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Saima Salehjee and Mike Watts, *Becoming Scientific: Developing Science across the Life-Course*, Cambridge Scholars Publishing: 2020; 257 pp.: ISBN: 1-5275-5498-8

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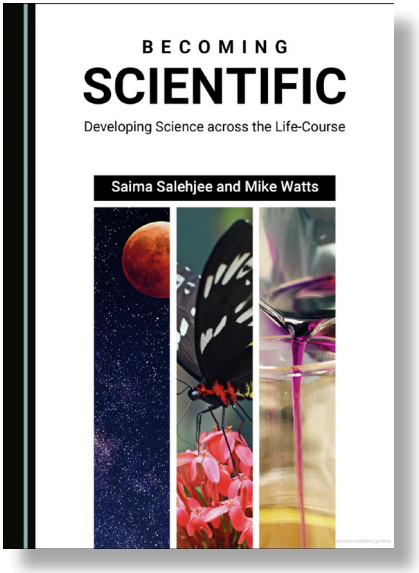
Being and becoming 'sciencey'



Saima Salehjee and Mike Watts have produced a very thought-provoking book considering the nature of peoples' relationships and identification with science over the life course. '*Becoming Scientific*' is not about science education *per se*, or at least not formal science education. Rather it considers the different influences (schooling included, but as just one among various elements) that might lead to people identifying with science, valuing science, rejecting science, and so forth, and considering themselves as 'sciencey', or not. The flavour (sic) of their mission is reflected in the culinary analogy they choose to use in the book, as in the following taster:

> …Do some people come 'sciencey-ready flavoured', or is it possible to 'science marinate' them over time? [Our view is, of course that both of these are possible.] How can we 'science' them? …A key follow-up question then might be: what exactly is the balance of ingredients - the formula of that 'science marinade' to help people become 'sciencey'? (pp. 2-3)

Salehjee and Watts consider the nature of identification with science or 'Sci-ID.' Although not limiting itself to formal education, the book clearly has great relevance for schools and schooling when we consider our purposes whether as educators or more generally as members of a society prescribing education. Clearly education policies and curricula vary from place to place, but it is very common that (a) young people, at least whilst considered children

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and often beyond, are expected (that is, usually required) to attend school, and (b) science is often part of a core curriculum. That is, contemporary societies generally consider that it is important for all citizens to be taught some science.

One rationale for this is that societies need a supply of scientists, engineers, medical professionals, technicians, and so forth. Yet it has long been argued that there is something questionable about a science education whose prime purpose is to service the career needs of a minority of those in the population who aspire to, and might be selected for, science-based occupations. Such a perspective can be considered disrespectful to the majority and perhaps undemocratic (a misuse of power, not considering the rights of the child) or even a kind of misplaced elitism. Of course, all children need to experience something of science if they are to make an informed choice about whether to proceed to science-based advanced study and/or careers, but that experience should be a science education for all, not just offering a foundation for elective higher level study. Moreover, even for the minority who will become scientists, a science curriculum focused on preparation for future study offers an impoverished science course.

The usual argument here looks at other perspectives on the purpose(s) of education besides the economic driver to provide personnel for employment. Education should be about supporting the development of the whole, well-balanced, person; about providing the basic skills required for adult life; about offering glimpses of, and pathways towards, different future possibilities (including, but not limited to, employment options); and induction into the culture(s) of the society. This latter strand may be considered a form of indoctrination (a term that need not necessarily carry negative associations), but also as an enablement or affordance. That is, something needed to take one's full place in society – just as how in a cultural tradition where community dancing is core to rituals and social activities a child would need to be inducted into dance; or as in a society where a canon of epic poetry was used as a key referent to discuss and understand social and political life then a full education must encompass examination of those poems.

Science is a key part of the cultures of modern democratic societies. Being cultured in such societies must therefore include a level of familiarity with science – its nature, and some of its products (e.g., models, theories, concepts) and applications. There was a time when this was not assumed, when, for most of those with influence in society, 'culture' meant music, literature, fine art, and so forth, and science was seen (if mistakenly) as a minority technical interest (Snow, 1959/1998). That stance is certainly not viable today. Full *engagement* in civic society is not possible without being able to enter into meaningful discourse about such issues as climate change, energy supply, deforestation, pollution,

biodiversity, recycling, genetic medicine and so forth. Moreover, everyday media and public conversation encompasses such ideas as evolution, atoms, extinction, the double helix, nuclear power, and the exponential growth of infections. It is not a matter of passing examinations, but of making lifeworld decisions (for example, about healthcare), and being included in everyday discourse.

Educators may see this in terms of the different *drivers* for education – what society seeks to achieve by committing so much public resource, and indeed in somewhat restricting individual choice, in prescribing compulsory schooling. Salehjee and Watts's engaging book reminds us that there is another way to look at this: not what society collectively thinks is good for people, but what people themselves come to value, and engage with, in relation to science. After all, science is the study of the natural world writ large, and that is going to be relevant to all.

Salehjee and Watts draw upon a range of different studies to support the arguments they make in the book. Those studies have taken place at different times, and for different purposes, with foci such as emotional responses to science, and using student question-posing in science education, as well as the authors' more recent work. However, the authors marshal their materials in the cause of an overall argument and mission.

So, Salehjee and Watts explore how different people relate to, engage with, and feel about aspects of science – even when those people themselves may not be primarily framing this engagement as a 'science' interest or activity. In this regard, their book has some similarity with Joan Solomon's last book, '*Science of the People*' (Solomon, 2013) which offered an ethnographic account of how people in Market Town (an assumed name) thought about science. One strong impression from reading that book was "that most people have interests related to science (even if they do not always recognise this), but even so they seldom rely heavily on their learning from formal science education" (Taber, 2015, p. 111). The accounts offered by many of the adult contributors to Salehjee and Watts's study would seem to reinforce that view. Sandra, a primary teacher with an arts and humanities background, but who expresses awe when learning about topics such as black holes and anti-matter, even offers a vignette supporting Solomon's (1992) account of how often learners' formal science learning largely takes place in isolation from their everyday, their everyday, 'lifeworld' notions of scientific topics deriving from quotidian discourse and activities,

> "…I am left with two often contradictory strands of thought that exist simultaneously. At times I actually make little attempt to reconcile my own view with the scientific one because, in my head, they do not come into conflict. Each idea is logged in separate compartments, so for me there is no real contradiction." (p. 34)

Whereas Solomon's study sought to explore the thinking and discourse of a variety of people in one geographic place, Salehjee and Watts's book offers a series of snapshots from different contexts to collectively build up a picture across the life course. In that sense, the book might be considered loosely cross-sectional, but rather than being the report of a single coherent study with sampling of people at different ages, it is more a patchwork of accounts of related studies which collectively build up an overall picture. These different slices of data cannot be considered to be strictly comparable as in a true cross-sectional study (and that is never claimed to be the aim), but certainly complement each other to make a very readable and informative book. Perhaps the weakest link in terms of comparability is the 'slice' taken from a higher education institution (Brunel University in London), where the focus shifts somewhat from natural science as such to the wider notion of 'STEM' (science, technology, engineering and mathematics), both in terms of a survey of students and the classification of case studies of academics (so lecturers in computer engineering and mathematics education are classed as 'scientists' for the purposes of the book). STEM has gained a foothold in international education discourse, but is more an alliance of discrete disciplines with some common interests than a unified domain. This raises the issue of whether (or, perhaps better, when) STEM can be seen as a proxy for science (or vice versa), or even to what extent science identify should be seen as a unitary notion (rather than physics identify, biology identity, and so forth). There are surely substantive differences in interests, priorities, foci and motivations – even if there is seldom a complete demarcation – between doing science as a means to better understand the world and applying science as a means to meet practical ends. As one example, whilst science qualifications are needed to study medicine, it is not clear if something like Sci-ID is so well aligned with aspiring to be a medical doctor.

Largely, the book can be considered to offer accounts of naturalistic studies, although one of the projects (in Chapter 6) reports on secondary students' responses to a year-long intervention to offer curriculum enrichments to a class of 13-year olds in a Muslim girl's school. This was an independent (i.e., private, fee paying) school that limited the science studied in the curriculum because "parents like their daughters to opt for and spend more time in studying religious education and humanities-based subjects" (p. 105). Perhaps in part reflecting such parental views, and the school's accommodation of them, one of the students commented that "unlike religious studies, science does not make sense at all, and it is not what I see, hear and feel in my day-to-day life" (p. 106).

In many ways, one of the key messages from the book is how contingent so many careers are: having a significant relative in a particular job (or

suffer some major health issue), a particular liking (or disliking) for a particular teacher, a response to some particular experience – such things can change the direction of a life. This, of course, becomes clear from the kind of conversational approach to research underpinning most of the studies drawn upon. An idiographic method that invites personal narratives reveals the idiosyncrasies of lives (and so lived realities) that tend to be obscured in approaches that seek to measure population variables.

Being 'sciencey' is, according to Salehjee and Watts, "the very nature of being a scientist" (p. 10), and is linked to what might be termed an enquiring nature about the natural world. They present a notion of a 'sciencey' person as someone not happy to adopt the natural attitude (Schutz & Luckmann, 1973) and just accept that the sun rises each day to illuminate the world, but to ask why, and what the sun actually is; a sciencey person is not content to take pleasure in the aesthetic response to the colours of flowers but rather enquires into why these phenomena have arisen. Yet, as these authors acknowledge, it is important to avoid representing science in science education as a cold, objective, rationale activity that is only interested in enquiry as a cognitive activity. For one thing, it would misrepresent the nature of science and scientists. Scientists may need to learn to bracket off the affective response to focus on the objective analysis of data during *some stages* of enquiry (and objectivity is a kind of ideal, which actual *human* scientists can at best only approach), but the aesthetic appeal of the natural world has been what has initially attracted many scientists to the focus of their enquiries, and – even if the lay person may not always appreciate this – for the scientist, understanding 'how' and 'why' often adds to the wonder of the natural phenomenon rather than simply explaining it away. So, to wonder at the complexity, subtlety and variety of human anatomy and to see it as evidence of a master craftsman creator, as William Paley (1802/2006) famously did, surely pales (sic) beside a neo-Darwinian account that seeks to explain how such exquisite 'design' can arise through contingency and natural mechanisms.

Moreover, to eliminate non-scientific values from science education would be completely at odds with the need for scientific literacy, as science education needs to prepare people to engage with science in the context of socio-scientific decision-making, where what is technically possible, and the likely consequences of different choices, need to be considered in the light of considerations external to science. So, when 13-year-old Vanessa is ambivalent about whether personal feelings should be valid features of science lessons, and suggests that "if you are dissecting an animal for data, you may feel sympathy for it and not do it" (p. 24), this should not be considered as an over-emotional

child being unable to focus scientifically in the classroom, but rather as a human being engaging their personal values to decide to treat a specimen as a creature that can be harmed rather than just scientific (or actually, here, educational) source material (cf. Keller, 1983). That, surely, is a good sign. Many people who would not consider themselves 'sciencey' would associate the image of cold, logic-led scientists with such cultural referents as Hiroshima and Nagasaki; Three Mile Island and Chernobyl; Bhopal and Seveso; chlorine used in battle in World War 1, and Zyklon B used to kill innocent non-combatants in concentration camps in World War II; smoking beagles, and rabbits used as living indicators to test cosmetics; and so forth. A science education that does NOT encourage learners to ask questions about the ethical aspects of both scientific enquiry and technological applications of science is not only deficient, but also unfit for purpose.

Through the book, Salehjee and Watts build up a "theoretical model of science identify: Sci-ID" (p. 59), considering how individuals are influenced by a combination of societal, community and personal factors. They draw upon various theoretical considerations and a good deal of data. Perhaps, for some, this will be the book's main strength. Whilst in some sense a work of bricolage, drawing from here or there, this is not an uncritical accretion of disparate ideas – for example, the authors show some scepticism about work around the notion of 'science capital' as tending to stress "the power of extensionality – the role of macro forces – more than the power of intentionality in science identify formation and transformation" (p. 66). Archer and her colleagues have proposed this construct (science capital) as a label for the "science-related forms of cultural and social capital…[for use] as a theoretical lens for explaining differential patterns of aspiration and educational participation among young people" (Archer et al., 2015, p. 922). Whilst science capital has certainly proved effective as a rhetorical device for drawing attention to a wide range of factors that can influence a young person's career (in the broad sense of the term), it is questionable whether a construct encompassing aspects of a person's experiences, aspirations, beliefs, values, knowledge – with aspects of the attitudes and behaviours of others that interact with them mixed in – has the ontological coherence to be considered as more than a useful theoretical phantom.

It could be suggested that Salehjee and Watts's own model of Sci-ID suffers a similar flaw, but whereas Archer et al. (2015) see science capital as something that can be quantified in a single score through a multi-scaled questionnaire – so that in an English sample of "3658 secondary school students, aged 11–15 years" (p. 922) they identified that 5% had a "high science capital"

score (p. 936)[2] – Salehjee and Watts offer an 'ecological' model of the layers of factors *impacting on* their Sci-ID, which they see as a variable characteristic of individuals: "the individual responds to both…his or her own internal sense of integrity, as well as to the external medium and large-scale forces that are in operation at any one time" (p. 73). As well exploring the stories their informants tell to conjecture about critical factors influencing Sci-ID, the authors are able to demonstrate the fluid nature of the construct with case studies of the shifts in the responses from schoolgirls who had been involved in the curriculum enhancement intervention.

Salehjee and Watts have brought together a great deal of testimony from a diverse group of people of different ages, inside and well outside formal education, illustrating just how variously people relate to and engage with (or sometimes disregard) science. This can be considered an important contribution, as although there are many scattered studies offering such glimpses, this modest volume gives voice to many different individuals who were prepared share their ideas, views, interests and responses to natural phenomena and science. If the mantra of 'science for all', which is supposed to be the mission of school science in so many countries, is to be taken as more than a slogan, then perhaps all those preparing to work as science teachers should read this book and reflect on how science lessons can genuinely help support everyone in the population to become more scientifically literate, and perhaps even encourage them to become more 'sciencey'.

2 It would seem arbitrary to assign any level of score as 'high' (or 'low' or whatever) *without* having some independent measure of 'science capital'. Archer et al. (2015: 936) are quite open that they obtained their result by considering the range of 'science capital' scores following statistical manipulation (a regression analysis informed by responses to five items assumed to reflect "future science job affinity"). As these processed scores ranged from 0 to 115, they simply divided the scale into three equitable regions: 'low' (0-34: 27% of the sample), 'medium' (35-6: 68% of the sample) and 'high' (70-105).

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