6 Decolonization and science education

What is at stake?

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Introduction

When writing and talking about decolonization and decoloniality we need to 'begin carefully' and 'walk tenderly along this path of relationships' (Nicol *et al.*, 2020, p. 191), mindful of risks such as misrepresentation and appropriation, yet ready to engage in critical conversations. We have previously shown how different legitimation rules can lead to a 'code clash' in this conversation in science (Adendorff and Blackie, 2020). Decolonial conversations typically foreground the subject and the context (Luckett, Chapter 3, this volume), while science tends to foreground objects, as illustrated in Chapter 7 of this volume. Despite these difficulties, we believe that this conversation offers science the opportunity to bring itself closer to the context of the society in which it operates, and to use its tools and products in the fight for cognitive justice with 'an equality of knowers form[ing] the basis of dialogue between knowledges' (Leibowitz, 2017).

Furthermore, finding solutions to wicked problems, such as poverty, world hunger and global pandemics, will require a concerted and collaborative effort involving science and various other environments, amongst which are indigenous knowledge systems and the humanities. A conversation between science and decolonization scholars is thus neither a luxury nor a threat; rather it is a necessity and an opportunity. However, like the 'two cultures' debate in the 1960s and the 'science wars' that followed that in the 1990s (Burnett, 1999; Gould, 2000; James, 2016; Maton, 2014a), the decolonial conversation in science is often marked by an us–them dichotomy (Gould, 2000). In this chapter, we like Aikenhead and Ogawa (2007, p. 540), hope to 'offer insights of value to science educators so they can build bridges between their own Eurocentric knowledge system and other ways of knowing'.

To do this, we will start by showing various tensions in the literature on decolonizing science. We will follow this by looking at how science and

indigenous knowledge systems (IKS) are portrayed using the concept of *constellations* from LCT (Maton, 2014a; Maton and Doran, 2021), before returning to the need for a conversation. Finally, we will enact the LCT dimension of Specialization to look at specific examples, in order to help us suggest a way forward.

The concepts of decolonization and coloniality in the context of science

Many of the prominent voices in the decolonization debate, such as Aimé Césaire, Ngũgĩ wa Thiong'o, Frantz Fanon, Achille Mbembe and Paulo Freire had roots in the humanities and social sciences or drew from these fields to formulate and communicate their ideas. With this work growing in prominence and extending to other contexts, the terms 'decolonizing', 'colonialism' and 'coloniality' started taking on a variety of complex, and sometimes even contested, meanings (Ideland, 2018; Nicol *et al*., 2020). It is thus necessary to briefly define the terms we will be using. Colonialism is generally taken to refer to a specific period in time, while coloniality has been described in terms of the longer-lasting attitudinal and ideological impact of colonization (Castro-Gómez, 2002 quoted in Ideland, 2018, p. 786). Colonization, in its most basic form, starts with the physical invasion of a land, with the invasion almost invariably also resulting in the domination and subjugation of the indigenous peoples of that land through 'cultural, social, and economic assimilation. The concept of colonization therefore includes a broad spectrum of contexts in which one culture forcibly imposes itself upon another' (Hassel *et al*., 2019, p. 4). Coloniality is the more pervasive product of this process, 'expressed in a language of salvation, help, or development' (Ideland, 2018, p. 786).

Decolonization in higher education thus becomes a means of bringing about attitudinal change by breaking with colonial influences and attitudes reflected in our curricula (Cleophas, 2020). To this end, the decolonization conversation in science needs to (1) recognize the way in which scientific knowledge has been shaped by ideology, context and politics and (2) address the 'mutual hostility' arising from this (Cleophas, 2020, p. 2). Various ways to approach this have been suggested. These include, but are not limited to, (1) research with indigenous communities as means of opening up possibilities for translation between Western science and concepts within indigenous knowledge systems (IKS) (Eglash *et al*., 2020), (2) a greater focus on access, identity and the history of science, i.e., the role science played in colonization practices (Crease *et al.*, 2019), as well as (3) bringing context or place-ness, an awareness of where and how science impacts society, into the often acontextual or placeless science curriculum (Marker,

2019). It is against this background that the decolonization conversation in science needs to be seen. Advancing this conversation, however, requires a way to make sense of the, often heated, exchange between scientists, rooted in their way of seeing and interacting with the world, and decolonization scholars, grounded in very different ways of building knowledge. To this end, we will start by looking at how the way in which science and science education is portrayed and positioned, and is positioning itself, in decolonization literature might be adding to the difficulty.

Science and indigenous knowledge systems in the context of decoloniality

Literature about decoloniality in science tends to pitch science against IKS. For example, science is regularly portrayed as a gatekeeper (Boiselle, 2016) and a 'powerful, colonial weapon' used, among other purposes, to silence Indigenous voices (Ideland, 2018, p. 786) by restricting what is taught or seen as legitimate knowledge (Green, 2012). Prominent themes in the literature include issues of power, i.e., the way science has been, and continues to be, used to exploit others for financial or political gain (Schiebinger, 2009; McClintock, 2013; Boisselle, 2016; Ideland, 2018), issues with epistemological access, identity and cognitive justice, i.e., who can access science and on what grounds (Boisselle, 2016; Ideland, 2018; Cleophas, 2020) as well as issues with the history of science, for example excluding non-Western contributions and failing to acknowledge science's role in colonization (Gould, 2000; Henriques, 2012; Ideland, 2018; Powers, 2020). These works describe science with words such as 'reductionist, secular, and objective/ substantivist' (Boisselle, 2016, p. 5). By contrast, IKS is presented as the relational, non-reductive, more situated 'antithesis of colonial' practices (ibid., p. 6). The risk with such 'othering' and 'counter-othering' strategies (Rip, 2019) is that it could create a situation in which one cannot value one, i.e., indigenous knowledge, without devaluing the other, i.e., Western/ formal science. It does not allow for a both-and approach (Maton, 2016, p. 47) in which science and indigenous knowledges could find a way to collaborate (Green, 2012; Boisselle, 2016; Rip, 2019). Rip (2019) and Green (2012) have independently argued that such a collaboration could help science gain an improved understanding of the context in which its products find application, while it might assist IKS in becoming more available or 'cosmopolitan' (Rip, 2019). However, while some commend the new agreements about 'the nature of reality' (Green (2012, p. 2) this could lead to, others hold that removing indigenous knowledges from their contexts would render them meaningless (Bishop, 1990). So, not only are science and other ways of knowing, such as IKS, seen as opposing forces, but there

doesn't seem to be agreement on how they should relate. Elements of the science–IKS portrayal is ominously reminiscent of the so-called science wars of the 1990s and the preceding two-cultures debate, both of which display a similar divide, defined by 'mutual incomprehension', between science and the humanities (Burnett, 1999).

The 'two cultures' debate and the science wars

Gould (2000) describes the science wars as an academic battle between 'realists' and 'relativists', with the realist position being most prominent among scientists and relativist position mostly seen among staff 'housed in faculties of the humanities and social sciences' (p. 253). The realist position focussed on the objectivity of science while the relativist position focused on 'the culturally embedded status of all claims' which would make science 'just one system of belief among many alternatives' (p. 253). Babich (2017) contends that what was at issue was legitimacy: 'who should be permitted to speak and who should be silenced' (Babich, 2017, p. 167). The so-called 'two cultures' debate between scientists and scholars from the humanities, which preceded the science wars, began in the late 1950s with the work of C.P. Snow and F.R. Leavis (James, 2016). This exchange presented the world as two 'noncommunicating cultures' – science and the humanities – which interacted by little more than 'hostile glares' (Burnett, 1999). Like the science wars, this debate stemmed from a power struggle between two camps using different epistemic logics to legitimize their practices (Maton, 2014a). The scientists in the debate were viewed as sharing 'a sense of loyalty to an abstraction called "knowledge"' (Mackerness, 1960, quoted by Maton, 2014a, p. 72) as well as a 'commitment to "truth" and allegiance to their discipline, which specialized their identity and claims to insight, regardless of their social backgrounds or personal attributes' (ibid., p. 72). The humanist culture in the debate was constructed as placing far less emphasis on knowledge. The specialized skills and knowledge required for legitimacy in science, was relatively unimportant in defining legitimacy in the humanities; what mattered here was 'possessing the right kind of dispositions or character' (ibid., p. 73); that is, being the right kind of 'knower'. The 'two cultures' debate can thus be depicted as a 'code clash' (Maton, 2014a) and struggle for supremacy between two fields with different underpinning legitimizing logics.

The more recent decolonial conversation, as it pertains to science, displays a similar dichotomy and struggle for supremacy. Interestingly, the early developers of modern science did not observe the dichotomy we see in discussions of science today (Gould, 2000). Instead, they saw the understanding they were seeking as arising from both the mind of the scientists

and the experiment, thus combining the scrutiny of one's own 'internal biases, both mental and social' and the observation of nature. It follows then that, from this vantage point, science does not build knowledge 'outside the social order and despite its impediments', but within the space of human relations (Gould, 2000, p. 255). Gould (2000) thus holds that the science–humanities divide might be viewed as little more than a false dichotomy resulting from naïveté about the history of science.

In his blog entitled *Revisiting the Science Wars*, Henriques (2012, para 6 and 7) similarly cautions against seeing science as a set of social constructions only, suggesting instead that we look at science as a justification system 'comprised of both analytic and normative components'. Literature, however, abounds with dichotomizing descriptions of science as either objective and acontextual or science as merely a set of social constructions. This is most notably manifested in science being portrayed as 'against' something: against the ancient philosophies of perfection, against religion, against humanities in the so-called 'science wars' (Gould, 2000) and most recently against indigenous knowledges, displayed as a battle between the West (science) and the Rest (indigenous knowledges) (Aikenhead and Ogawa, 2007).

The LCT dimension of Specialization (Maton, 2014a) offers a heuristic that can help us drill beneath the surface of this objective realism and social constructionism divide in these discourses. Specialization allows a means of unravelling the relations between knowledge and knowers in different knowledge-building practices. In this case, it can help to shed light on the logics underpinning the apparent dichotomy. We could, for example, use Specialization to argue that the social constructionist position valorizes the knower as the basis for legitimacy, thus placing emphasis on the social aspects such as context and knower subjectivity, while the objective realist position valorizes the more objective, explanatory aspects of knowledge. But Specialization also helps us to understand that despite what a field may valorize or emphasize, all fields consist of *both* knowledge *and* knowers. So, whilst legitimacy in science is more closely related to the epistemic elements of the practice, the social elements of this practice cannot be ignored (see Chapter 7).

One way of addressing the polarized set of views is through critical conversations that would include topics on the history, philosophy and sociology of science. Such conversations would allow us to address issues such as concept of objectivity and the acontextual nature of science. It could, for example, open spaces to engage with the idea that science 'maximises, but does not achieve, objectivity' through minimising 'the subjectivities of individual scientists and of tradition in that community' (Aikenhead and Ogawa, 2007, p. 546), and allow us to explore the position that scientific

endeavour can be likened to a 'dance of agency' or 'back and forth nego-tiation' between scientists and nature, in which knowledge is 'constantly produced and reproduced in interactions' (Green, 2012). Similarly, a better understanding of the history of science can 'help legitimize the role of sci-ence in society' whilst 'enhanc[ing] the professional identity or credibility of science' (Powers, 2020, p. 581), both of which are critical steps in reposi-tioning science in the cognitive and social justice conversation.

Through this chapter, we hope to show some ways in which 'polarised thinking' (Vandeyar and Swart, 2019, p. 776), for example, seeing science as either purely objective or purely socially constructed, or seeing science as a problem and IKS as a solution, can be 'dismantled' in order to enable a constructive conversation.

The conversation about decolonization and science

We have already established that the divide between science and humani-ties seen in the two-cultures debate and the science wars also extends to the decolonial conversation in science. Green (2012), for example, warns against (1) defining the knowledges in science and IKS as so different that there is 'very little chance of discovering the linkages and partial connections that might begin a new conversation' (p. 6), and (2) think-ing that 'either all ways of knowing the world, including the sciences, are belief, or all are knowledge' (p. 7), the dichotomy at the heart of the science wars. Even though a 'dichotomous discourse' might at times be necessary to help us 'act politically' (Rip, 2019, p. 90), finding a shared ground from which to respond to the ways in which African knowledges, histories of knowledge and ways of knowing have been and are still being marginalized (Gould, 2000; Green, 2012; Rip, 2019) would greatly benefit from a less dichotomized approach. The dichotomous othering/counter-othering and us/them portrayal of science in literature and in decolonization conversations thus poses a significant challenge to find-ing a productive opening or starting point for decolonial conversations in science (see Green, 2012).

The breakdown in the #ScienceMustFall (#SMF) conversation has been attributed to multiple deep disagreements in the 'conversational thread', resulting from a 'historical lack of constructive engagement and dialogue between scientific thinking and cultural beliefs' (Ally and August, 2018, p. 355) as well as a code clash originating in the legitimation practices used by different role players in the conversation (Adendorff and Blackie, 2020). Just as Green (2012) has argued for a 'translation' between different kinds of knowledges, we have called for mediation between scientists and those calling for decolonization (see Adendorff and Blackie, 2020).

Legitimation Code Theory offers a number of analytical tools for investigating the knowledge practices underpinning science and decolonization. In a previous study, we employed Specialization to uncover reasons for the breakdown in the decolonization conversation (i.e., the code clash we have mentioned). We will now drill deeper into nature of the science IKS dichotomy, using the concept of *axiological constellations* to analyze the problem and suggest a way forward.

Building knowledge with constellations

The concept of *constellations* analogizes to the familiar idea of grouping stars into recognizable images to help explain how actors shape what is seen as legitimate in a field (Maton, 2014a; Maton and Doran, 2021). The stars that form part of a constellation are selected from a vast array of possible celestial objects and are not necessarily in close proximity to one another, although they might appear so when viewed from Earth. Ideas, objects, values and beliefs, just like stars, can be grouped together to form constellations that can help us navigate the knowledge in a field or knowledge practice. The way in which this happens is determined by the cosmology of the intellectual field doing the *constellating*. All intellectual fields have *cosmologies* or worldviews, the ways in which they make sense of the world, for example whether there is an 'objective' truth to be discovered or whether all 'truth' is situated and relative. These worldviews act like the vantage points in that they determine what we see and how we group ideas to make sense of them. If we believe that there is an objective truth to be discovered, we are likely to design our experiments from that perspective and fail to account for the role of our own subjectivity in the chosen design. To help us make sense of the cosmologies that underpin knowledge practices, and the constellations that they lead to, we need to start with the concept of Specialization.

Starting from the perspective that all knowledge practices involve both knowledge and knowers, Specialization is concerned with what counts as a legitimate knowledge claim and who is allowed to make such claims, in other words who would be counted as legitimate knowers (Maton, 2014a). It thus sets up two relations: *epistemic relations* (ER) concerned with knowledge, and *social relations* (SR) concerned with knowers. These relations form the basis for deciding what counts as legitimate knowledge and who counts as a legitimate knower. Different knowledge practices emphasize these relations in different ways. In other words, practices may place a greater emphasis on either epistemic relations or social relations or both or neither. Practices that valorize epistemic relations will place a greater value on possession of specialist knowledge, such as scientific knowledge while

practices that valorize social relations will place greater value of the attributes of the knower. Since both can vary from weaker to stronger, we can plot these two relations on a plane and analyze practices in terms whether they emphasize one, both or neither as the basis for status and achievement.

Stronger epistemic relations (ER+) coupled with weaker social relations (SR −), i.e., where practices emphasize the possession of specialized skills, knowledge and procedures as the basis for success whilst downplaying the attributes of the actor making the claim, yield a *knowledge code*. Conversely, with weaker epistemic relations (ER+) coupled with stronger social relations (SR −), i.e., when what you are studying and how is less important than who you are and what kind of interactions you were shaped by, we have a *knower code*. Where both epistemic and social relations are both relatively weak, we have a *relativist code* and when both are relatively strong, an *élite code*.

Social fields can thus be understood as *knowledge–knower structures* (Maton, 2014a): all knowledge practices include *both* knowledge *and* knowers. What differs is how these are organized and what (and who) is valorized. Scientists are not absent from the knowledge project in science, but their attributes are not generally used as a basis for success. Knowledge practices in knowledge-code fields (like those often found in the sciences) are underpinned by an *epistemological cosmology*, giving rise to *epistemological constellations* where ideas, objects, practices and beliefs are organized around their ability to coherently explain observations.

In knower-code fields, such as the fields underpinning decolonization scholarship (Luckett, Chapter 3, this volume), we often find *axiological cosmologies* where value-laden meanings are grouped together to form *axiological constellations*. In both cases, the meanings that are clustered together are also selected from a vast field of possibilities, tracing boundaries that will exclude some meanings and include others. *Axiological constellations* thus represent connected groups of value-laden meanings that are used to make sense of or navigating a knowledge field.

The concept of constellations also draws on the LCT dimension of Semantics as we have just shown 'to distinguish epistemological and axiological forms of condensation whereby stances are imbued with meanings that are then differentially charged with legitimacy' (Maton, 2014a, p. 150). Semantics focuses on how meanings are made and introduces two concepts to that end: semantic gravity and semantic density. *Semantic gravity* (SG) describes the degree of context-dependence of meanings and it may be stronger (+) or weaker (−) along a continuum of strengths. 'The stronger the semantic gravity (SG+), the more meaning is dependent on its context; the weaker the semantic gravity (SG −), the less dependent meaning is on its context' (Maton, 2014b, p. 2).

Semantic density (SD) refers to the degree to which meaning is packed into the terminology used in a practice and may be stronger (+) or weaker (–) along a continuum of strengths. With stronger semantic density (SD+), more meanings will be condensed into the terminology in that practice; while practices with weaker semantic density (SD –), will have terminology that have fewer meanings condensed into it (Maton, 2014b, 2020). Returning to the concept of constellations, meanings in *epistemological constellations* will be epistemologically condensed (with explanatory meanings), while meanings in *axiological constellations* will be axiologically condensed (strong connections of moral meanings).

We have previously shown that decolonization conversations tend to downplay explanatory power whilst emphasizing moral virtue (Adendorff and Blackie, 2020). In this chapter, we are interested in exploring the way in which this is the result of a specific kind of constellating, the consequence of which is a dichotomous portrayal of science and IKS in literature.

Constellation analysis of the IKS–science binary in decolonization literature

There is a growing body of literature that compares and contrasts Modern Western Science (also called modern science knowledge systems (Tharakan, 2017)) and Eurocentric sciences (Aikenhead and Ogawa, 2007), with IKS (also called by various other names, such as traditional knowledge, indigenous technical knowledge, local knowledge, ecological knowledge and sometimes people's science, with much debate about what would be most appropriate, see for example Tharakan, 2017 and Mazzocchi, 2006) often setting them up as binaries. A constellation analysis of these depictions of science in the decolonization literature can show how the concepts related to 'Modern Western Science' and 'indigenous knowledge systems' are part of two binary constellations (see Table 6.1). In places where such dichotomous constellations are constructed it usually implies that agreeing or associating with one element in one of the constellations means agreeing with all the others as well. For example, seeing the world from a realist perspective implies also holding an anthropocentric view that sees nature as a servant to humankind (Aikenhead and Ogawa, 2007). Looking at Table 6.1, we see another instance of a code-clash, here between the underpinning axiological cosmology (value-laden connections of meanings) manifested in topics such as modern/postmodern, localized/globalized and the epistemological cosmology typically underpinning science (premised on explanatory power). This is especially well represented in the position offered by Cleophas (2020) who 'rejects an over emphasis on knowledge content as a vehicle for understanding', instead aiming to 'challenge deep

Table 6.1 Indigenous knowledge systems vs Modern Western Science constellations in the literature used in this study

Indigenous knowledge systems	Modern Western Science
Postmodern	**Modern**
Monist	Cartesian Dualist
Relativist	Objectivist, Positivist
Social constructivist	Realist
Post-colonial	Colonial
Post-human	Humanist, Anthropocentric
Holistic	Reductionist
Local	**Global**
Socially embedded	Socially distanced
Multicultural, Differentiated	Universalist
Place-based	Place-less
Community focused/local	Globalized
Context aware	Abstracted
Relational	Competitive
Relational	**Anthropocentric**
One with nature	In control of nature
Value circulation	Value extraction
Nature as self-modifying	Nature as static
Environmentally sustainable	Environmentally destructive
Subjective	Authoritarian
Spiritual	Secular
Embodied	Disembodied
Time as circular	Time as linear

assumptions, beliefs and values that hold institutional knowledge and values in place' (p. 2).

　The ideas or stances listed in Table 6.1, drawn from the sources used in this chapter, are not disparate but reflect an underlying cosmology (see Maton, 2014a). In order to makes sense of this cosmology, we have organized the stances into more coherent groups, reflecting the key points of opposition: postmodern–modern, local–global, relational–anthropocentric. We will now unpack the sets of stances in Table 6.1 to further elaborate on this cosmology and its implications for the conversation between decolonization discourses and science.

Modern–postmodern

The terms 'modern' and 'modernity' have been closely linked to colonization and colonialism (see for example Boiselle, 2016). Here, the

modern–postmodern tension pits science as an oppressive 'colonial', 'reductionist' and 'dualist' commercial exploiter and gatekeeper, with a sub-jugating role, against all indigenous knowledges as the oppressed, 'holistic', 'relativist' and culturally aware, position which is respectful of multiple ways of knowing and being (Dube, 2019). It captures the objective–subjec-tive divide and draws on the idea of science as a 'hegemonic' and 'powerful' weapon used to silence the indigenous voices, by positioning itself as the only valid way of knowing.

Global–local

The global–local tension sees science as 'globalized', 'socially distant', 'placeless' or contextually unaware or blind and competitive, operating in the decontextualized, theoretical domain while it views IKS as 'community focussed', 'socially embedded', 'place-based' or contextually aware and 'relational' as well as more accessible through operating in the lived-world context.

Anthropocentric–relational

This tension pitches IKS, as in tune with nature, versus science, as in control of nature. It depicts science as an 'authoritarian', 'environmentally destruc-tive' and self-serving enterprise with IKS portrayed as 'environmentally sustainable' and 'subjective' or in harmony with our natural resources and more focussed on the greater good.

Constellating practices

Axiological cosmologies are constelled through four main processes (Doran, 2019): (1) positioning, which includes mentioning the source of a position and showing things from alternative perspectives; (2) opposi-tioning, which involves putting something up as opposition in order to take it down; (3) likening; and (4) charging positions, either positively or negatively.

Positioning

Positioning can happen through acknowledging a source as well as through presenting alternative perspectives, 'hint[ing] at the tensions that underpin the texts' (Doran, 2019, 30min:43s), i.e., Eglash *et al.* (2020, p. 1346) do this by positioning IKS first from Latour's perspective and then giving the

alternative 'Indigenous perspective', indeed pointing to the underlying tension found throughout literature:

> **Latour's claim** is that science creates innovation because it allows hybridity, whereas Indigenous knowledge is static because animism freezes society in accordance with fixed categories in nature. As noted previously (Eglash, 1997), Latour is assuming a Western perspective in which nature is static. **From an Indigenous perspective** nature is full of self-modifying unpredictability.
>
> (emphasis added)

Oppositioning

Oppositioning pits one position against the other usually with the purpose to cast down one. In this excerpt from Boisselle (2016), indigenous knowledges from various sources are set up as diverse, spiritual and relational in opposition to science which is portrayed as reductionist, secular and objectivist:

> First Nations people like the Inuit and Hopi of North America, and the Nepuyo of Trinidad practice a relational science **in comparison with** WMS [Western Modern Science] which is reductionist, secular, and objective/substantivist'.
>
> (Boisselle, 2016, p. 5, emphasis added)

Charging

In Boisselle's 2016 text, this move of oppositioning supports the negative charging of science and the positive charging of IKS, i.e., calling the former flawed:

> the standard account of science is not just Western and modern but also secular in its disposition as it continues to negate the impact/role of Spirit or God in any form in its activities. It is suggested that Western knowledge (as is WMS) might be **flawed** on two counts'.
>
> (Boisselle, 2016, p. 4)

Likening

Likening 'sets up oppositions that appear to group together' (Doran, 2019, 35min:44s). Eglash *et al.* (2020, p. 1346) group together the idea of science

as anthropocentric (controlling nature) with concepts of value-extractive environmental destruction (poor models and practices such as mass production agriculture) and nature as static, appearing in the anthropocentric-relational group in Table 6.1:

> It is the Western view that has, in many ways, based its assumptions on **static**, linear frameworks: technical obsessions with **optimization, linear control, routinization**, and so on lead to poor models and practices such as **mass production** agriculture.

(emphasis added)

Seeing the constellations set up in these processes, found throughout STS and decolonization literature, helps us understand some of the difficulty with the conversation and why science might struggle, or might even be reluctant, to engage in it. However, whilst these constellations form a necessary part of critiquing and understanding the sociology of science, they also create a binary that is problematic to bridge. Even so, the process of forming axiological constellations is not the problem here; the problem is failing to recognize these processes as part of the logics of knowledge practices. With recent literature on decolonizing science stemming mostly from the fields of STS, humanities and the social sciences, all underpinned by axiological cosmologies, what is valued – both in terms of legitimacy and how meaning is made or knowledge is created – in these texts differs substantially from what happens in science with its epistemological cosmology. With recent literature on decolonizing science stemming mostly from the fields of STS, humanities and the social sciences, all underpinned by axiological cosmologies, what is valued in these texts – both in terms of legitimacy and the manner in which meaning is made or knowledge is created – differs substantially from what happens in science with its epistemological cosmology. It stands to reason that scientists would read these texts through the filter of their epistemological cosmology, looking for the different constellating principles applying there. Understanding this might help us find a way to advance the conversation in science. Consider the example of the South African government's initial handling of the AIDS crisis in the early to mid-2000s. Although the government at the time was correct in recognizing the importance of attending to the social issues pertaining to the crisis, their denial of what science could offer (Green, 2012; Broadbent, 2017) came at a great cost despite the presumed governmental motivation of a virtuous decolonial agenda (Broadbent, 2017). What we can learn from this is that the solution to problems such as these will require moving beyond dichotomies such as local–global, scientific–traditional, good–bad, a process that will need to start with the role-players (i.e., scientists and decolonization

scholars) agreeing to what might be a difficult conversation and having access to tools or analyses, like the one offered in this chapter, that could help to mediate the conversation.

Taking the conversation forward

We have elsewhere proposed that the code clash in the conversation about decolonizing science might be mediated through using facilitators that can shift the codes of their messages to match that of the intended audience (Adendorff and Blackie, 2020). In this chapter, we have showed how the cosmologies or worldviews underpinning the calls for decolonization from within science and the humanities set up an axiologically charged dichotomy between science and indigenous knowledges that is not easy to navigate. In a study that investigates the equally dichotomous climate change conversation, Glenn (2015) suggests that there are two ways in which conversations can be productive in overcoming such clashing or opposing binaries: translating and transforming. In translation strategies the messenger acts as a mediator, translating between the viewpoints of the different parties involved in the conversation. Translating can happen in a number of ways, the first of which involves recognizing the different 'languages' or Specialization codes in the conversation and 'translat[ing] between them' (ibid., p. 209) by shifting the code of the message to match the audience's code. This requires someone to 'translat[e] between languages on behalf of the audience, or in LCT terms, matching the audience's codes' (ibid., p. 209), the audience here being science (and scientists). In the decolonial conversation in science, this would imply translating between the knower-code, axiological cosmology underpinning decolonization calls and knowledge code, epistemological axiology of scientists. Another way to achieve this is to use messengers who share the intended audience's cosmology, who thus do not need to shift codes to translate messages. In this instance, translating might even involve not mentioning the dichotomous topic, i.e., decolonization, but instead requiring the audience to take action for 'other reasons', though ultimately still addressing the issue at hand. In the decolonial conversation in science education, useful frames for this purpose could be understanding how cultural influences might impact science learning or charting a sustainable future for the Earth (Aikenhead, 2017). Both of these approaches, as well as Green's (2012) suggestion of IKS helping science connect with its context, could provide useful motivations for change that do not necessarily require the audience (science) to completely change its cosmology and align with all the beliefs underpinning the IKS constellation. It might,

however, open a door for engaging with some of the beliefs underpinning the IKS cosmology, without setting the two up as binary oppositions.

Transformation is interested in changing people's views and actions and is thus typically a slower and more challenging process since it 'requires the audience to learn to speak multiple languages and shift between them, or at least to adopt useful features of the new language' (Glenn, 2015, p. 209). For science, this would imply shifting towards a knower code, to be better able to understand and act on the decolonization calls.

We will now briefly comment on our own experience with utilizing translation during decolonization discussions with various science-based audiences. Drawing on our experience in seven unexpectedly productive conversations, and the principles laid out in this chapter, we will show how the forms of translation offered by Glenn (2015) functioned to advance these conversations in science (for an example of one such a conversation, see Adendorff (2018)).

Shifting the code of the message to match the audience's code

The purpose of this translative action is to reduce resistance by making the topic, in this case the decolonization conversation, feel less alien through matching the code of the message with the audience's legitimation codes. In science this would imply foregrounding and strengthening epistemic relations – specialized knowledges and skills – or using a knowledge code as basis for legitimacy in the conversation. In our case, we did this by focusing on 'making sense of the decolonization conversation' and offering an analytical tool, LCT, to help us do that. With its ability to be used in a technical or empirical way, exhibiting stronger epistemic relations, LCT can help us make the conversation feel less foreign to scientists. Here employed for its explanatory power, LCT thus offers an approach that not only speaks a language closer to that of science, but might prove enticing. Epistemic relations were emphasized and strengthened throughout these sessions when the tools from the LCT dimensions of Autonomy and Specialization were employed and enacted. Although we foregrounded social relations when the topic of decolonization was introduced, for example explaining that the sessions were about opening up a conversation and figuring out how we can start a conversation about decolonizing science education (see, for example, Adendorff, 2018, September, 6), we did not offer it as the basis for legitimate participation in the conversation. With these actions, we located the conversation in science's reason-based epistemology rather than the value-based cosmology of decolonization scholarship.

Messengers who share the audience's cosmology

This approach assumes that there will be different ways of viewing the decolonization conversation in science and thus works to activate these alternative positions through communication. We, as the authors of this chapter and facilitators of these conversations, are both scientists who have gained legitimacy in science through acquiring the prerequisite specialized skills, as evidenced in science PhDs. However, we both have some experience and legitimacy in the social science context too, through immersion in the higher education studies canon and interaction with noted works and scholars. We thus both have access to the epistemological cosmology underpinning science and can make sense of the axiological cosmologies underpinning the social sciences and humanities. Glenn (2015) suggests that this approach of matching the audience's cosmology works best when the messenger uses helpful frames and discourses that are supportive of the goal of the conversation, reframing the decolonization conversation as 'good' and necessary. In our discussions on decolonizing science curricula, we postulated that the alienation that some students experience in science courses could be a useful approach for drawing participants who were reluctant to engage in decolonization conversations into the discussion. Starting the conversation using the epistemology of science, we could show the scientists that we 'spoke their language', opening a space in which we could activate motivations such as finding ways to help students access the field or contributing to sustainable living.

In conclusion, we found that LCT acted both as a theoretical framework or mediatory agent and as a legitimizing tool. Using the explanatory power of LCT as an analytical tool helped to strengthen epistemic relations, thus legitimizing the conversation as something sufficiently close to what counts in science. We believe that this strategy of offering an explanatory framework through which scientists can make sense of the axiologically charged knower code conversation can create a space in which a conversation could grow into dealing with increasingly complex topics. We thus suggest that the conversation can be mediated through a few code shifts and a deep enough understanding of both the knowledge and knower codes involved as well as the resulting constellations to be able to translate the calls for decolonization calls into the science context. Anecdotal feedback from scientists who attended the decolonization discussions in which we applied these analytical tools mentioned that the more epistemically strengthened approach offered by LCT removed the emotive elements from the conversation, and this was one of the reasons for a greater readiness to participate in the conversation. In the words of one of these participants: 'I've sat in a number of these decolonizing fora and discussions and I think as a scientist

this is the first time that I feel it has made some sense to me' (Adendorff, 2018, 44min:50s).

Conclusions

In this chapter, we have shown the appeal of the stronger epistemic relations or explanatory power of LCT in the science context. It not only served as a mediatory tool in conversations about decolonizing science, but also as a legitimizing tool, strengthening the epistemic and discursive relations of the message offered by the facilitators. In using the tools offered by Specialization especially, we may avoid the risk of knowledge-blindness (Maton, 2014a) associated with treating decolonization in science in much the same way as decolonization in other fields. Given that the literature relating to decolonizing science is ambiguous and varied, understanding the differences between the meaning making practices in science and those in other fields can help us chart a course for a more successful conversation in science. We have found that the more analytical approach offered by LCT can reduce the emotive elements from the conversation, thus proving an unexpectedly useful tool for mediating the decolonization conversation in science contexts.

Green (2012, p. 1) argues that a conversation is needed 'both in the sciences and the humanities if universities are to be able to respond to the continued marginalisation of African intellectual heritages in the region'. We would add that such a conversation could start with the premise that neither science nor IKS would need to become the other, but that both can learn from the other. This will enable science, the humanities and IKS to retain their unique ontologies and epistemologies, though not uncritically, drawing on the strengths of both. We have shown, through the constellation analysis, that the current dichotomous argumentation is doing little to advance either IKS or science. Solving the real world problems in the global South requires not only the products of science (e.g., vaccines and cell phones), but also the social understanding of the humanities and the contextual awareness of IKS. Thus, these conversations need to be constructed to enable this dichotomy to be challenged and bridged.

We contend that science needs to be repositioned not in opposition to the humanities and IKS, but as a collaborator with other knowledge practices. We have seen the harm done when the products of science are exploited (or devalued) by those with or reaching for political or economic power. We argue, along with Gould (2000), Green (2012) and Powers (2020), that science education needs to pay more attention to the history, philosophy and position of science in society. We cannot wish away or undo the harm done

by the naïve or wilful ignorance or worse, of those wielding the powerful weapon of science during the period of colonization. Perhaps then we can wish for a better future, one which the humanities and IKS can help us move towards using the products of science as equally powerful weapons in the fight for cognitive justice (see for example Tamarkin's (2017) work on DNA testing).

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