Steering STEM education development through play

The growing importance of science, technology, engineering, and mathematics (STEM) for learning at school and beyond is placing increased emphasis on building the framework for their experiences in early childhood. However, designing the learning progressions children experience during this time undervalues a remarkable fact: children’s connection with STEM is intuitive. Chelsea Cutting of the University of South Australia’s STEM Education Research Centre, University of Canberra’s STEM Centre in Canberra, such developmental play is also the foundation for spatial and logical reasoning – which are critical to how young children develop STEM concepts. With this as their focus, they have developed an innovative approach for investigating and supporting children’s learning in early childhood.

THE ‘MESSINESS’ OF LEARNING

Children’s development is often conceptualised around what are known as ‘learning progressions’, sometimes called ‘learning trajectories’ – recognised pathways of how children develop knowledge within a specific domain. Notably, such learning progressions, or LPs, shape instruction and learning design and assessment. This is especially the case in maths and science. Given the nature of these subjects, LPs are usually focused on content – for example, knowing certain basic mathematical ideas by a specific age. Most approaches to developing LPs usually involve cross-sectional, clinical interviews with children, observing the behaviours children may exhibit while doing particular tasks, or the more hypothetical focusing on the tasks that promote children’s development within a conceptual domain. However, Cutting and Lowrie argue that the LPs that emerge from such approaches simplify the learning process and undervalue the direct and indirect influences on it – the ‘messiness’ of everyday, play-based learning.

Imagine a group of young children playing, and the focus of their game involves play tools at their disposal. They will sort out a suitable allocation of resources among themselves; it wouldn’t be ‘fair’ or functional for one child to have all the tools, so they will eventually share them. That requires basic mathematics. When they start using the tools, they will realise that certain ones are better suited for specific purposes, digging, say, or carrying water. Those can be considered elements of engineering. When you consider childhood play from that perspective, it becomes increasingly clear how children embrace the central precepts of STEM from an early age.

Cutting and Lowrie, this is critical when developing LPs; it’s also more faithful to the fundamentals of early childhood education.

In Australia, educators place significant emphasis on child-led, play-based education during early childhood, underpinned by the Early Years Learning Framework (EYLF). Developed with input from the early childhood sector and early childhood academics, EYLF holds that, far from being vessels for learning, young children are active participants in their education. Furthermore, EYLF is structured around five learning outcomes: children have a strong sense of identity; they connect with and contribute to their world; they have a strong sense of wellbeing; they are confident and competent communicators. It’s easy to see how the content-focus priorities of STEM education in structuring LPs provide opportunities for disconnect, or at least tension, with the basic principles of EYLF.

PROGRESSIONS

‘Learning progressions’ emerged from a national play-based learning programme, ELSA (Early Learning STEM Australia), believes that young children don’t make sense of the components of STEM as individual subjects but collectively, via the spatial and logical ways of reasoning. Built upon the work by Lowrie, Fitzgerald, and Leonard, who suggested children do this through a combination of ideas, methods, and values, Cutting and Lowrie propose that it is these that should be the basis for a BLP pedagogical architecture. Problem posing and questioning are examples of ideas children will have; they may encode and decode information involved learners, and they are effective communicators. It’s easy to see how the content-focus priorities of STEM education in structuring LPs provide opportunities for disconnect, or at least tension, with the basic principles of EYLF.

BOUNDARY LEARNING PROGRESSIONS

Cutting and Lowrie propose that learning progressions are bounded by the context in which learning occurs. Specifically, children will have; they may encode and decode information involved learners, and they are effective communicators. It’s easy to see how the content-focus priorities of STEM education in structuring LPs provide opportunities for disconnect, or at least tension, with the basic principles of EYLF.
Behind the Research

Chelsea Cutting and Tom Lowrie explore the importance of play and intuition in children’s early connections with STEM learning.

Research Objectives

Chelsea Cutting and Tom Lowrie explore the importance of play and intuition in children’s early connections with STEM learning.

Detail

Bio

Chelsea Cutting is a lecturer in mathematics education at the University of South Australia, in the Early Childhood and Primary Teacher education programmes. She is currently undertaking her PhD exploring the role spatial reasoning plays in young children’s understanding of fractions.

Centenary Professor Tom Lowrie is Director of the STEM Education Research Centre (SERC) and Program Director for the Early Learning STEM Australia (ELSA) project. Tom’s research translation has led to the creation of a commercial learning platform (splatmaths.com.au) that promotes young children’s STEM engagement and learning.

References


Personal Response

What next steps do you think are necessary to enable future STEM learning frameworks to be embraced into early childhood practice?

We hope that our framework will be valuable in supporting educators and researchers to capture learning in ways that respect children’s culture and context. From a policy perspective, this includes being able to monitor learning in situations that are play-based and intentional rather than through traditional assessment processes. Teachers should be encouraged to use their professional knowledge and skills to promote authentic and sustained learning engagement, rather than being pressured by ‘content achievement’ and assessment practices that are at odds with the very nature of early childhood pedagogy. Enabling such agency is critical to promoting and fostering quality educational outcomes.