Science and Mathematics Textbook Authors' Hopes for Peace and Sustainability in a Changing World

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Abstract: *We seven interviewed science and mathematics textbook authors in Canada to understand better how they reconcile personal, disciplinary and societal demands in their writing. In particular, we asked how they position themselves in relation to their hopes and fears for students, society and the environment, how their hopes appear in the text they have written, and what challenges and insights they have experienced while trying to integrate their hopes into their writing. The authors identified professional stakeholders resistant to innovation (and some responsive) in addition to more mundane challenges. Our interviews prompted them to consider new possibilities for writing disciplinary material they thought could support the development of global citizens responsive to environmental and social concerns.*

1. Objectives

It is hard to imagine educators who do not claim to be working for peace or sustainable development, yet these interests are not prominent in school textbooks, especially in science and mathematics. Why do textbooks avoid these important goals? This question motivates our interest in the tensions textbook authors experience in relation to their hopes for peace and environmental sustainability. We are part of an international team supporting jurisdictions that wish to develop textbooks that put peace and sustainability at the heart of education. In this paper we report on our research motivated by that effort.

We have interviewed science and mathematics textbook authors in Canada to understand better how they reconcile personal, disciplinary and societal demands into their writing. With our interest in the way authors position themselves in relation to their hopes and challenges, we asked them what their hopes and fears are for students, society and the environment, how their hopes appear in the text they have written, and what challenges and insights they have experienced while trying to integrate their hopes into their writing.

Science and mathematics are especially ripe for this analysis because they are the school subjects most closely associated with objectivity, which may seem at odds with the idea of hope. Considering that textbooks have been largely unchanged over the years, we realize that there are strong disciplinary forces at work that maintain the shape and content of the texts, including the science and mathematics disciplines and other school discourses. We hope that a focus on the experiences of textbook authors in reconciling these discourses in relation to their social and environmental goals will help us better understand school disciplines and discourses, authors of textbooks (and other resources), and teachers who use them.

2. Theoretical Framework

The word 'hope' is used in a variety of ways, usually with relatively vague meaning. A general sense of hope might be described as optimism or an attitude of resilience in the face of challenges. This sense

of hope is common in religious traditions, which provide a way of living with tragedy. Alternatively, 'hope' can refer to specific and distinct goals or wishes, which could be dependent on luck or on planning and effort. Such hopes are usually in reference to the wishes of a particular person. This specific sense of hope features strongly in psychology literature (e.g., Idan & Margalit, 2013; Synder, 2002). This goal-seeking may extend beyond the individual, because one's vision for the future necessarily involves wished-for relational situations (Ludema, 2000; Tiger, 1999). Psychology research often measures hope (Douglas & Strobel. 2015) and identifies its correlates (Adelabu,2008; Chang & Banks, 2007)—hope as a contributing factor in other endeavours or hope as a product of other factors (Hughes, 2011; Palaiologou & Male, 2016).

We are especially interested in collective hopes, which relate to Freire's (1994) articulation of hope—ontological, but rooted in practice for "there is no hope in sheer hopefulness" (p. 9). This sense of hope requires a sense of optimism and resilience because our individual efforts to develop and support a peaceful and sustainable future cannot be realized by our efforts alone (Peters, Grégoire, & Hittleman, 2004; Shade, 2006). We have to act with the optimism that others too will act with these goals in mind. In this vein, Rorty's (1999) conception of romantic hope describes a "shared utopian dream" and Halpin (2003) describes a radical intersubjectivity, a willingness and sense of responsibility to bring people together in empowerment and collective agency. Freire's sense of practical optimism, along with Rorty's and Halpin's realization that such hope requires a collective leap allows for the articulation of particular and specific hopes that can be discussed in relation to practice.

In addition to our interest in hope, we are attentive to scholarship relating to textbook authorship. Research on mathematics and science textbooks rarely focuses on authorship in any way. Kuhn (1970) saw science textbooks as conservative exemplars of disciplinary paradigms. Kuhn's recognition of the conservative nature of textbooks, and how they present the least controversial aspects of a discipline, reflects back on the tradition of textbooks, but this characteristic of textbooks continues to carry forward into the present. Hyland (2000) described textbooks as a conservative force promoting "tamed and accepted theories of a discipline" (p. 105), a canonizing discourse. By contrast, open texts invite readers to explore a variety of perspectives and equip them to confront systems challenges such as the United Nations' (2015) Sustainable Development Goals.

Science textbooks continue to be considered the main instructional tool (DiGiuseppe, 2014; Kelly, 2007); for instance, 75%–90% of instruction and 90% of all teacher-assigned homework are based on textbooks (Chambliss & Calfee, 1998; Chiappetta, Ganesh, Lee, & Phillips, 2006). Research has also reported problems in textbooks such as poor projections of the nature of science, narrow worldviews in scientific knowledge (McTigue & Slough, 2010) and obfuscation of human agency in environmental problems (Sharma & Buxton, 2015).

Research on mathematics textbooks generally focuses on content analysis—comparing the content in different contexts (e.g., Charalambous, Delaney, Hsu, & Mesa, 2010), comparing content against a prescribed curriculum (e.g., Polikoff, 2015; Sidenvall, Lithner, & Jäder, 2015), or evaluating the depth or level of content on a particular focus area (e.g., Davis & Fonger, 2015). There are also discourse analyses that, for example, identify gender constructions (e.g., Hottinger, 2010), and features of grammar that illuminate aspects of mathematics and mathematics education discourse (e.g., O'Keeffe & O'Donoghue, 2015; Herbel-Eisenmann & Wagner, 2007; Wagner, 2012).

3. Methods

To understand lived experiences and the hopes of textbook authors, we have adapted the tradition of narrative storytelling as a research method. The complex nature of human experiences can be shared

and understood in the form of storytelling. Narrative stories are one's voices, relationships, and reflections on experiences, which provide us social and cultural contexts of one's being and positioning in the community (Clandinin & Connelly, 2000; Miller, 2009).

We engaged seven textbook authors to share their stories of textbook authoring (four science, three mathematics). To set the stage, we invited them to share their experiences and challenges of textbook writing and their hopes and fears in relation to peace and sustainability. We followed this with an elicitation of narratives of their attempts to address these hopes and fears, reflecting back on their own experiences of textbook authoring. The initial interviews were over an hour long followed by a shorter interview some weeks later to draw out elaborations based on what we heard in the other interviews.

Due to limited space, we cannot adequately represent the authors' stories here. In this paper we list challenges and hopes the authors identified, and we will elaborate them with the authors' voices in the presentation. Our sample of authors should not be taken as representative. Instead, their accounts should be seen as existence proofs—the challenges they identified are challenges that exist and may be influential for others. We know there are further challenges that other authors might identify.

4. Results—Challenges Identified by Authors

Every one of the authors identified challenges relating to marketing textbooks—in order for a textbook to sell well it needs to be recognizable, and look like previous textbooks. This is the conservative force described by Kuhn (1970). The authors' stories recognized an interest in innovation among publishers, but clarified that the people who decide on which textbook to purchase usually are not the teachers who would use them and so marketability is complex.

Some of the authors noted that teachers were not ready or not prepared for some textbook innovations, another example of the conservative force. Others noted that many teachers were excited about the innovations in their textbooks. Some authors identified conflicts with curriculum writers and large-scale assessment directors. Some authors identified space constraints, as their more innovative work that related to peace and sustainability tended to be seen as add-ons above curriculum and thus an extra cost in publication and printing.

Some authors identified more mundane challenges, not necessarily related to innovations for peace and sustainability. Some authors identified time constraints as they had full time professional roles as well as family responsibilities, which competed with their writing. Some described tensions relating to teamwork, noting that it is hard to identify one's own writing in a published work because of the many people involved in the process, or that team members were not always disciplinary experts (and thus had relatively simplistic or conservative views of the discipline). Some authors described the challenge of meeting the needs of students with varying access to resources, especially information technology.

Some of the authors saw their innovations as related to peace and sustainability, and thus they saw their challenges in relation to these concerns. Others reflected on their innovations as insufficient, focused more on developing disciplinary understanding than on engendering global citizenship. Our questions prompted them to see new possibilities for addressing peace and sustainability in textbooks and other teacher resources.

5. Results—Authors' Hopes

The authors had different ways of articulating their hopes for the children who use their textbooks and other textbooks. Considering their reflection on the hopes they brought into their initial experiences of writing, we and the authors see these as relatively naïve hopes, for they all described a rapidly changing world with new needs for global citizenship within science and mathematics. Each of the authors entered their writing with excitement for their discipline and a belief that good understanding of

the discipline would be good for the students who used their books. None of the authors we interviewed critiqued their disciplines for their roles in the world's current social and environmental challenges (though such critiques are warranted and well-represented in science education and mathematics education literature).

Most of the authors said that they had not before thought of their discipline as having a role in supporting peace and sustainability. However, the authors described new possibilities for addressing the rapidly emerging problems in our society, and sometimes noticed that the innovations they had brought forward with an interest in the their discipline are also important for peace and sustainability. Materials addressing the role of science in society are notable examples of this: our authors had used significant environmental challenges as examples for developing scientific concepts. New needs for innovation identified for science textbooks included:

- focus on examining evidence and finding reliable truth (amidst the escalating proliferation of misinformation online)
- promoting more active students (amidst increasingly internet-mediated experience, characterized as generally passive)
- focus on evidence-based decision-making
- addressing significant current issues despite political resistance

New needs for innovation identified for mathematics textbooks included:

- using problems that draw students' attention to different perspectives (amidst increasing cyber-bullying and racism in political discourse)
- drawing on indigenous wisdom relating to ways of teaching and learning (recognizing our colonialist past)
- using examples and problems that draw attention to human rights

6. Significance

The science and mathematics textbook authors we interviewed noted significant systemic challenges that relate to the conservative force of textbooks described by Kuhn (1970). This reality underlines the need for intentional change amongst all stake-holders—textbook authors, publishers, teachers, school administrators, and bureaucratic leaders including curriculum developers and assessment directors. All these stakeholders will need to recognize and embrace the need for positioning science and mathematics as important to developing global citizenship that is responsive to environmental and social challenges. Amongst all these stakeholders, we argue for explicit discussion of their hopes, to see them develop a practical optimism (in the sense of Freire, Rorty, and Halpin), and understanding that they need to act together to achieve their hopes.

A synonym of hope is *aspiration*, which has the Latin root *spiritus*. This is the word for spirit and for breath. Hope is the heart of one's living being. The kind of hope we see as a necessity for educating for peace and sustainability would have educators con-spire, breathe together, sharing the same spirit and vision. When educators conspire in this way, our individual actions may join together to make societal and environmental goals possible.

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