
- counting sticks.

Use of space

In the early years learning environment, space should be zoned for different areas of learning. A well-considered environment may allocate space for the following learning contexts:

- play trays
- small worlds
- role play
- graphics area
- construction area
- reading and listening area
- ICT
- modelling/malleable materials and painting area
- 'washing line'.

Not only can these learning contexts provide excellent, creative mathematical learning opportunities (see Chapters 4–7), they can also act as 'meeting places' where children can discuss ideas, collaborate, solve problems and make important connections between maths and other learning. Pound (2008) argues that offering such opportunities 'is to be welcomed because it highlights the links between mathematics and other aspects of life and learning'. Table 2.1 summarizes mathematical opportunities in these learning contexts.

Displays

The most successful displays are of current investigations which reflect the children's thinking. It is important to display children's own mathematical graphics (see Chapter 3) as this raises the profile of the children's own marks and, by implication, their thinking and problem solving. Children's graphics that communicate mathematical symbols also act to provide an 'environmental model for children' (Carruthers and Worthington, 2011).



Principles into practice

- Provide a display board at child height specifically for children's mathematical graphics. This allows children to select and display their own work, thus giving them ownership of the process.
- Allow children to 'publish' their own booklets about mathematical concepts and display these alongside real books about the same maths theme.
- Where the nature of the recorded work is not immediately accessible to others, display explanations of the intended communication alongside.

Table 2.1 Learning contexts

Learning context	Mathematical features	Resources
Play trays	Offers problem solving involving counting, sorting, pattern making, mathematical operations, shape and measures. (See Table 2.2 for examples of activities and links with other areas of the curriculum.)	• acorns • buttons • conkers • corn • cornflour and water ('gloop') • dog biscuits • fir/pine cones • gravel • leaves • pasta (dried) • paste (water and flour, coloured) • porridge oats • potting compost • sawdust • spaghetti (cooked, coloured, sprinkled in oil) • straw • twigs/bark • wood shavings • wood • wool
Small-world dramas	The 'bird's eye' view of play stimulates the purposeful use of positional and directional language.	• blue, green, brown, grey fabric/hessian for fields, roads, seas, rivers, etc. • plastic/wooden blocks placed beneath the fabric to create undulating landscapes • natural materials: pine cones; driftwood; bark, to create shelters/enclosures/fencing • small animals, play people, houses, vehicles
Role play	Structured role play – café, vets' surgery, travel agents, etc. encourage the writing of lists, bills and receipts and the use of money to buy items and give change. (See Table 2.3 for mathematical opportunities in role play.) Unstructured role play – young children, aged 3–5, benefit most from unstructured role play using open-ended resources (see Further reading). This facilitates emerging social and problem-solving skills. Observations may reveal whether the children are using mathematical vocabulary with understanding and their preferred schemas.	• address/appointment books and cards • bucket balance • calendars and diaries • calculator • cash till • clocks (digital and analogue with clear numerals) • coins and credit cards • dials • dressing-up clothes • forms and notebooks • jugs/containers (of different sizes) • numeral cards (for numbering patients' beds in the hospital etc.) • price tags • recipes • stamps • tape measures • ICT equipment (decommissioned), e.g. telephones, keyboard, laptop, scanner, monitor, etc. • plain tabards • scarves/lengths of fabric • large wooden blocks/crates/wooden frames for den making • cardboard tubes and boxes of varying sizes • writing materials • counting collections (see Chapter 4) • 'treasure' (old jewellery/glass beads) • bunches of keys • bowls, plates, cups, tankards in different materials

(Continued)

Table 2.1 (Continued)

Learning context	Mathematical features	Resources
Graphics area	A dedicated 'work station' for writing and drawing and combines literacy and mathematical graphics. It can be provided for in a tool box, allowing the resources to be carried from one space to another as needed.	• paper of varying colour, shapes and sizes (including squared paper) • pencils and coloured pens • scissors • glue sticks • stapler • sellotape • ready-made booklets of differing sizes • number lines (including empty number lines) • sheets of large numerals (suitable for cutting out) • sheets of mathematical vocabulary (suitable for cutting out) • plastic 2D shapes (for drawing around) • ruler
Construction area	Offers exploration of individual shapes and the spatial relationship between them. Encourages strategies for using blocks to record children's mathematical thinking and problem solving.	• wooden blocks • commercial kits • clearly labelled boxes with words and pictures to help with tidying and storing • challenge cards, e.g. 'can you ...?' and prompt cards, e.g. 'the queen built a large castle ...' • writing materials for children to record responses • small-world animals and people for children to extend their play
Reading and listening areas	Supports and extends mathematical vocabulary.	See Resources
ICT	Supports all aspects of maths. There are some specific examples later in the book which are referenced here.	• Cameras (Chapter 4) • IWB (Chapter 4) • Visualizers (Chapter 6) • Digital microscope (Chapter 5) • Talking boxes (Chapter 4) • Programmable toys (Chapter 6) • Video conferencing (Chapter 7) • SMART interactive table (Chapter 5) • ipad • laptops
Malleable materials and painting area	Modelling dough used to construct and deconstruct shapes; explore length; form numerals. Paint – paint numerals and explore repeating patterns, number, shape, space and position.	• modelling dough • paint • clay tools • theme-related objects
Washing line	Offers opportunities to sequence numerals and measures (including big pictures of coins) and construct repeating patterns along its length.	• laminated numeral cards • theme-related pictures

Table 2.2 Mathematical play tray activities

Context for play and suggested resources	Concept/Skill	Examples of mathematical activity	Links with other areas of learning
Planting Potting compost; butter beans; plant pots (of different sizes); trowels	• estimating how many • counting • using vocabulary of number and capacity • exploring pouring and filling • comparing and ordering capacities	• filling and emptying plant pots • planting beans	• science – growth, materials • literacy – <i>Jasper's Beanstalk</i> by Nick Butterworth and Mick Inkpen
Dinosaur swamp Green paste (water, flour, green food colouring); smooth twigs/driftwood; pebbles; plastic dinosaurs of different sizes	• ordering by size • counting • using vocabulary of number • partitioning • making a sequence or pattern • counting	• lining up dinosaurs in order of size • constructing enclosures for the dinosaurs • lining up minibeads in a sequence or pattern	• science – materials, changing materials • literacy – <i>Bumpus Jumpus Dinosaurumpus</i> by Tony Mitton and Guy Parker-Rees • science – materials • geography – natural materials from the local environment
In the wood Twigs; leaves; conkers; acorns; pieces of bark; plastic minibeads	• making fair shares	• making homes for equal numbers of minibeads	• literacy – <i>Ladybird, Ladybird</i> by Ruth Brown; <i>The Gruffalo</i> by Julia Donaldson and Axel Scheffler
Goldilocks Mugs of 'milk' for the three bears (water with a little white powder or liquid paint); 3 cups of different sizes; jugs	• exploring pouring and filling • estimating how much • comparing and ordering capacities	• filling and emptying cups of 'milk'	• science – changing materials • literacy – <i>Goldilocks and the Three Bears</i> (traditional)
Clothes Buttons of different shapes, colours and sizes; 'clothes', 'boots', 'shoes' (card outlines of trousers, dresses, boots, etc. covered in fabric)	• making a sequence or pattern • sorting • counting • using language of number • exploring and comparing areas	• selecting buttons to lie in a line on the front of the 'garment' • covering 'clothes' in buttons	• geography – clothes suitable for different weathers • art/design – selecting colour/style • literacy – <i>Jamaica and Brianna</i> by Juanita Havill and Anne Sibley O'Brien
Designing a garden Wet sand; dried/artificial flowers; pebbles; sticks; shells	• making a sequence or pattern • exploring properties of 2D shapes • using vocabulary of shape and position	• laying out pebbles, flowers, shells, etc. in a sequence or pattern • sculpting shapes	• science – materials • art – sculpture • literacy – <i>Mary, Mary Quite Contrary</i> (traditional); <i>The Sand Horse</i> by Ann Turnbull and Michael Foreman

(Continued)

Table 2.2 (Continued)

Context for play and suggested resources	Concept/Skill	Examples of mathematical activity	Links with other areas of learning
Jungle swamp 'Swamp' (green food colouring in water); pebbles; driftwood/twigs; plastic snakes and lizards of different lengths	- comparing and ordering by length - counting - using language of number and measurement - making a sequence or pattern	- arranging creatures in order of length - laying out creatures in a sequence or pattern	- science – materials - geography – habitats - literacy – <i>The Enormous Crocodile</i> by Roald Dahl and Quentin Blake
On the farm Grain; small hessian sacks of different sizes; scoops	- exploring pouring and filling - estimating how many - counting - using language of number and capacity - comparing and ordering capacities	filling and emptying sacks with grain	- science – materials, food - literacy – <i>Rosie's Walk</i> by Pat Hutchins
In the pet shop Dog biscuits (of different shapes and colours); thick paper bags; scoops	- sorting - making a sequence or pattern - counting - exploring properties of 2D shapes - exploring pouring and filling - estimating how many - using language of number and capacity	- selecting biscuits to put into bags - laying out biscuits in a sequence or pattern - filling and emptying bags	- science – food - literacy – <i>The Pet Shop</i> by Allan Ahlberg and Andre Amstutz; <i>A Bit More Bert</i> by Allan Ahlberg and Raymond Briggs
Noah's Ark 'Sea' (blue food colouring in water); large plastic boat; twigs/driftwood; leaves/ greenery; pairs of plastic animals; play people	- sorting - making a sequence/pattern - counting in 1s and 2s - partitioning	- matching animals - laying out animals in a sequence or pattern - marshing animals into the ark	- literacy/KE – <i>Noah's Ark</i> (traditional) - science – materials
Fishing game Numbered laminated card fish with paper-clip attachments; fishing rods (dowelling, string with magnet)	- counting - numeral recognition - addition by counting on	- counting fish caught - reading numeral on fish - devising simple games	- science – magnets - literacy – <i>The Mousehole Cat</i> by Antonia Barber and Nicola Bayley
Animal journey 'Lake' (card covered in silver paper); stones; twigs; greenery; plastic animals (mice, frogs, butterflies, lizards, crickets, etc.); play people	- sorting - counting - making a sequence or pattern - partitioning - making fair shares	- putting animals into like groups - laying out animals in a sequence or pattern - making enclosures for animals	- science – materials - geography – habitats, Africa - literacy – <i>Handa's Hen</i> and <i>Handa's Surprise</i> by Eileen Browne

Table 2.3 Mathematical opportunities in role play

Concept/Skill	Possible mathematical activities in the Flower Shop	Possible mathematical activities in the Health Centre	Possible mathematical activities in the Pirates' Voyage
Reading/Writing numerals	- using cash till/telephone/calendar/credit cards - making price tags - filling in order forms - writing addresses and telephone numbers - writing cheques - writing opening/closing times - labelling displays	- writing/reading appointment cards - using calendar/telephone - writing in/reading appointment book - writing prescriptions - writing addresses - using waiting number tags	- reading numerals on doubloons - recording times/dates/items of treasure found in logbook - using/making maps
Counting	- flowers in 1s, 2s, 5s, 10s - message cards in packs of 10 - rolls of ribbons - number of plant pots	- number of patients - appointment cards in 1s, 2s, 5s, 10s - prescription bundles	- counting biscuits/rations - treasure - doubloons in 1s and bags of 10s
Ordering	- items on the shelf in price order - plant pots by size - flowers by stem length	- patients in the queue - position in queue number tags	- telescopes by length - bags of treasure by weight
Sorting	- ribbon by colour/length - flowers by colour - plant pots by size - flowers by stem length - coins in cash till	bandages, plasters, medicine bottles	jewels/treasure/doubloons
Mathematical operations	- calculating prices - giving change - calculating total number of flowers/messages - cards by counting in 2s, 5s, 10s	calculating the total number of appointment cards by counting in 10s	- sharing jewels/doubloons among the crew - finding the total amount of doubloons
Pattern	- flowers by colour for window display - pots and flowers for display		hanging small coloured flags (bunting) in a pattern

(Continued)

Table 2.3 (Continued)

Concept/Skill	Possible mathematical activities in the Flower Shop	Possible mathematical activities in the Health Centre	Possible mathematical activities in the Pirates' Voyage
Weighting	• amount of flower bulbs		• estimating/comparing weight of treasure
Measuring length	• estimating/measuring length of ribbon • estimating/measuring length of flower stems	• estimating/measuring length of bandages	• estimating/measuring length of telescopes/bunting
Time	• using clock • making/displaying opening and closing time signs • recording times of deliveries	• using clock • giving appointment times • displaying opening/closing times • time each patient's appointment	• recording dates in logbook
Shape and space	• wrapping flowers in differently shaped paper/cellophane	• applying bandages	• making small flags • drawing picture maps
Capacity	• filling paper bags with flower bulbs	• filling boxes with rolls of bandages	• filling bags/boxes with treasure
Using money	• making amounts • giving change		• using doubloons as currency

Good mathematics displays need to be interactive and a mix of 2D and 3D displays, taking a variety of forms:

- data displaying the contents of the snack basket or lunch preferences
- wall displays involving counting or pattern that can be discussed and changed daily (see Chapter 5)
- 3D displays of objects for children to manipulate, count, order by specific criteria or arrange in a pattern (see Chapter 4)
- photographs of mathematical activities in role-play situations, or the outside environment, accompanied by written descriptions or documentation
- themed displays showing connections between mathematics and other areas of learning.



Creative ideas for good practice

- Use children's theme-related paintings for pattern making, such as different sized leaves on a giant beanstalk, garments on a washing line or toy vehicles in a traffic jam.
- During a theme about the garden centre, for example, display baskets of large seeds, small plastic wallets and mathematical questions alongside. By counting and bagging the seeds in 10s, a quick and effective display can be made to show what 100 actually looks like.
- Put numerals on objects such as cardboard lighthouses made during technology sessions to stimulate mathematical opportunities in small-world play (see Photo 2.1).
- Encourage children to record their mathematical graphics or lunch choices in the form of a pictogram (see Glossary) on an IWB using a virtual pen to share with parents as they come into the setting on a morning (see Chapter 4).

Display checklist



- Are the children involved in making the display?
- If the display is of completed work, what questions need to be displayed alongside to encourage reflection and talk?
- What information/types of questions need to be displayed to enable parents/carers and others to understand and value the child's work?
- Are all aspects of mathematics displayed over the course of a term?
- What resources or questions could be added to displays from other curriculum areas to help create a mathematical learning environment?

The outside environment

Learning outdoors has long been considered an important aspect of early years education; Margaret Macmillan, Friedrich Froebel and Susan Isaacs have all advocated the benefits of outdoor learning. In recent years, there seems to have been a revival of outdoor learning and the EYFS endorses this as good practice; many settings are now offering outdoor classrooms and Forest School education. The provision of outdoor learning is considerably more than a consideration of resourcing and



Photo 2.1 Including numerals and simple artefacts in this technology display stimulates small-world play with a mathematical content

deployment of staff; indeed Forest School education has a specific pedagogy. It is not the place of this book to discuss the pedagogical principles here (see Further reading) but merely to suggest how to provide for an environment that encourages and supports young children's mathematical development in playful contexts. Pratt (2011) argues that in order for children to become effective mathematicians they should develop a 'mathematical disposition'. This, he suggests, can be supported by the doing of maths outdoors, enabling children to develop an awareness that maths is all around them, allowing them to make connections in their learning and experience natural materials in situ. Knight (2011) suggests that children will be more creative outdoors where they have freedom to be 'innovative, flexible and adaptable' and that this environment will stimulate creative mathematical thinking. To summarize, exploring mathematics outdoors is beneficial as it will:

- offer a sense of freedom without the 'constraints' of the indoor environment
- encourage a 'mathematical disposition' and enable children to make useful links in their learning
- be memorable in that it offers mathematical pursuits in a context not normally associated with mathematical learning
- encourage exploration and risk taking
- support emotional well-being
- contribute to the child's self-image of themselves as a 'mathematician'.

It is important, however, to consider the outdoor and indoor environments as complementary spaces that are linked by their capacity to support children's interests and extend their learning. Some children will of course prefer one environment to

the other because of the different opportunities and atmospheres each affords. Adults should be clear about their role outdoors: are adults there to lead guided work or to support children's own initiated activity? Indeed, Forest School activities would not be true to their principles if they were heavily practitioner-directed.

There are several types of outdoor provision and Bilton (2010) offers definitions. Considered here are two broad types: (1) the dedicated outside teaching and learning area – an enclosed, supervised outdoor space, where children will have free-flow access between indoors and outdoors, and (2) the Forest School experience.

Outdoor teaching and learning area

This outside space should support the seven areas of learning in the EYFS which are Communicating and language (CL); Physical development (PD); Personal, social and emotional development (PSED); Literacy (L); Mathematics (M); Understanding the world (UW) and Expressive arts and design (EAD). These areas may more easily be planned and provided for if the outdoor area can be organized into zones that complement one another. When considering provision in this space practitioners should consider the following points:

- ensure continuity of management strategies and ethos between inside and outside
- give equal status to the teaching and learning of mathematics in each environment
- plan to ensure meaningful links between inside and outside themes and learning areas
- plan for appropriate access for all children
- provide quality and appropriate resources
- provide dedicated time and space for mathematical activity
- allow free-flow access between the environments where this is physically possible, and where it is not, ensuring that children have good 'chunks' of the day outside
- plan for assessment and evaluation of mathematics inside and outside.



Principles into practice

During a theme on 'clothes', practitioners might plan:

- launderette role play inside, while outside there may be washing lines, streets of clothes shops built out of blocks, ride-on 'delivery vans' delivering 'dry-cleaning', numbered parking spaces, etc.
- that all practitioners working in the team spend time in both environments, ensuring that children do not perceive practitioners as 'the inside one' or 'the outside one'
- that a balance of focused teaching and independent activity is carried out and assessed in each environment
- to display photographs of mathematical activities and recorded work from both environments.

Table 2.4 Mathematical opportunities outside

Area of learning	Features stimulating mathematical activity
Expressive arts and design	(In addition to role-play resources list) • dressing-up clothes on numbered hangers • signposts • road signs
Understanding the world (construction)	• numbered and labelled construction kits/trolleys • wooden planks/bamboo/tubing/guttering of different lengths and widths • diggers/ride-on toys with number plates • road signs illustrating speeds, distances • frames to encourage tessellating unit blocks, such as a plywood 'roof' with rim
(science)	• laminated labels indicating dates of planting/order of planting – 1st, 2nd, 3rd • equipment, including clipboard, for measurement and recording • tubs/flower pots of graduated size • buckets/watering cans of different capacities • funnels of graduated size • laminated questions such as, 'How many ladybirds can you find today?' • play tray activities • a selection of natural materials presented in such a way as to encourage pattern making
(ICT)	• a camera for filming the mathematical activity • control technology toys to program movement around a course made by wooden blocks etc. • recording equipment to record 'mathematical stories'/measurements made in the garden area etc. • Apple TV
Physical development (large scale)	• numbered ladders and A-frames • equipment laid out in an identifiable sequence or pattern, straight or curved lines • tunnels of different lengths
(small scale)	• equipment stored in bags of 2s, 5s, 10s • numbered cones • access to games/targets that encourage numeral recognition/shape recognition/counting • sand timers to mark start/stop for specific games
Maths/communication and language/Literacy	• number mat • books depicting number and mathematical skills and concepts (see Resources) • mathematical rhymes and story CDs/recordings

Table 2.4 suggests how mathematical opportunities can be planned for in the outdoor teaching and learning area.

Resources that support outdoor mathematical development include:

- big number tiles, digit cards and numbered cones
- cones numbered in multiples of 10s – this is particularly useful if the children are engaged in counting large numbers of interesting leaves or stones that they have collected
- permanent ground markings, such as parking spaces, number lines, number snakes and decision trees. If these are left unnumbered, the children can number them themselves using number cones or tiles
- containers that can be labelled and numbered to provide further opportunities for sorting, counting and numeral recognition. These also create links with inside management (Bilton, 2010)
- a portable graphics area, such as a tool box containing mark-making resources, number lines, digit cards, etc.

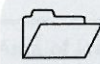
Table 2.5 Mathematical activities for Sukkot

Activity	Environment	Opportunities for mathematics
Making biscuits for a 'celebratory' meal. Counting 10 biscuits on each plate	Inside	• weighing ingredients • counting in 1s and groups of 10s • measuring capacity • using related mathematics vocabulary
Collecting natural materials (branches, ivy, leaves) for roof construction	Outside	• discussion of shapes and sizes of leaves • comparison of lengths of leaves and branches • discussion of patterns on leaves • use of mathematical vocabulary
Construction of three-sided structure for sukkah using hollow wooden blocks/crates	Outside	• discussion of optimum size and position • tessellation of blocks and exploration of properties of shapes • measurement of height, depth, width • exploration of symmetry • problem solving – will it be big enough for us?
Decorating sukkah by constructing paper chains and making celebratory posters	Outside or inside	• constructing paper chains in a colour pattern, such as blue, red, blue, red • incorporating 2D shapes and numerals into posters
Pouring drinks for a celebratory meal	Inside or outside	• using mathematical vocabulary of volume and capacity • measuring capacity • counting • equal shares
Developing role play using a celebratory meal and previous discussions about Sukkot as a stimulus	Outside	• sharing biscuits and drinks fairly • 'reading' mathematical posters • addressing/reading invitations to a celebratory meal • counting/setting places for a celebratory meal

Table 2.5 illustrates how natural links between the inside and outside environments can be used effectively in the teaching and learning of mathematics in mixed-age classes. It illustrates mathematical opportunities based on the Jewish festival Sukkot (see Glossary).

Forest School

Forest School education provides children with a 'wild' context where they are presented with risks and challenges. It is underpinned by truly inclusive principles with great emphasis on personal, social and emotional development, and with an overriding aim to support children in understanding their own capabilities and relationships within their group in the 'forest' environment. The wild and natural environment offered by Forest School encourages a creative freedom that the indoor environment cannot and it is here where children are more likely to be innovative (Knight, 2011). Activity undertaken in Forest School by young children may not necessarily sit comfortably in one curriculum area, but may fluctuate between several. Children will develop their own line of enquiry to satisfy their curiosity and will often find themselves deeply involved in purposeful mathematical investigations. The practitioner's skilful observation will identify mathematical activity when it occurs and sensitive prompts and open questioning can support the creative mathematics as it unfolds. This is illustrated in the following case studies.



Case study: Measuring 'worms' – Foundation Stage (Reception) (4–5 years)

The Reception children prepared for their first Forest School session. The Forest School practitioners' primary aims for the session were to introduce health and safety routines for this and all future sessions, and to set a simple, achievable task enabling all children to succeed. In order to encourage the children to explore the site safely and to facilitate their careful observation, the Forest School practitioners had placed string 'worms' around a designated area. The children were invited to look for the 'worms' and gather up what they found. Working alone, or with others, they began to investigate this new environment and seek out their 'worms'. This simple task gave the practitioners the opportunity to observe the children as they interacted with the environment and with one another. Two girls worked together and, satisfied with their 'worm' collection, sat on a log and lay their discoveries in a line along the log's length. They spontaneously began to compare the worms' lengths, picking up individual worms and laying them alongside others as they discussed their observations and conclusions. The children were highly involved in their exploration, spending an extended period of time comparing the 'worms' using mathematical language. The unobtrusive observation by a practitioner enabled her to notice that:

- the girls were able to develop their self-initiated mathematical enquiry in a collaborative and playful context
- both girls displayed an understanding of comparison as a means of measuring length
- the girls used such language as 'longest', 'shortest', 'shorter than', 'longer than', 'biggest', 'smallest' with understanding
- the girls may be displaying signs of a trajectory schema which could be confirmed by further observations, both indoors and out, and, if confirmed, could then be planned for and extended.



Case study: Estimating numbers and measures – Years 1 and 2 (6 and 7 years)

The children had spent the morning whittling willow to make puppets. They had gathered together for their drink and snack and were enjoying this social time. Two boys spontaneously began to gather sticks around them. One of the boys began to hammer a stick into a small earthy area beside him. The second boy joined him, enquiring how many sticks they might need to fill this space. The boys began to work collaboratively and as they worked they talked continuously about the number of sticks they would need to completely fill the space. As she observed the boys' activity, it became clear to the Forest School practitioner that the boys had devised their own rule for the way in which the sticks should be hammered into the ground. The boys had decided that they must place each stick exactly the same distance from the next one and did so without the use of any uniform unit to measure, merely estimating by sight. As they continued to hammer the sticks, they revised their earlier estimates of the number of sticks needed, now estimating in multiples of 10. Finally, their work was complete. They had hammered 35 sticks and were confident that the sticks were placed at equal intervals. The boys were eager to talk about their activity with the other children and this gave the Forest

School practitioner the opportunity to ask the children how they were certain that the sticks were placed equal distances apart. This prompted discussion in the group about the use of standard units of measurement. Without a standard measure to hand, some children suggested using a short stick as a unit of measurement. The boys were happy to adopt this uniform non-standard measure and, using a short stick, readjusted some of their arrangement, ensuring that it was accurate. While some children in the group began to count the sticks in ones, other children began counting in twos. This spontaneous, playful activity of gathering and hammering sticks gave rise to a lively discussion about the use and application of mathematics and provided a real and immediate context for exploring estimation, uniform measures and counting in different units.



Photo 2.2 Children estimating equal distances between sticks



Creative ideas for good practice

- Encourage a positive ethos in the learning environment which enables children to perceive themselves as competent and enthusiastic mathematicians.
- Provide interactive displays, labels and signs that support mathematical thinking and activity.
- Establish creative, well-planned contexts for play which promote the use of mathematical vocabulary and for which there are clearly identified learning intentions.
- Ensure all areas of the learning environment provide rich mathematical opportunities in order to facilitate good quality child-initiated mathematical learning.
- Provide dedicated time and space for children to use the learning environment for both practitioner-initiated and child-initiated play, and use the environment to show how these are valued.
- Give equal status to the teaching and learning of mathematics in both outside and inside environments.

Glossary

Array: an ordered collection of objects or numbers, often presented in rows or columns.

ICT: information and communication technology.

IWB: interactive whiteboard.

Natural numbers: the number 1 and any other number derived by adding 1 to it repeatedly.

Ordinal: a number denoting the position in a sequence, such as 1st, 2nd, 3rd, etc.

Pictogram: a visual representation of data using pictures to denote the nature of the information it represents.

Schema: repeated patterns of behaviour in young children.

Sukkot: a Jewish autumn festival during which families build a three-sided shelter (sukkah) with a roof made of branches and greenery in their garden. It reminds them of the Jews' journey from Egypt to Israel.

Further reading

Bilton, H. (2010) *Outdoor Learning in the Early Years: Management and Innovation*, 3rd edition. Abingdon: Routledge. This comprehensive book outlines the history of outdoor learning and offers practical advice on planning and provision.

Bruce, T. (ed.) (2012) *Early Childhood Practice: Froebel Today*. London: Sage Publications. Based on Froebelian principles, the emphasis of this book is on the education of the whole child and includes chapters on learning outdoors.

Knight, S. (2013) *Forest School and Outdoor Learning in the Early Years*, 2nd edition. London: Sage Publications. The principles and benefits of Forest School education in the early years are presented here, along with guidance on planning and developing Forest School provision.

Parton, G. (2012) *Belair: Early Years – ICT: Ages 3–5*. Glasgow: Collins Educational. This text contains lots of practical ideas for activities and displays using a variety of ICT equipment in the learning environment.

Rogers, S. and Evans, J. (2008) *Inside Role Play in Early Childhood Education*. London: Routledge. This book explores how a child's involvement in role play, and particularly unstructured role play, helps develop their social skills and dispositions for learning and problem solving consistent with those required by the emerging mathematician.

Waite, S. (ed.) (2011) *Children Learning Outside the Classroom: From Birth to Eleven*. London: Sage Publications. This edited book explores why learning beyond the classroom is important, giving examples which provide links between theory and practice.

White, J. (ed.) (2011) *Outdoor Provision in the Early Years*. London: Sage Publications. This is a very accessible book with clearly signposted prompts and ideas to help the reader understand, plan and develop a range of outdoor learning experiences.