What's the 'big ideas'?

How quality STEM education can be integrated into family day care through children's everyday activities.

Research shows that young children—including infants—are capable of learning mathematics and science concepts (Baroody, 2003). It shows that learning of science, technology, engineering and mathematics (STEM) concepts in the early years is associated with children's later school readiness and academic achievement (Duncan et al., 2007). There is also consensus among researchers that going beyond surface-level STEM experiences is vital for nurturing lifelong learning dispositions including creativity, curiosity, problem-solving skills, risk taking, resilience and the ability to recognise interconnections and relationships between ideas and concepts.

But what should quality STEM experiences look like in prior-to-school settings? This was less clear until the US-based Early Childhood STEM Working Group (2017) deliberated over the concerns around ensuring high-quality STEM experiences in future early childhood education and care, and published a report providing multiple recommendations on how this could be achieved. This group of scholars, policy-makers, curriculum developers and educators collaborated for two years before coming up with principles and recommendations, which are gaining traction in the field. One of their main recommendations focuses on discipline-specific concepts and skills, known as the big ideas (see Table 1 for examples). Engagement with these big ideas at an early stage is projected to support 'long-term disciplinary understandings and challenge misconceptions' (Early Childhood STEM Working Group, 2017, p. 29).

So, understanding these ideas can inform educators' identification, design and extension of STEM learning experiences for children.

Big ideas in practice

As part of a larger research project (Whiteford, in review) that aims to bring about change in the implementation of STEM education in the early childhood sector, I recently investigated the big ideas of STEM in a metropolitan family day care (FDC) setting. I selected the FDC setting because this context is generally under-researched, and because it provides a rich learning environment with strong foundations for positive learning experiences (Freeman & Karlsson, 2012). I hypothesised that STEM experiences were occurring within FDC environments daily, and by providing case studies linked to big ideas I hoped that educators would increase their confidence with STEM experiences in FDC contexts.

In one observation, a three-year-old boy was investigating the rolling of a toy aeroplane down a ramp. First the boy rolled the toy down the rough side of the ramp. He then flipped the ramp over to reveal a smoother side, and rolled the toy down this side. He exclaimed to the educator that the smooth side made the aeroplane go faster. This experience explored the changing coefficient of friction. In terms of the big ideas, the boy was exploring the properties of materials from the discipline of engineering, and the notion of 'cause and effect' while changing a variable, which is in the discipline of science (Early Childhood STEM Working Group, 2017).

Luca and Amelia make a balance scale to measure weight and learn big ideas from the engineering and mathematics disciplines.

Luca learns about friction by rolling a toy aeroplane down a ramp that has a smooth side and a rough side.

'So, understanding these ideas can inform educators' identification, design and extension of STEM learning experiences for children.'

In another observation, two children of different ages were interested in measuring the weight of sand, to explore the concept of things being heavier or lighter. The educator provided the children with open-ended materials so they could design and construct a tool that would help them reach their aim of measuring weight. They created a balance-scale with a piece of wood. During this experience, the children connected with some big ideas of engineering, such as materials having properties that can be explored and described, and learnt that engineers use a multi-step process to solve problems. They also experienced a mathematical big idea, that of measurement involving a fair comparison (Early Childhood STEM Working Group, 2017).

These case studies can provide educators with real-world examples of big ideas in action in the FDC environment. Engagement with real-world scenarios can increase educators' confidence in identifying and extending STEM experiences within their settings. Experiences within the settings can be natural and spontaneous (such as what happened in observation one) or can be a planned extension of children's interests (observation two). With an understanding of the big ideas, educators can more readily identify and engage with STEM learning experiences in their settings. As the FDC setting is unique and often has a sole educator, it is vital that we continue to explore STEM education in this environment.

Dr Chrystal Whiteford
Lecturer in Early Childhood and Primary Mathematics Education
School of Teacher Education and Leadership
Faculty of Education
Queensland University of Technology

References

Baroody, A. (2003). The development of adaptive expertise and flexibility: The integration of conceptual and procedural knowledge. In A. J. Baroody & A. Dowker (Eds.), *The development of arithmetic concepts and skills: Constructing adaptive expertise* (pp. 1–34). New York, NY: Routledge.

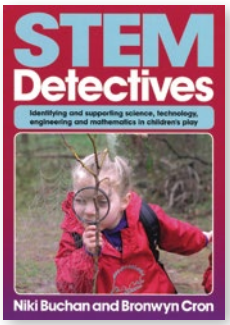
Duncan, G. J., Claessens, A., Huston, A. C., Pagani, L. S., Engel, M., Sexton, H., … Japel, C. (2007). School readiness and later achievement. *Developmental Psychology, 43*(6), 1428–1446.

Early Childhood STEM Working Group. (2017). *Early STEM matters: Providing high-quality experiences for all young learners*. Chicago, IL: UChicago STEM Education and Erikson Institute. Retrieved from http://d3lwefg3pyezlb.cloudfront.net/docs/Early_STEM_Matters_FINAL.pdf.

Freeman, R., & Karlsson, M. (2012). Strategies for learning experiences in family child care: American and Swedish perspectives. *Childhood Education, 88*(2), 81–90.

Whiteford, C. (in review). *STEM education in the early childhood years*. Women in Research Grant.

ECA RECOMMENDS



STEM detectives: Identifying and supporting science, technology, engineering and mathematics in children's play
Niki Buchan and Bronwyn Cron
$49.95

This practical resource will encourage educators to identify the STEM—science, technology, engineering and mathematics—skill present in children's play. It will guide them to develop the skills and understanding to support a deeper level of STEM exploration and discovery.

To order or find out more, please visit: www.earlychildhoodaustralia.org.au/shop/sund805 or (free call) 1800 356 900.

Table 1: Sample of big ideas in STEM disciplines*

Within the Early Childhood STEM Working Group (2017) report is a list of big ideas, alongside examples of how to implement them within an early childhood context. Below is an example and more can be found on pages 30 and 31 of the report at ecstem.uchicago.edu.

DISCIPLINE AND BIG IDEA	EARLY CHILDHOOD EXAMPLES
Engineering: Materials **Big idea:** *Materials have properties that can be explored and described.*	Sandpaper is "scratchy, rough, stiff and brown" and felt is "fuzzy, soft, bendable and green".
Science: Structure and Function **Big idea:** *The shape and stability of an object or living thing is related to its properties and functions.*	Animals and objects with wings can fly; animals and objects without wings can't fly.
Mathematics: Patterns **Big idea:** *Identifying the rule of a pattern brings predictability and allows one to make generalisations.*	After lunch comes recess. If we keep counting people's feet, it will always be 2 more.

*Source: Early Childhood STEM Working Group, 2017.