‘This Machine Cleans the Air’ – Early Childhood STEM in Ireland

A look at current policy and inspiring practices

This article examines some of Ireland’s current early childhood STEM policies and practices, focusing on two examples of settings where exemplary STEM practices were seen to be already taking place. Such illustrations can provide inspiration to other settings and show that the current early childhood STEM policy aspirations are well founded. Timely implementation of these policies could see exciting times ahead for early childhood STEM practice in Ireland.

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Introduction

It is widely recognised that young children are both interested in and capable of engaging in STEM learning (Patrick & Mantzicopoulos, 2015; McCormick Smith & Chao, 2018). Research has also indicated that supporting young children’s STEM learning in early childhood education (ECE) settings can improve their educational outcomes long-term, in both STEM and other subjects (Schoenfeld & Stipek, 2011; Morgan et al., 2016). Government educational policies and curriculums, recognising the developmental potential of early STEM learning, often recommend that STEM learning opportunities be provided for children in ECE settings (DES, 2017a; Australian Government Department of Education, 2022).

In Ireland, the STEM Education Policy Statement (DES, 2017a) recognised the importance of giving children opportunities to engage in STEM learning from early childhood. The STEM Education Implementation Plan (DES, 2017b) indicated that an evidence-based model of STEM practice in ECE settings would be developed. Although the Covid-19 pandemic delayed progress, the National Council for Curriculum Assessment’s (NCCA) Aistear Síolta Practice Guide has been updated to include guidance on STEM teaching and learning in ECE settings, a welcome addition for ECE educators (NCCA, 2020).

However, many ECE educators, who have had little or no training in STEM pedagogy or practice, continue to lack the skills, knowledge, and confidence to successfully implement STEM learning for young children in their settings (DES, 2020a; DES, 2020b). The DES Guide to Early Years Education Inspection, reflecting the aims of the STEM Education Policy Statement, seeks evidence that ‘children have

opportunities to engage with activities that build early positive dispositions' towards STEAM (DES, 2018, p.22).

The Department's report on practice in ECE settings indicated that STEM learning achievements and STEM teaching were 'less than satisfactory' in 28% of the lessons observed (DES, 2020b, p.14). Lack of knowledge around age-appropriate digital learning and government STEM education policy were also apparent in reports (DES, 2020a, 2020b). It was acknowledged, however, that further supports were necessary for ECE settings to progress in the area of STEM (DES, 2020b).

Despite delays to appropriate supports for ECE settings to progress STEM learning for young children, there are examples of high-quality STEM practices in ECE settings across Ireland. These settings lean into Aistear's model of inquiry-based learning in an emergent and play-based curriculum, to build positive learning dispositions such as curiosity, investigation, and creativity (NCCA, 2009). During inspections in such settings, children were seen to be engaging in 'activities that fostered creativity and critical thinking skills . . . enabl[ing them] to be natural discoverers, inquirers, engineers and explorers' (DES, 2020b, p.14).

Excellent STEM practice in ECE settings

We have seen examples of excellent STEM practice in such ECE settings. Below, we describe practices we have observed and offer brief commentary on the features that contributed to our excitement at witnessing them.

In one ECE setting, Hamsa saw initial examples of young children's interest in the idea of electricity. The educator mentioned that one child, waving a piece of wire, had said: 'It's electric.' The educator had noted this, and said to Hamsa that she was going to wait for other children to pick up on the idea, before following up on it with the group. Her patience was rewarded: a few weeks later, examples of this child and another child's model-making related to electricity. Her records and interpretations of these two children's talk about their models are as follows:

Four-year-old child's words about his machine: 'This machine cleans the air. The wire is the electricity, and it brings the air down into the machine. The blue and pink bits are where the air is cleaned – it goes around. Then the clean air comes out of the cork. The gold beads are the buttons to make it work.'

'The Stinger Pupper Machine' (child aged 3.5)

Extract from learning journal:

You started to combine the wire with the clay, and when I commented on how you had made the wire 'stand up really tall', you explained that it was a 'Stinger Pupper Machine'. You then proceeded to tell me that 'when I put lightning in it, that makes it sting. The lightning comes from the cloud, and it goes inside the wire and then the wire stings.'

From this event you demonstrated your ability to use the clay and wire to create a product, and when considering what your creation could be you drew on your knowledge of lightning and its ability to 'sting' you. You also had knowledge of how electricity is conducted.

Subsequently, several children started drawing pictures of electricity, and decided to build a model electric car charger in their talk in a game about traffic, and drew pictures of electricity. The educator noted at this point that she had purchased an electric circuit to show them how electricity is conducted and a kit to show them how the energy stored in a potato can be used to power a clock.

What is marked for us is this educator's knowledge base and pedagogic skill. She noticed fragments in children's flow of talk that were important markers of their current interests and frames of reference, and these could be linked to important strands of science and the technologies linked with designing and making. This kind of 'noticing' skill has been extensively described as a key marker of skilled pedagogy (Jacobs et al., 2010).

The educator was also patient enough to wait for interest to spread organically beyond a single child, before offering conversations and activities for children to engage with that could take their ideas forward, while also having a sense of 'suitable conversations' – conversations that could build a thread from children's interests and understandings towards the disciplinary understandings that would be recognised by scientists.

These threads often take years to develop, but we were fortunate enough to access teaching that exemplified important parts of this trajectory in the work of this teacher. And across this work, the approach was learner-centred and play-based, while also attuned to the forward trajectories of scientific and technological ways of thinking, concepts, and ideas.

Part of our work as teacher educators and policymakers is to make illustrations of these kinds of shorter-term trajectories more available for ECE educators, who may be a little less confident about what to do when children express ideas that appear to have STEM-related possibilities. These trajectories are not always easy to capture in the course of children's play-based learning, where the timelines of individual and small-group learning

have little in the way of pre-defined schedules. But the illustration above shows what is possible in the hands of a skilful and engaged ECE educator.

In another setting, staff reflected on the benefits of technology use in their setting during the pandemic, particularly the use of Zoom for remote visits to their local nursing home or for children who had to stay home. This prompted a move towards 'teaching the children about mindful usage and the joys technology could bring' while a technology vision statement was developed with families. Trust in the children's capabilities with technology led to the development of skills such as leadership, creativity, and communication:

> *The first real introduction was the camera on the iPad. Instead of the teachers taking the pictures, the children started to take the pictures, with amazing results. When the teachers took the pictures, not all the children would be relaxed in them, but when their friends took photos, children were relaxed, making faces and really showing off. It was also lovely to see the educators in the pictures.*
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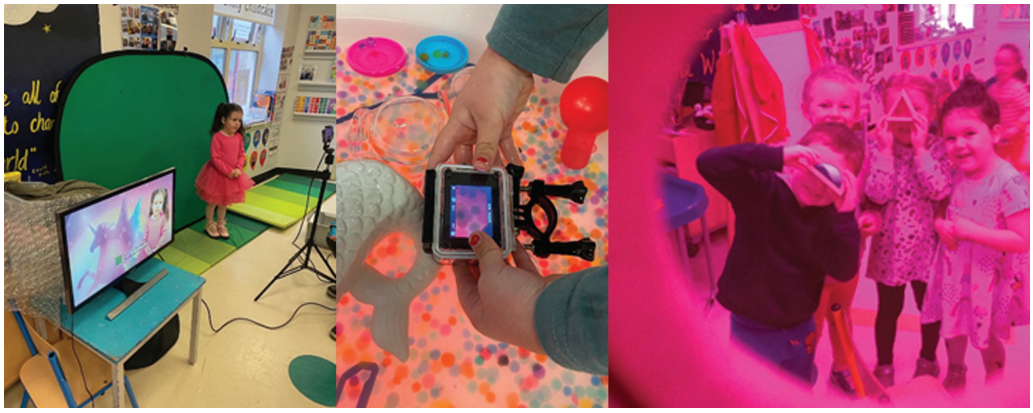
> *Children did picture collages, emailing their photos to the computer for printing and sticking them into their own journal, so they became leaders of their own learning from start to finish. This evolved into the use of a green screen and even underwater cameras. It was truly amazing to watch them grow in confidence with the cameras.*



Over time, the setting added more technology, including walkie-talkies to talk through the window to their friends in the local nursing home, iPads with different apps, digital weighing scales and calculators, a coding mouse called EARL, a digital microscope, a light table, and an outdoor programmable Rugged Robot. The children's innovative use of technology even allowed them to act as active citizens and educators in their local community:

> *The email also became a huge part of the curriculum. We emailed Meath County Council to tell them about the broken traffic lights in the village. When they were fixed after three days and an email came back to say*

thank you, the children were delighted and it highlighted their active citizenship role in their community for them.

When we finally got back down to our local nursing home for in-person visits, the children chose to bring down the Rugged Robot and the digital microscope. It was lovely to watch them teach Albert, who was 96, how to use the Rugged Robot, and laughter erupted as they used the digital microscope on John's bald head, to see if they could find any hair follicles. We also met Richard, an adult with Down's Syndrome, who used an iPad to communicate – this clearly showed the children and the parents that technology could be an amazing tool.

The introduction of technology into this setting, which emerged from the educators' reflective practice (Schön, 1991), resulted in improvements to both curriculum and pedagogy:

We embraced technology with both hands in our early years service, and I am so glad we did. It has truly added to the children's learning and increased their engagement. When we identify a learning opportunity, technology has allowed us to enhance that learning. The educators in the classroom are learning too, with all of our new teaching materials.

Conclusion

It is the kind of work that we see in these two settings that we find particularly exciting in the directions of the Irish ECE policy commitment to STEM education, and that we hope to engage more with in the next few years.

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