Why does the teaching of science at primary school matter?

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Abstract

Learning starts immediately at birth and a growing body of evidence shows that this learning is highly sophisticated from a very young age. If we believe that science is an important subject, it cannot be sidelined until secondary school. Looking into the future, science and technology will play an ever-increasing role in our lives and, in order to prepare young learners now for that future, we need to adopt the practices of the outstanding teachers. In this special issue, we reflect on a wide range of presentations and practice that were presented at the Primary Science Education Conference (PSEC) II.

Introduction

The second international conference on the teaching of science at primary school level, hosted by the Primary Science Teaching Trust (PSTT) in Edinburgh in June 2019 (www.psec.org.uk), was by any standards a great success. The presentations and workshops were wide-ranging, with outstanding keynotes and presentations by teachers, many from the PSTT College (Shallcross *et al,* 2015). The presentations by teachers demonstrated cutting-edge innovation and research-informed practice (e.g. Trew *et al,* 2019, 2020). In this paper, I will refer to elements of the Conference and the wider work of PSTT and its stakeholders, to answer the question 'Why does the teaching of science at primary school matter?'.

It is often said that we should be preparing our young children for a future where careers in that future have not yet been imagined (something that one keynote speaker, Kate Bellingham, discussed). We can articulate key skills that any child might need in the future, such as problem-solving, communication, numeracy, team working, data synthesis and analysis (e.g. Rocard *et al,* 2007) and, although it is possible to impart these without reference to science, it is much easier to use the many opportunities that science provides. Children are curious about the world around them from a very early age (more on this later) and stimulating that curiosity is beneficial. The UK's industrial strategy (UK Industry Strategy, 2017) points the way forward for the near future (possibly up to the next 10 years), where the Grand Challenges identified are: Artificial Intelligence (AI) and a Data-driven Economy; Clean Growth; the Future of Mobility (including transporting goods and people); and addressing the issues of an Ageing Society. Our first keynote speaker, Professor Jim Al-Khalili from the University of Surrey, led us on a journey into a possible future and the role of AI in this. In the most recent wave of themes under the Grand Challenges Fund, we find, for example: accelerating detection of disease, self-driving cars, driving the electric revolution, the Faraday battery challenges, healthy ageing, precision medicine, industrial decarbonisation, manufacturing and future materials, robots for a safer world and smart sustainable plastic packaging. Primary school-aged children can understand many of these themes and the wider grand challenges to varying degrees, and the challenges would be an excellent stimulus for engaging with science for children and adults.

If we needed further reasons for engaging future generations in science, we only have to look at the United Nations 17 Sustainable Development Goals (Figure 1, https://sustainabledevelopment.un.org/#). Many of these goals require science, engineering and medical solutions, one of the most pressing being climate change, with associated impacts on food and water security and supplies, sustainable cities and the requirement for humans to produce affordable and clean energy and to consume and produce responsibly. Therefore, the need for future generations to be science-literate has never been clearer, and aspects of how we can engage and encourage young learners are contained in the STEM section of this special edition.

Why we cannot wait until secondary school

The Conference included presentations from Professors Laura Schulz from the Massachusetts

Institute of Technology, USA, and Paul Ramchandani from the University of Cambridge in the UK. Both Laura and Paul alerted the Conference to the rapid rate of development of young children from around 0-5 years, and how important interactions with parents, carers and other adults (and children) are during this rapid development phase (Ramchandani *et al,* 2013). Laura Schulz's research in early years has demonstrated that, during free play, pre-school children can distinguish between confounded and unconfounded evidence and can disambiguate confounding variables (Schulz & Bonawitz, 2007), something that is quite remarkable.

In a further study, Schulz's team demonstrated that 4-6 year-olds could systematically converge on solutions to problems, consistent with the ability to imagine the abstract properties of causal problems and their solutions – do we give our young children enough time and space to imagine? In a further study of 15 month-olds, Schulz and co-workers showed that infants make more attempts to achieve a goal when they see adults persist (Leonard *et al,* 2017). Laura stated that '*... in primary education, we teach children what we already know and* ***skills to find out more for themselves*** *and, in the fullness of time, they're going to maybe re-engineer the planet. It is the only thing that has ever done anything like that in the history of the universe. So it's quite remarkable'.* I think that the words highlighted in bold are key here: empowering young people with the skills of investigating and problem-solving. The early years phase is a very important time in primary school and those teachers who excel at the teaching of science at this level are so important, yet they are not valued as such.

Role of play

During the first PSEC, held in Belfast in 2016, Dr. Stuart Brown gave an excellent keynote talk on the role of play in learning and showed how a lack of play in childhood can cause problems in later life (Brown, 2010). Play was a common theme at this Conference, where Laura Schulz noted that *'Play is one of the biggest mysteries of learning. I think we don't have a real scientific answer. The smartest species play the most, so there's every reason to think that play enhances learning'.* However, can we do more to encourage 'playful learning' throughout primary school?

Professional learning and pedagogy

In this special edition, there is a section dedicated to professional learning, which includes contributions on co-teaching and lifelong learning. It is here that it is important to understand the role of this journal, *Journal of Emergent Science (JES),* a joint venture from ASE and the PSTT. Access to primary research is becoming

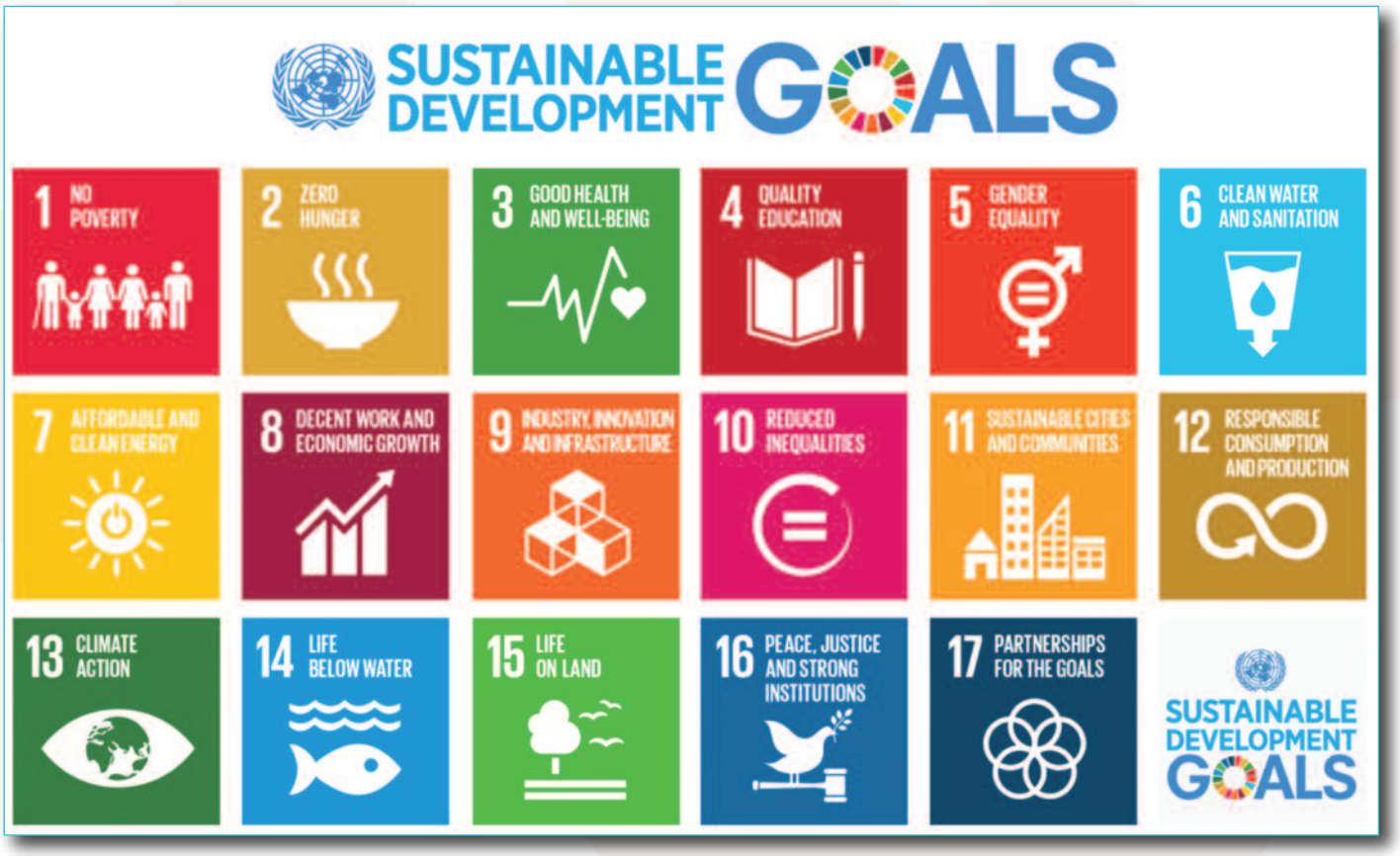

Figure 1. The United Nations' 17 Sustainable Development Goals (see https://sustainabledevelopment.un.org/#).

easier through open access, but no easier to understand, sadly, for the class teacher, and yet that research could be informing practice. Equally, excellent publications such as ASE's *Primary Science* (which is also hosting a PSEC II special issue this year) provide a platform for teachers and practitioners to share ideas and tips on how to teach a subject. There is a chasm between this type of publication and research publishing, and it is here where *JES* wants to position itself, allowing teachers to report on action research that does inform fellow practitioners, but also gives researchers a platform from which to disseminate wider current research in an accessible way, as with the pedagogy section in this special issue.

The teachers

It was incredible to see so many PSTT Fellows (Shallcross *et al,* 2015) present their work at the Conference and is a testament to the excellence of science teaching at primary school level in the UK. Outstanding teachers empowered with a dynamic curriculum encourage investigation, questioning and discussion, exemplified by the *Thinking, Talking and Doing Science* project (Mant *et al,* 2007), a project that was originally funded by AZSTT. The innovation, pedagogy and content knowledge of the teachers who presented were incredible.

Future prospects

Data science, machine learning and artificial intelligence are all terms that are discussed now and will be commonplace in the future. Will our current cohort of primary-aged children be ready for this when they leave school? Yes, if they are provided with the tools of investigation, synthesis, evaluation and reflection from an early age and, given the excellent presentations at PSEC II, there is every reason to believe that the UK will be at the forefront of education, recognising the vital role played at primary school.

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