# The Primary Science Capital Teaching Approach: Building science engagement for social justice

● Meghna Nag Chowdhuri ● Heather King ● Louise Archer

## Abstract

*Although many children enjoy school science, not all of them feel that science is 'for them', especially those belonging to minoritised communities. This paper showcases the Primary Science Capital Teaching Approach (PSCTA), developed by researchers in partnership with primary teachers to support every child's engagement and identification with science. The PSCTA is a reflective framework, which provides practical ideas about how to embed an equitable approach in everyday science teaching in primary schools. The social justice framework supports children's voice, agency and active participation in the issues that matter to them – including climate injustice, racial injustices etc. Over the course of two years (2019-21), with the support of the Primary Science Teaching Trust (PSTT) and The Ogden Trust, the reflective framework of PSCTA was developed in partnership with 20 primary teachers across England. This article presents the framework alongside illustrative examples, insights and testimonials from participating teachers.*

**Keywords:** Social justice, primary science teachers, science capital, professional development, science engagement

## Introduction

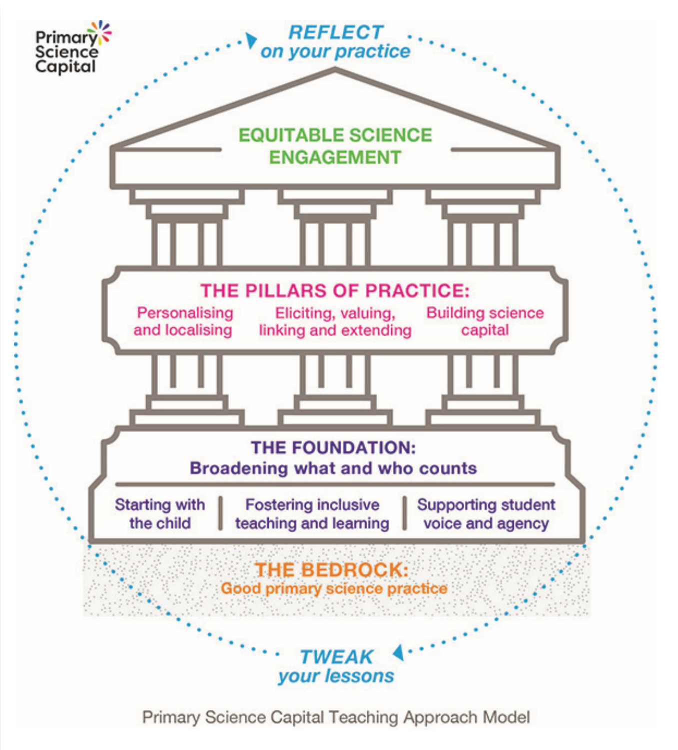
Studies show that despite increasing emphasis on making science more accessible, there continues to be marginalisation of children from underserved communities who feel science is not 'for me' (Archer *et al*, 2010). Social justice-oriented pedagogies, which acknowledge systemic inequalities, are powerful in redressing this imbalance (Ladson-Billings, 2013). This article introduces The Primary Science Capital Teaching Approach (PSCTA) – a social justice-oriented teaching approach that focuses on supporting underserved and minoritised children in developing their science engagement and identity (Archer *et al*, 2013, 2015, 2017). By focusing on children's assets (rather than viewing them from a deficit lens), it supports children's voice, agency and active participation in science (Barton & Tan, 2010). School science lessons thus become an opportunity for young people, and their teachers, to be empowered to act on all sorts of societal issues, from local environmental concerns to climate injustice and global sustainable living. Over the course of two years (2019-21), with the support of the Primary Science Teaching Trust (PSTT) and The Ogden Trust, the reflective framework of PSCTA was developed in partnership with 20 primary teachers across England. This article outlines the core elements of the approach, along with examples from teachers' practice.

## The PSCTA

The Primary Science Capital Teaching Approach (PSCTA) is based on cycles of critical professional reflection and intentional action, in which teachers make small changes to their pedagogy aimed at challenging and redressing imbalances in power and privilege. The PSCTA is a culmination of work that started in 2013 with secondary schools (Godec, King & Archer, 2017), and has since been developed with primary schools in England between 2019-2021 (Nag Chowdhuri, King & Archer, 2021).

As detailed in Figure 1, the PSCTA model consists of three core components: *bedrock of good science teaching*, the *foundation*, and three related *pillars of practice*. The approach is then enacted through iterative processes of professional reflection in which teachers '*reflect and tweak*' their practice. The following sections detail each of these elements and present examples from teacher practice.

**Figure 1.** Primary Science Capital Teaching Approach Model.




## Bedrock of good science teaching

The approach is based on a bedrock of good primary science teaching, as informed by the contemporary science education research literature, including elements such as learner-centred learning (Dole *et al*, 2016; Weimer, 2013), play-based learning (Fleer, 2019; Jahreie *et al*, 2011), enquiry and investigation-based teaching and learning (Minner *et al*, 2010). Our approach builds on and extends these elements through a specific focus on equitable science engagement.

## The foundation: broadening what and who counts

The foundation is based on broadening what we value in science teaching and learning, and challenging (rather than reproducing) traditional representations of science as white, male, hierarchical, elite, etc. (Carlone *et al*, 2015; Chaffee & Gupta, 2018; Dawson, 2019). This foundation seeks to value all students and focuses on changing the way that we teach science in order to better engage and support all children, but particularly those from under-represented communities. The approach suggests three practical ways of achieving this: starting with the child, fostering inclusive teaching and learning, and supporting student voice and agency.

- ***Starting with the child*** critically reorients the lens of science pedagogy by centring the child. This simple shift in lensing supports shifts in teachers' thinking by focusing on what children already know and care about, rather than what they ought to know. For example, the following extract describes how Mr. Collins reorientated his lessons based on what he actively noticed about the needs and experiences of children in his Year 4 class (age 8-9):

*'Mr Collins explains that the original un-tweaked lesson was on puddles, but he tweaked to personalise more. He had noticed that lots of children were missing school in the morning recently when it was wet (it had been very wet recently with several days of torrential downpours) because their clothes hadn't dried out properly. So, he changed the lesson plans for this series of 3 lessons to start with an experiment in which the class wetted shirts in water and then hung them up in different places in the school, then went back to see how much liquid was left (how much they could squeeze out and measure) to work out how much had evaporated. The children really seemed to respond to and engage with this and enthusiastically recall it in class. Children enthusiastically and knowledgeably shared their experiences – they knew how to disperse steam and dry clothes and could connect with the science behind it'* (Field notes, October 2019).

- ***Fostering inclusive teaching and learning*** encourages teachers to reflect critically on power dynamics within their classrooms and identify pedagogical ways of disrupting these. This aspect of the foundation challenges the reproduction of social disadvantage (e.g. by gender, race, class, disability and so on) that permeates science classrooms. For instance, Ms O'Connors recognised that some girls in her Year 4 class preferred to have more time to respond to questions, rather than being expected to put up their hands and answer questions immediately. By broadening the ways in which she encouraged children to contribute, Ms O'Connors challenged the dominant masculine ways in which science is often performed (Archer *et al*, 2016):

*'Ms O'Connors paid attention to two girls in her class, who she believes do not engage in science lessons. By providing multiple ways of student expression (providing time for all children to write their answers/responses on Post-its) she encouraged all children to contribute. She then focused on the*

*responses of the chosen girls. One of the girls used a metaphor for understanding canine teeth as 'vampire teeth'. Ms O'Connors appreciated the contribution and referred back to it and linked it to the teaching'* (Field notes, January 2020).

- ***Supporting student voice and agency*** recognises that the goal of science learning is not just the acquisition of knowledge, but also to empower children to be able to use science more widely in their lives, for example, as critical thinkers and active citizens. This is particularly important in climate education, where students' agentic approaches to climate change can empower them to take action (Trott, 2020). This form of agency-based pedagogy can support children's critical understanding of their own and their communities' needs, struggles and injustices (Schenkel & Barton, 2020). The following example shows how Ms Lessing helped Year 3 children (age 7-8) to develop ownership of their learning and use their expertise to help others and take action:

*'Ms Lessing goes to the children's local park and takes a photo of the puddles on the field. It generates spontaneous contributions from a range of children. Children then write letters to their local council to share their knowledge about what sort of soils would work best for a new all-weather football pitch. This enables them to see that they do have agency and can be recognised as knowledgeable producers of science'* (Field notes, January 2020).

## Pillars of the PSCTA

Learners' engagement, experiences, aspirations and identification with science are shaped by the extent to which a given setting recognises, values and legitimises who students are and what they bring with them (Archer *et al*, 2015). Thus, the purpose of the pillars of the approach (which often overlap) is to strengthen students' relationship, identity and agency in relation to science. The pillars provide practical ways of connecting science with individual students' lives: personalising and localising; meaningful eliciting, valuing, linking and extending; and building science capital dimensions.

- ***Personalising and localising*** is a technique to help teachers connect science content to students' own lives, experiences and understandings. Context-based science learning has been important to science education, but it often focuses on application, comprehension and utility of science in everyday life, rather than foregrounding cultural, personal and political aspects of children and schooling (Sevian *et al*, 2018). Accordingly, this pillar prompts teachers to tailor science content specifically to the children in their class and develop a critical understanding of the cultural and political aspects of children's personal lives and their communities.

For example, the following extract involves Ms Wilson reflecting on a Year 3 lesson on soils, in which she wanted to make sure that children who did not have access to a garden were not disadvantaged by this, or seen as 'lacking'. She decided that accessing soil for the lesson would not be linked to this privilege. She also tried to personalise the task in an inclusive way: *'...asking them to bring in a soil sample in a little bag...was effective but also because I talked them through the fact that I wanted them to get it from near their house...we wanted to sample it near their house but not their own garden. Thinking about the children's circumstances is really important and making sure that what you're asking of them is not going to be a barrier'* (Ms Wilson).

- ***Meaningful eliciting, valuing, linking and extending*** takes personalising a step further by supporting children to bring their own knowledge and understanding into the classrooms. Teachers develop techniques to elicit responses (meaningfully) from children and then value them and link these to the curriculum, extending where appropriate. For example, Ms Rizwan was teaching the classification of animals and wanted to explore the scientific method of classification. She elicited responses from students, valued these respectfully and used that knowledge to talk about the topic:

*'Children in Ms Rizwan's Year 6 class were from various different cultural backgrounds and the teacher wanted to value and celebrate their cultural experiences. During a lesson on 'classification of animals', she began by asking students about the different types of sweets that they eat in their families to highlight how these can be sub-classified. Gulizar named her favourite sweet as halva. Ms Rizwan valued Gulizar's contribution by giving recognition and importance to what she was sharing. She then linked this to the topic of classification and*

*asked if she knew of different types of halva (e.g. red/white, sticky/hard). The teacher drew up a classification chart on the board using Gulizar's example. As the lesson proceeded to cover the classification of animals, the teacher referred back to Gulizar's example to help the children understand the topic' (*Field notes, November 2019).

- ***Building science capital dimensions*** focuses on the dimensions developed by Archer *et al* (2015) based on sociological conceptions of capital (Bourdieu, 1986). These dimensions determine to what extent learners find science is 'for me'. The components of science capital include: scientific literacy, science-related dispositions/preferences, knowledge about transferability of science in the labour market, science-related behaviours and practices (consumption of science-related media), participation in out-of-school science learning contexts), science-related social capital (knowing someone who works in a science job, parental science qualification, talking to others about science, future science aspirations, science identity). Through this third pillar, teachers are encouraged to explicitly ensure that their teaching supports and builds scientific engagement through these dimensions. For example, Ms Wilson showcased diversity among scientists by linking science to the jobs that children in her class could see around them:

*'During the lesson on "What Is Soil?", we did a little survey of children's parents' occupations. One child's father is a builder and that connected him to the lesson and it seemed to boost his confidence. When I presented different jobs related to soils to the class, I made an effort to put lots of pictures of diverse people and those images really helped children see that soil scientists can be different types of people from different backgrounds*' (Ms Wilson).

## Implications

The PSCTA supports teachers' critical professional reflection about inequities and injustices that are prevalent in science education, and provides a model that can be applied to any curriculum. It is enacted through an iterative, ongoing process of reflection and tweaking, which over time can lead to shifts towards a social justice-oriented pedagogical mindset. By valuing children's identities, experiences, histories and changing how school science is represented, taught and experienced, the practice supports teachers to change their science practice. PSCTA supports teachers to use science as a vehicle for supporting children's voice, agency and active citizenship, rather than seeing the value of learning science as being only the acquisition of knowledge and/or the supply of future scientists. In other words, the approach supports teachers in critically reflecting on children's lives, their social conditions and linking those with the science being taught. When embedded into the teachers' practice, this has the potential to become a powerful tool for raising critical social issues that are meaningful for students – including climate injustices, racial inequalities and socio-economic issues. PSCTA can be a powerful way of bringing about change in science-related practices in primary schools across the UK.

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**Dr. Meghna Nag Chowdhuri,** IOE, UCL's Faculty of Education and Society, University College London, UK.
**E-mail:** m.chowdhuri@ucl.ac.uk

**Dr. Heather King,** School of Education, Communication and Society, King's College London, UK.

**Professor Louise Archer,** IOE, UCL's Faculty of Education and Society, University College London, UK.