

Play and Picture Books in Early Mathematics

Mathematics learning does not only happen in classrooms. Children learn mathematical ideas from each other, from parents and others as they engage in everyday play and activities. Imaginative or real-world contexts can be used to assess and extend children's mathematical thinking. In this section we discuss how play and picture books might be used as contexts for children's mathematical activities. Other contexts such as project work and learning mathematics through art and physical education are discussed in chapter of RR18.

Play

The importance of play to children's learning has been recognised by research and by various curriculums internationally. However not all playful activities lead to mathematical understanding. Interaction with an adult who plans or notices opportunities to make mathematical connections is important.

In addition, research suggests that the most effective settings for young children strike a balance between teacher-initiated mathematical activity and mathematical activity that arises incidentally from child-led play experiences.

In both approaches, sustained shared thinking time or extended discussions, are key to supporting the development of children's mathematical thinking. (For more on this, see the section on Talk).

The Early Childhood Curriculum Framework, Aistear, describes a range of different types of play: 'creative', 'games with rules', 'language', 'physical' and 'pretend'. Each of these can contribute to children's mathematical learning across all strands of the mathematics curriculum as indicated on the table below.

Type of Play	Brief Description (from <i>Aistear, The Early Childhood Curriculum Framework</i> (NCCA, 2009))	Some Possibilities for Mathematics Teaching and Learning
Creative	Creative play involves children exploring and using their bodies and materials to make and do things and to share their feelings, ideas and thoughts. They enjoy being creative by dancing, painting, playing with junk and recycled materials, working with play-dough and clay, and using their imaginations.	<ul style="list-style-type: none"> ● Sort and display collections of toys or other objects in creative ways. ● Identify 3D shapes during junk art. Create and describe structures, e.g. compare size and shapes. ● Draw, paint or glue with shapes. Create shape pictures using shapes or tangram pieces. (See First Class activity plan on Shape). ● Explore and describe 3D shapes and position during block play. ● Create and describe patterns using different materials. ● Use playdough/clay to make shapes, structures or patterns. Make comparisons and explore measures language. ● Explore rhythm and pattern within music and dance. ● Develop spatial awareness through dance and movement.
Games with rules	In the beginning children often play by their own rather flexible rules! In time they also partake in more conventional games with 'external' rules. Language is an important part of games with rules as children explain, question and negotiate the rules. Rules are often an important part of pretend play where children negotiate rules about what can and cannot be done.	<ul style="list-style-type: none"> ● These are particularly useful for sorting and classifying. See the '<i>What's my rule?</i>' game on the Junior Infant Sorting activity plan. Here the teacher only lets certain shapes into her set (e.g., four-sided shapes) and children must guess what the rule is. The game sets up the need to use mathematical language and provide explanations and justifications.
Language	Language play involves children playing with sounds and words.	<ul style="list-style-type: none"> ● At first glance, language games may look more

	<p>It includes unrehearsed and spontaneous manipulation of these, often with rhythmic and repetitive elements. Children like playing with language – enjoying patterns, sounds and nonsense words. They also love jokes and funny stories.</p>	<p>appropriate to developing children’s literacy. However, all mathematics teaching must attend to developing language to reason with as well as mathematical vocabulary.</p> <ul style="list-style-type: none"> • Songs, chants and rhymes are examples of language games that may have mathematical content such as counting, addition and subtraction, shape or positional language, e.g., The Grand Old Duke of York or Five Little Monkeys. • Consider how language is developed in the Billy Goats Gruff Preschool activity plan.
Physical	<p><i>Physical play</i> involves children developing, practising and refining bodily movements and control.</p> <p><i>Exploratory play</i> involves children using physical skills and their senses to find out what things feel like and what can be done with them.</p> <p><i>Manipulative play</i> involves practising and refining motor skills and includes manipulating objects and materials.</p> <p><i>Constructive play</i> involves building something using natural and manufactured materials.</p>	<ul style="list-style-type: none"> • Children’s own movements and positions can be described in spatial terms. • Playing with water and sand provides opportunities to explore capacity and to devise ways of figuring out which containers hold more or less. • Manipulative or construction objects offer opportunities for counting, but also for using comparative language (e.g. wider, taller, smallest) and the terminology of shape and position. For example, see the Preschool activity plan on Block play. • Placing clothes on a mini washing line encourages discussion about size and pattern (and also refines motor skills).
Pretend	<p><i>Pretend, dramatic, make-believe, role, and fantasy play</i> involves children using their imaginations. Children use their developing language to move</p>	<ul style="list-style-type: none"> • Exploring the concept of length while measuring in the building site (e.g. using vocabulary of long/short, longer/shorter than, imaginative play using

	<p>from thinking in the concrete to thinking in the abstract. Children may act out real events but may also try out roles, occupations and experiences in their pretend play. <i>Early numeracy</i> is clearly evident in this type of play, for example when children pretend to buy items in a shop.</p> <p><i>Small world play</i> involves children using small-scale representations of real things like animals, people, cars and train sets as play props. <i>Socio-dramatic play</i> involves children playing with other children and/or adults. It provides opportunities for children to make friends, to negotiate with others, and to develop their communication skills. This play helps extend language. The ability to write stories also has its roots in socio-dramatic play.</p>	<p>measuring tape).</p> <ul style="list-style-type: none"> ● Identifying and using coins (e.g. in the shop). ● Classifying and sorting (e.g. sorting food in different ways in the restaurant - fruit and vegetables, healthy and unhealthy). ● Matching (e.g. in the home corner matching items that belong together, e.g. knife and fork, cup and saucer). ● Opportunities for informal recording/writing (e.g. writing prices on receipts in shop).
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Picture Books

Teaching mathematics using story picture books has the potential to develop conceptual understanding, improve language ability, and foster positive attitudes towards mathematics (Trakulphadetkra, 2018, 2015, among others). Stories can provide a meaningful, enjoyable context for young children's learning of mathematics. Picture books can be enjoyed at any age, but are particularly relevant for younger children whose literacy skills are still developing. The pictures themselves may show visuals of mathematical concepts (e.g., a number of objects for counting or a tiny snail and a large whale).

Some picture books make the mathematical content very explicit. It is clear that they have been written to teach mathematics concepts such as counting objects or naming shapes. In other books, the mathematical content is implicit. It is embedded in a story which can be enjoyed in its own right. For example, the *Billy Goats Gruff* story used in the Preschool activity plan is an example of a story with implicit mathematical content. Teachers used this story as a context to develop the positional (e.g. over, under) and comparative language (e.g. taller, narrower) and related concepts. Other well-known books and stories which have implicit mathematical content include: Day Monkey, Night Monkey, Handa's Surprise, Goldilocks and the Three Bears, Six Dinner Sid, Ten Apples up on Top, Ten in the Bed, The Very Hungry Caterpillar, The Smartest Giant in Town, The Snail and the Whale, and We're Going on a Bear Hunt. See [MathsThroughStories](#) for recommended books and activity guides, including many developed for Irish classrooms.

Talk between teacher and child or between children themselves may help make explicit and meaningful the mathematical content of a story. Such interactions create opportunities for shared attention to mathematical meanings and reasoning. At times this attention to mathematical meanings may arise incidentally from children's responses to specific picture books. It is also possible to select picture books purposefully with specific mathematical content in mind.

The list below shows some short articles written for teachers on using books to teach mathematics. Some of the articles also discuss the potential for increased parental engagement through

For Irish primary teachers, the Teaching Children Mathematics articles are available through the [Teaching Council Online Library](#).

Fitzgerald, E., & Twohill, A. (2019). Investigating the effect of shared picture book reading on parental involvement in mathematics. In L. Harbison, & A. Twohill (Eds.), *Proceedings of the Seventh Conference on Research in Mathematics Education in Ireland (MEI7)* (pp. 83–90). Dublin, Ireland: Zenodo. <http://doi.org/10.5281/zenodo.3539081>

Marston, J., Muir, T. & Levy, S. (2013). Can we really count on Frank? *Teaching Children Mathematics*, 19(7), 440–448

McCarty, D. (1998). Books + Manipulatives + Families = A Mathematics Lending Library. *Teaching Children Mathematics*, 4(6), 368-375.

Yeon Lee, M., & Francis, D. (2019). Measuring Penny. *Teaching Children Mathematics*, 25(4), 232-241

Analyse and Reflect

- Review the types of play described by Aistear and the sample mathematical activities provided on the table. Which types of play do you use most frequently in your teaching? Which strands of mathematics do you include (Number, Shape, Measures, Algebra, Data)? Are there opportunities to develop activities targeting other types of play/other mathematical areas?
- In your school/setting, what is the balance between teacher-initiated mathematical activity and mathematical activity that arises incidentally from child-led play experiences? What do you think children feel about the current approach? Could there be potential benefits from trying something new?
- Review the Early Years section of the [Nrich](#) website for other play-based or playful approaches to the teaching and learning of mathematics
- Think about the last five books you read to your class. Did they have explicit or implicit mathematical content?
- Think of three books you already have that might be used for the teaching of mathematics. See [MathsthroughStories](#) if you are short of ideas.