“Platforming” the science curriculum: a strategy for reframing content

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Introduction

This paper ponders how the content of the school science curriculum might rapidly evolve in response to the accelerating challenges posed by human-induced global changes that are collectively known as the “Anthropocene”. Slaughter (2012) describes this as a time when humanity “needs to change course, revise its modus operandi, and steer away from the abyss” (p.199) of irreversible changes to the climate and conditions for life on our planet in general. Notwithstanding clear warning signs that radical change is needed, he notes that humanity “continues on it merry way, apparently oblivious of the very real danger it is in, and uncaring of the costs to present and future generations” (p.199).

Does what we teach students in science unwittingly contribute to this existential problem? Scholars who describe the social and environmental conditions of the Anthropocene as “post-normal” (i.e. beyond the life experiences that we see as normal) would certainly answer this question in the affirmative. For example, Sardar (2010) argues that the complexity, chaos and uncertainty that characterise the post-normal times demand a rethinking of old certainties, including “the old image of science, where empirical data led to true conclusions and scientific reasoning led to correct policies” (p.436). He argues for greater humility in the claims we make for our knowing, for more creative and flexible thinking that encompasses multiple perspectives, and for an explicit focus on the ethical consequences of our reasoning and actions. This explicit focus on ethics is contrasted with claims of rational empirical “normal” science to be value-free and hence outside of ethics.

The latter point implies a need for epistemic modesty in the claims we make for the “nature of science” (NOS) component of the curriculum. But what about the core “content”—the canon of accumulated science concepts that constitute the bulk of the traditional curriculum? In an updated discussion of his paper on post-normal times, Sardar (2015) also makes arguments that have implications for how we envisage the phenomena that are the focus of traditional science concepts. Beginning with the assumption that ethics is about our *being* in the world, he notes that we need to be aware of: “how we are related to the rest of the world – the individual within a web of community, the resources we share and distribute amongst ourselves, our relationship with the flora and fauna, nature and environment, planet and the cosmos” (Sardar, 2015, p.37).

All the entities listed by Sardar feature in the content of traditional science curricula, but not necessarily presented within an ethical framing that places humans squarely within the web of actions and consequences, rather than outside the natural world looking in. Ontological challenges raised by this argument sit alongside the epistemic challenges posed by a reframing of the NOS component, as sketched in the previous paragraph. Such changes will not be easy to make. I next outline some of the challenges that make deep change so hard.

Why we need new change processes

Educators have not been blind to the need for change in the school curriculum. International entities such as the OECD and the Partnership for 21st Century Learning, to name just two, have poured considerable resources into rethinking the what and how of curricula. We have felt their influence in New Zealand via the inclusion of “key competencies” in our national curriculum framework (Hipkins, 2018) but their presence has not generated the thoroughgoing changes we optimistically envisaged (McDowall & Hipkins, 2018). Some futures scholars argue that these efforts cannot create the sorts of changes that are needed because they do not address fundamental questions about the purpose of education (Howard, 2018) and because learning has come to be seen as an end-in-itself (Biesta, 2013). Howard is careful to say that these efforts do constitute a positive step forward:

In many respects 21st century educational initiatives represent a moving away from traditional education approaches that are transmissive, controlling, authoritarian and demanding of compliance in behaviour and thought. The attention on creativity and imagination, collaboration, and critical thinking is hopeful, as is the renewed emphasis on student-teacher relationships” (Howard, 2018, p.6).

Why is it so hard to achieve even these changes (which do align readily with the influence key competencies were intended to have) let alone get beyond them? Howard argues that radical change requires a fundamental shift in the deep values that drive our tacit thinking about what education *is for*. As long as the (unexamined) dominant purpose is presumed to be preparation for education and life in normal times, then what he calls the “money code values” (ibid, p. 189) of neoliberalism and globalisation will continue to drive our thinking. In this value-system money begets more money, which is presumed to be an unquestioned good. Extending his model, we might say, knowledge begets more knowledge, and the more you know the better educated you are. This is certainly the tacit assumption underneath the organisation of current curricula and assessment systems. Any attempt to change it is likely to be interpreted as “dumbing down” the school curriculum, just as any attempt to redistribute the resources of the planet is met with fierce resistance from those who already have the most, and hence the means of getting even more.

Richard Slaughter (2012) addresses the challenge of how we might go about achieving radical change in economic systems. He proposes “platforming” as “a strategy that maintains existing economic activity and culture, while building a new direction and products or services that are based on futuring” (p.123). This is a strategy that purposefully takes account of the complex and chaotic nature of change in post-normal times (Sardar, 2010), including allowing for unexpected consequences that demand rapid rethinking of the proposed actions. Such changes would need to be carried out by “cultural innovators who are willing and able to be ‘independent agents outside conventional models of service provision’” (Slaughter, 2012, p. 123). The change processes demand the inclusion of many different perspectives, where contradictions become important reminders of the limits of our individual knowing, exposing our ignorance of other ways of thinking about what might be (Sardar, 2010).

Change in the school curriculum, including in school science education, is also complicated by the necessity to keep the system working for current students while changing direction. Could the “platforming” strategy proposed by Slaughter provide a useful way of thinking through complex change cycles that do take people with them by supporting explicit exploration of fundamental values that are usually held tacitly? This paper is a modest attempt to address this question. Adapting the platforming idea, three strategic change steps are proposed. Each of these steps attempts to envision the broad scope of activities that might be undertaken.

Strategy 1: A critical focus on specified content

The knowledge base of science keeps on growing exponentially (Harding and Vining, 1997). Scientists themselves face a significant challenge in keeping abreast of work in their own fields, let alone keeping in touch with other disciplinary developments that might impact their own. This accumulated body of theory is literally "too big to know" (Weinberger, 2011). Curriculum-builders already face an almost impossible translation challenge in distilling the most significant science ideas from the huge volume of accumulated theoretical knowledge. Trying to 'cover' every concept of significance has led to curricula that have been characterised as 'a mile wide and an inch deep'. Teachers already live with this pressure and in my personal experience it is generating increasing unease. Thus content reduction could a logical first step in platforming the science curriculum. We could think of it as building a new (yet still familiar) platform from which to launch other changes.

I have already noted the deeply held tacit assumption that accumulating more and more knowledge is the hallmark of a successful education, which points to the risk that any attempt to corral a more modest set of concepts will be seen by many as limiting students' opportunities to grow and thrive. One strategy for addressing this challenge is to co-opt as many people as possible into the decision-making processes. There is a useful beginning example of this in a recent consensus project carried out by European science educators. Participants were experts from across the EU. They worked together over several years to identify a set of big ideas that could underpin a coherent school science education programme (Harlen, 2015). They did not aim to encompass everything that could be learned in science. Rather their set constitutes an attempt to identify a small number of *centrally important concepts* that are foundational to understanding other science ideas, including those yet to come. They also carried out preliminary work on a small set of concepts about science (i.e. NOS ideas).

A more deliberate platforming process would arguably seek to build a wider consensus than that arrived at by the EU group of essentially like-minded experts. It would also need to be framed by critical questions about what the specified knowledge is important *for*—a critical and radical examination of purposes for learning would need to be a more overt part of the conversation than has been the case in the past (Howard, 2018).

Strategy 2: Refocusing content to take account of changes in science itself

With a new base platform in place, priorities and conceptual goals could rapidly evolve. We could **refocus** aspects of traditional topics that make the cut as big ideas. As suggested by scholars such as Sardar (2010), complexity theory should provide one important lens for refocusing activities. There would be a much greater focus on interconnections between ideas and events, with associated implications for supporting students to understand why uncertainty is an inevitable part of seeking solutions to complex issues.

Illustrating this need for refocusing, one of the EU set of big ideas reads "Genetic information is passed down from one generation of organisms to another" (Harlen, 2015, p.28). This could be understood within a traditional linear/complicated framing of genetic activity and included in school curricula as business-as-usual. However the sorts of complex questions raised by current applied research in this field (e.g. should we genetically modify crops to feed more people more efficiently?) have not necessarily been the traditional focus of science curriculum. Nor does the important recent development of the complexity-informed fields such as proteomics and epigenetics figure in what students are currently expected to learn. Refocusing would need to take *explicit* account of dynamic interactions between genes and their surrounding environments (Hipkins, 2009). This in turn, would lead to new existential questions about matters such as the human-environment interface and what actually constitutes a 'human' cell (e.g. Buhler, 2012). This one theory alone has many implications for how students' encounters with knowledge might be expected to unfold—and what the indicators of successful learning might look like (e.g. Bay et. al. 2017).

I have drawn on my personal disciplinary expertise to illustrate this refocusing challenge. Many more such examples will exist and others will be better placed than me to identify them in their own areas of expertise. As Sardar (2010) notes, the greater the diversity of perspectives, the more our own assumptions and contradictions will be exposed to scrutiny, and the more likely we will be to arrive at new and constructive curriculum responses to complex challenges, and to be able to rapidly evolve these when we see how our initial selections pan out.

Another important aspect of refocusing activities could centre on the ways that knowledge is currently organised along discrete disciplinary lines. These are useful categories for organising traditional bodies of concepts and I am not suggesting that they should be dispensed with. But we do need to think carefully about the ways that this form of curriculum organisation might limit the development of complex insights into the nature of current life conditions on our planet. Illustrating this, one of the EU set of big ideas reads: "The total amount of energy in the Universe is always the same but can be transferred from one energy store to another during an event" (Harlen, 2015, 23). A colleague and I recently compared this big idea to the treatment of energy in the *New Zealand Curriculum.* We found that key ideas about energy are not clearly and coherently conceptualised. Instead, they are scattered across the traditional silos of biology, chemistry, physics and earth sciences. A complex-systems view would require them to be deliberately brought together.

Refocused concepts will have implications for the ways we live our lives, and reimagine our impact on the lives of those to come. For example, awareness of the impact of our lifestyles on future generations (via the mechanism of epigenetics) exposes our direct biological responsibility for the health of our children—those already here and those not yet born (e.g. Indrio et. al. 2017). Similarly, the energy crisis related to "dwindling natural resources—such as oil (possibly) and fish (definitely)" (Sardar, 2010, p.435) demands an urgent rethinking of how we consume and share the resources of the planet. These challenges point to the third step in my proposed platforming strategy, as I next outline.

Strategy 3: Reframing ways we think about ourselves in relation to the natural world

Once these less confronting changes have been achieved we would need to turn to some important **reframing** of ways we think about ourselves in relation to the natural world. Specifically, all the topics in the traditional science curriculum that position humans as 'other' to the rest of the natural world would need to change. We could, for example, teach the concepts of classical ecology as a lesson in misguided and outmoded thinking, now replaced by complex systems accounts in which we are fully immersed in the world.

Howard (2018) argues that this type of change will not be easily achieved because it will be necessary to replace the tacitly held "money code of value" with a "life code of value". In the latter, learning about life stands in the service of preserving and enhancing the means of life on our planet and hence aims for more life, as opposed to more money (or as I have argued, more knowledge per se) as the ultimate outcome of learning. He argues that such a curriculum must be *experiential*. It will enable "students and teachers to be fully engaged in a way that enhances well-being for all members of the community of life" (p.10).

Notice that at this point the curriculum argument shifts from the "what" to the "how" of curriculum change. (I am assuming that the "why" of change will be an ongoing thread throughout the whole.) Pedagogy would now move more meaningfully to the centre of change, affecting the profound shifts that have proved not to be possible with current '21st century' curriculum changes (Howard, 2018). There are already innovative pedagogical models that address more imaginative, creative and life-affirming ways to teach science ideas in key areas such as ecology (Judson, 2010). However these are not yet widespread or well known. Pedagogical change needs to make sense to teachers before it will be adopted. I am hopeful that the intellectual work of rapidly evolving the content of the curriculum, as sketched above, would support the rapid and more widespread uptake of teaching and learning strategies such as those already being explored by groups such as that led by Judson in Canada.

At this point, evolving change would also potentially open up a new ways of thinking about how to incorporate bicultural perspectives in the New Zealand curriculum. Instead of "othering" Mātauranga Māori as an interesting (quaint?) way of accounting for natural phenomena, we could explore how being fully immersed in, and part of, the natural world changes our sense of responsibility for our actions, and for future generations. This latter question potentially circles back to epigenetics, and the in-utero impacts now known to be passed to generations yet to come. Such synergies between the different changes and topics would help consolidate a new science education curriculum that proactively responds to the challenges that await us in the Anthropocene.

Concluding thoughts

Sardar (2015) notes that "plurality, diversity and multiple perspectives are essential for understanding and steering through postnormal conditions" (p.37). However this short paper is inevitably limited by my own ability to think forward in the discipline I know best, namely biology, and specific parts of biology at that. Many more voices will be needed in the change conversation, and perspectives from other science disciplines must be brought to bear. Chemistry, physics, earth and space science all currently form part of the New Zealand science curriculum and, at least in terms of content organisation, are treated as being of equal importance. Should they be? What might we be missing? What else will need to change? Step 1 of the platforming strategy I have proposed needs to begin with urgency as we stand on the edge of an abyss of our own making (Slaughter, 2012).

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