



Filling the learning cup: Capacity in kindergarten

A group of young children are playing in a mud kitchen. They scoop sand into a bucket using differently sized cups. They are describing measurement concepts using language such as 'big' and 'small', 'full' and 'empty', commenting that one cup puts more sand into the bucket compared to another cup. They decide to make cups of tea for the teachers and educators. Using the largest cup, they pour water into the smaller cups and laugh when the cups overflow. A teacher observes their play, jotting down the terms they are using, and thinking about ways to extend the capacity concepts they are exploring.

This moment captures the spontaneous and playful nature of early mathematical learning. In this scenario, children are filling, pouring, and comparing, engaging with foundational ideas about capacity and informal measurement. Experiences such as these, a staple in early childhood contexts, foster reasoning, comparison and problem-solving skills.

This article explores:

- how capacity is experienced and understood in kindergarten settings
- why it matters for early learning, the importance of mathematical language
- how teachers and educators can intentionally support and extend children's mathematical language and thinking through everyday interactions and planned experiences.

The *Queensland kindergarten learning guideline* (QKLG) identifies measurement, including capacity, as a significant learning that children engage in (Queensland Curriculum & Assessment Authority, 2024). Within the learning and development area of *Communicating*, and the key focus of *building numeracy in personally meaningful ways*, children are supported to use everyday language to notice, describe, and compare attributes of capacity. These experiences are embedded in play, routines, and interactions, forming a foundation for mathematical thinking in early childhood.

Capacity is a measurement concept referring to the amount a container can hold. If we imagine a cup, for example, the capacity is how much liquid can be poured into it before it overflows. But learning about capacity is so much more than this, as the opening scenario shows. Filling buckets with sand and transferring water from one container to another not only supports exploration of how full the container is, but also develops their understanding of how the size of containers affects their capacity. Through hands-on experiences, they are exploring concepts, like full, half-full, empty, and measurable quantities, and engaging with reasoning, comparison and problem-solving.

Why learn about capacity in kindergarten?

Early childhood mathematical experiences lay important foundations for lifelong learning. Early mathematics skills have been shown to predict later academic success in domains such as mathematics, reading and science (Claessens & Engel, 2013; Watts et al., 2014). Understanding how these concepts emerge in the early years allows teachers to more intentionally support and extend children's mathematical thinking.

We know that children are exposed to measurement from very early ages and their understandings about measurement begin prior to school (e.g. Clements & Stephan, 2004; Gervasoni & Perry, 2015; Whiteford, 2019). From infancy, children are laying the foundations of capacity, enjoying filling and emptying cups. By kindergarten, children can compare containers based on how much they hold and begin to quantify these differences (Clements & Sarama, 2020).

Exploring capacity lends itself to exciting and engaging hands-on experiences. These experiences not only deepen children's understanding of capacity, but also foster critical thinking, problem-solving, and reflective skills. As children compare, estimate, and measure, they make predictions, test ideas, reflect on outcomes and build confidence in mathematical reasoning. Activities like filling and comparing containers encourage children to articulate their thinking, confront misconceptions (e.g. assuming taller containers hold more than wider ones), and revise their understanding.

How can early childhood teachers and educators engage children in capacity experiences?

Children explore capacity through a variety of experiences. Everyday routines and interactions, such as cooking or tidying up, offer authentic opportunities for children to engage with capacity concepts in meaningful and relevant ways (MacDonald & Murphy, 2019). These routine experiences are rich in mathematical potential, particularly when teachers are attuned to the learning embedded within them and deliberately plan for learning in these moments.

Equally important are play-based capacity experiences that are active, hands-on, and purposefully designed to extend children's thinking (Dunphy, 2018; Knaus, 2017). These may be planned as stand-alone experiences or emerge as part of other inquiry explorations. When teachers plan for capacity learning across diverse contexts, they create opportunities for children to deepen their understanding through exploration, discussion, and reflection.

Using stories

Storytelling is a powerful strategy for supporting children's understanding of capacity. Picture books are a well-known resource for engaging children and have been found to contribute to young children's understandings of mathematics (McGuire et al., 2020). Some stories that explore capacity language and concepts include:

- *A Beach for Albert* by Eleanor May focuses on predicting and comparing capacity of different containers using the language such as 'bigger', 'full', 'same', 'taller', 'wider'
- *Mr Archimedes' Bath* by Pamela Allen explores displacement and overflowing, encouraging discussion about volume and capacity.
- *Tiddalick the Frog*, a traditional Dreamtime story can be used discuss how Tiddalick emptied all the water from the lakes and rivers, leaving none for others, and how those water sources could be refilled.

Using open-ended resources

Providing children with a variety of open-ended materials, such as small spoons, large pots, recycled containers, and natural items like sand, water, shells or leaves, encourages exploration of capacity in diverse and meaningful ways. These materials can be offered across different play areas, including water play, painting, and cooking.

Asking questions (lots of questions)

Questioning is a foundational strategy that supports the development of mathematical reasoning, reflection, and conceptual knowledge (e.g. Nergård, 2023; Stites & Brown, 2021). In the context of capacity, purposeful questions can prompt children to notice, compare, and reason. Rather than focusing on correct answers, effective questions invite children to articulate their observations, test their ideas, and engage in sustained mathematical inquiry.

Teachers and educators can draw on a range of question types to support and extend children's mathematical thinking (e.g. University of Cambridge, n.d.):

- **Open-ended questions** such as 'What do you notice?' or 'What do you think will happen next?' promote exploration and multiple perspectives.
- **Comparative questions** like 'Which one holds more?' or 'Is this cup bigger or smaller than that one?' help children develop the language of capacity.
- **Reflective questions** such as 'How did you know it was full?' prompt children to explain their reasoning and consider alternative viewpoints.
- **Extending questions** like 'How can we find out if these two cups hold the same amount?' invite further experimentation and deeper engagement.

These types of questions not only support the development of capacity understanding, but also mathematical language development. In fact, purposeful questioning is a key driver of **math talk**, the rich mathematical dialogue that helps children articulate, justify, and refine their thinking (MacDonald & Murphy, 2019). When teachers model and encourage this kind of talk, they support the development of mathematical language, which is linked to later success in mathematics (e.g. Purpura & Reid, 2016).

In the opening scenario, children in the mud kitchen are already engaging with capacity concepts through their play with scooping, pouring, and comparing different containers. A teacher observing this play might use questions such as 'Why do you think that cup made the bucket overflow?' or 'Can you find a cup that holds the same amount?' thus guiding the children to think more deeply about capacity within their play.

Reflection

Contexts for learning

- What opportunities do different learning environments (indoors, outdoors, routines, and real-life experiences) offer for children to explore capacity in authentic ways?
- How might I make better use of everyday moments to highlight and extend children's understanding of how much things hold?

Purposeful provisioning

- What types of containers, tools, and materials could I offer to invite children to investigate and compare capacity?
- How can I ensure that the resources I provide reflect a range of sizes, shapes, and cultural contexts to support inclusive and meaningful exploration?

Responding to children’s thinking-in-action

- What have I noticed in children’s play, language, or problem-solving that reveals their current understanding of capacity?
- How can I build on their actions, questions, and discoveries to co-construct deeper learning experiences?

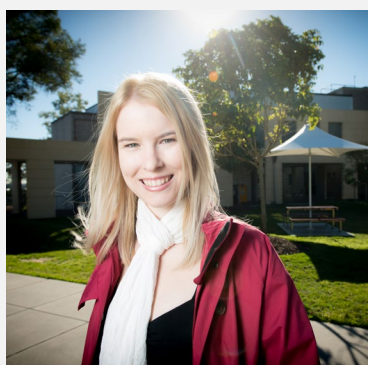
Intentional teaching

- How can I use intentional questions, prompts, and provocations to support children in noticing capacity?
- How can my curiosity and responsiveness support children’s mathematical thinking in the moment?

Reflecting on practice

- Reflecting on the mud kitchen scenario, what strengths do I see in my current practice, and what could I take away from the example to inform how I plan future experiences to support capacity learning?
- How might I document and revisit these moments with children to deepen their understanding and celebrate their thinking?

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