Difference as a resource for learning and enhancing science education

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Received: 27 September 2009 / Accepted: 27 September 2009 / Published online: 9 October 2009
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In social life it seems we are always dealing with difference and, speaking for myself, in some fields I am more successful than in others. Basically, the criterion for success is to meet individual and collective goals within a field while maintaining solidarity among participants in the field. Within a given field, such as science education, participants cluster together around social categories (i.e., structures) such as adherence to theoretical orientations—such as sociocultural theories, conceptual change theories, and positivism. Given the existence of these islands, a goal is to bind the clusters, that is, to create social bonds and networks that connect social groups within a field, not by eliminating difference in favor of sameness, but by showing respect for difference. This is the situation we face within the field of science education.

During 2009 I have had the good fortune to participate in numerous international conferences in science education, in the US (2), Australia (2), Turkey, Spain and Taiwan. During these meetings I got a strong sense that the theoretical perspectives that inform my work are very much in a minority. The mainstream is still centrally involved in theories that regard learning as conceptual change and for the most part address social and cultural issues as context, which is seen as separate from (but related to) the object of their inquiry. When I make a presentation, even a plenary address, my experience is that leaders in our field are not in the audience and when I read policy reports, reviews of research, and research reports from mainstream science educators they seldom cite work in science education that involves the uses of sociocultural theory. Consistent with this experience, during the plenary sessions at the meetings I attended this year, research in science education that employed sociocultural theory frequently was ignored entirely or presented as a framework that is not well understood, ill defined, and lacking cohesion. One way to describe the way in which the mainstream has dealt with difference, in this example, is to say it has been silent about the difference or has regarded difference through deficit lenses. Being in the minority in this case I experience the mainstream approaches I have described as painful—disrespectful, unscholarly and detrimental to science education.

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There are exceptions. Due to our efforts in preparing a special issue of *Cultural Studies of Science Education* (CSSE) on conceptual change theory and sociocultural theories (Volume 3, Issue 2) there has been a flurry of interest in synthesizing, adapting, and incorporating different theories to advance science education. For example, at the 2009 annual meeting of the National Association for Research in Science Teaching, Catherine Milne organized a symposium to follow up on issues raised in the special issue of CSSE. Since then numerous science educators from the international community informed me that they benefited greatly from the good-natured debates that occurred during the symposium. Their comments focused on the quality of the conversations and the positive emotions generated in the symposium. It appears that at least some of the audience enjoyed the conversation among scholars who disagreed about theoretical orientations but showed respect for one another's integrity as scholars and willingness to learn from expressed differences.

During the 2009 Conference of the European Science Education Research Association (ESERA) I spoke briefly with a leading European science educator. After a cordial exchange he remarked (as he walked away): "One day you will have to explain this *Cultural Studies of Science Education* business. I just don't get it. What is it?" Naturally enough, I invited my colleague to join me in a conversation about cultural studies, science education and CSSE—but the discussion never occurred, probably because he had no interest in these issues. Probably the statement that one day I should explain the connections was intended to be disrespectful, a sign this person (who has a long history of editing journals) does not value CSSE and the material it publishes.

During these meetings there were also other signs that concerned me, even among those who embrace sociocultural perspectives in their work. For example, later in the ESERA conference, during a symposium on cultural studies of science education in Europe, the discussant commented that all science education research was social and cultural and perhaps there was no need for a special journal to publish such work. "Wouldn't all research in our field qualify?" she argued. This stance reflects a status quo that pre-dates the establishment of CSSE and fails to recognize the dominance of mainstream standpoints that made it difficult for research embracing sociocultural theory to grow and flourish. The establishment of CSSE provided a forum for many scholars and, as we complete Volume 4, and even more articles published electronically in Online First, we have approximately 5,000 pages of research in science education that incorporates a sociocultural perspective. Of course some of this work would have been published in other journals, but the presence of CSSE created spaces in which this work could grow. An extant challenge is for our scholarly work to have more of an impact on mainstream science education. Making science educators aware of our work and the journal is just a start. It is now a priority to reach out to scholars from science education's mainstream, especially to those who adopt deficit views of difference (regarding their standpoints as true and promising and alternatives as dead ends—wrong and unworthy of further elaboration). It is time to educate those who embrace alternative perspectives and enlighten them about the affordances of sociocultural theory. The goal is not imperialism, but education and the improvement of science education.

In the same session at ESERA many participants called for uniformity in the defining of culture and there appeared to be consensus that culture should carefully be defined. The call for a common definition makes sense on one level and reflects a preference for sameness. However, the call for one definition fails to recognize that culture is a construct that has interpretive power at many grain sizes—including macro, meso, and micro. Rather than standardize through the use of a common definition of culture, my preference reflects

a hermeneutic stance whereby scholars of culture would make its meaning clear through its uses—using examples and thick description to depict the meaning of culture in its uses. In my own research culture is used consistently, as something that is enacted in fields. There is more to it of course, and my preference is to show the nuances of how I understand culture as the need arises in my research reports—when and as needed. Having stated my own preference, I hasten to add that those who want to define culture in particular ways to reflect their own projects are at liberty to do so, with the proviso that in doing what they do, they do not restrict my agency and continued progress in my own projects. I regard difference as an opportunity to learn from others and for others to learn from me. Accordingly, my preference is to clearly articulate meaning in the texts we publish in CSSE and elsewhere, providing objects for readers to consider different standpoints reflexively, understand the affordances of different perspectives and, as necessary, adjust their personal standpoints.

After my keynote presentation at the *VIII Congreso Internacional sobre Investigación en la Didáctica de las Ciencias* in Barcelona, I participated in a separate question and answer session that was attended by a fellow keynote speaker. Consistent with courteous professional protocol he congratulated me on the presentation and the associated question and answer session. Then, as we commuted back to the hotel on the subway, he asked: “how would any of this be different if it were done in some other subject area—like a social studies class? What is there about this that is particular to science education?” This is a very common question and I was pleased to have a chance to answer it. An assumption underlying the question concerns separation—the question assumes that it makes sense to separate enacted culture into social categories, consider them separately, and enact them as if they were independent from one another. In the specific instance I had reviewed research involving the use of cogenerative dialogue in science classes. As he listened he did not reject the applicability of what I presented to the teaching and learning of science, but he reasoned, the results would apply equally well to other subject areas, and this probability diminished the relevance of what we had done for science education. I find this assumption common and damaging, especially when it is adopted by peer reviewers who decide that a project is not worth funding or publishing because it might be just as applicable to other subject areas as it is to science education. For too long science educators have used rationale such as this to reject articles, deny funding, and to excuse familiarity with research done in areas of the curriculum outside of science education. In fact, an extreme form of this argument separates work done in science education from work done, for example, in physics and chemistry education. I emphasized to my colleague that the importance of the research I had spoken about is that it was done in science education and therefore had direct implications for science teacher educators, science teachers, policy makers in science education, and researchers of science education. Unfortunately our journey back to the hotel was completed before we could complete the conversation and I fear that completing it might be more of a priority for me than for him.

In CSSE’s publications there are also issues that arise from different scholars’ handling of difference in perspective. How are alternative standpoints considered during the review process, including the forum? As Editor-in-Chief I have been intrigued by the different standpoints leading scholars bring to critique. In this issue of CSSE the forums associated with the featured articles illustrate different ways in which critique is undertaken and accepted in CSSE. As a central part of peer-review, forums are intended to open up dialogue on issues that are critical to science education. Having this goal does not preclude convergence, agreement, and criticism of others’ standpoints. In this issue we see some of that. However, we also see examples of divergence and willingness to learn from

standpoints that do not cohere. In some forums published in this issue, the authors of the original article are offered an opportunity of further participation. In other forums the choice was made to expand the dialogue by involving scholars who were not authors of the original article. The decision of which authors to include in a forum depends on the specifics of the original manuscript, the way the peer review process unfolds, and the judgments of the lead editor of the particular manuscript and its forum (usually a member of CSSE's Editorial Board). Accordingly, there are differences from one set of papers to the next. As I mentioned in a previous Editorial (Tobin 2009), radical listening can be used to greatly expand the potential of forums, not only by suggesting alternatives and criticizing what has been done, but first by making sense of what the author of the original paper has proposed, consider possibilities of what has been proposed in contexts that have not been addressed in the original paper, and fully explore the possibilities of what was learned in the original paper. Radical listening is an activity that goes beyond making sense to include giving new suggestions a try—applying them to explore their potential before offering something new.

In this issue

This issue of CSSE contains five clusters, each consisting of an original article and an associated forum. Below I briefly describe each cluster.

The grotesque in science education

While I was involved as a teacher researcher in research at City High, in Philadelphia, one of my colleagues, a teacher-administrator at the school told me that his students loved science as long as they could cut things up or blow things up. I was reminded of this comment while reading the work of Matthew Weinstein and Matthew Broda, who employed Mikhail Bakhtin's *Carnival* in an investigation of the grotesque in school science (Bakhtin 1988). In his work on carnival, Bakhtin showed how peasants could undermine official culture within a field through the use of comedy, laughter, humor, irony, satire and what he referred to as grotesque humor. That is, the structures of a field can support two systems of culture, an official culture and a counterculture, which may be considered as resistance. As Bakhtin noted, carnival is not directed at individuals, but at a collective, and those in authority cannot defeat carnival, the only option being to join it. Matthew Weinstein and Matthew Broda examine the grotesque as a form of social capital with the potential to engage the marginal and oppressed in science. No doubt their work is a basis for an extensive discussion among science educators and a good degree of radical listening.

The Forum participants, Giuliano Reis and Mark Zuss adopt different standpoints in their contributions. Reis provides an analysis of what he views as shortcomings of the article and Zuss takes what is in the article as an opportunity to expand and go beyond what was provided by Weinstein and Broda. In a brief rejoinder Weinstein and Broda present a playful response that draws our attention to the role of theory in research and clearly eschews name-calling, which often reflects stance taking and is a regular feature of critique.

Science inquiry as a goal for science education

Alandeom Oliveira examines the teaching and learning of science inquiry with elementary level students in US schools. In so doing he uses a variety of theories and methods to explore

teacher student interactions before and after participation in a teacher development program. His research provides interesting insights into the role of language in establishing and sustaining authority structures while pursuing goals that assume some measure of student autonomy and emancipation. Not surprisingly, Emily van Zee and Lawrence Bencze raise interesting alternative perspectives in the Forum and open up a fruitful dialogue on the nature of inquiry and how to teach for inquiry, and how to recognize, describe, assess, and study inquiry. The different perspectives represented in the Forum give us much to consider further. It is apparent that this set of papers has not resolved the problems addressed in the featured article and represented in the work of scholars in our field for many years. Even though definitive national level reports are cited along with alternatives, it is my view that studies of science inquiry and argument (so prevalent in the mainstream of science education) are topics that can benefit considerably from social and cultural theory.

Connecting everyday knowledge with science knowledge

Bryan Brown and Matt Kloser examine conceptual continuity in a study of high school youths' evolving understandings of baseball and physics. Their work points to the need for educators to adopt a more language sensitive approach to science teaching and learning. The value of looking at research through different theoretical lenses is highlighted in a forum consisting of two review essays authored by Sung Won Hwang and Mijung Kim and Jennifer Yeo, respectively and a rejoinder from the authors of the original paper. For example, the adoption of a dialectical perspective is advocated as an affordance that might illuminate different pathways—different ways of looking at data, raising different questions, and producing different answers and associated implications for practice. I take this forum as an opportunity to argue that the strength in difference is not to play “gotcha” with the authors of the original paper, not to adopt a deficit perspective of others' (different) perspectives, but to expand the conversation, present alternatives, and elaborate on them with the motive of advancing the quality of science education. This forum addresses rich possibilities, opening up issues that will be kernels for further dialogue among scholars in our field. The issues addressed in this set of papers can be further expanded through scholarship that embraces sociocultural theory.

Science and children's literature

Trevor Owens examines the ways in which Albert Einstein and Marie Curie have been depicted in children's literature and in so doing show salient gender-related trends that have implications for science educators, especially those involved in research, teacher education, and curriculum. A forum consists of review essays written by Rachel Wilson, Amber Jarrard and Deborah Tippins and Sonya Martin and Christina Siry, respectively. Collectively, these papers emphasize a need for critical analyses of texts read by children, to reveal and critique embedded standpoints about gender, science, and social institutions such as school. There is clearly a problem that stereotypes can be reinforced through children's literature and student identities might be framed in ways that are hegemonic.

The cultural embeddedness of interpretive repertoires

Albert Zeyer and Wolff-Michael Roth raise an important concern for science educators with a concern for whether or not science education makes a difference in the world

outside of the classroom and other places in which science is learned. Among the issues they raise are the roles of macrostructures such as media and political rhetoric in shaping schemas, referred to as interpretive repertoires, which underpin life decisions concerning crucial factors such as the environment and environmental protection. In research conducted with Swiss junior high school youth the authors show how collectively shared interpretive repertoires can produce beliefs that actors have little control and a tendency to be ecologically passive. The authors present implications for the role of science education in educating youth to be agentic in regard to their lifeworlds.

The forum consists of review essays authored by Michael Mueller and Catherine Milne, respectively. These authors advocate the adoption of an historical approach that pays attention to macrostructures such as US consumerism, ecojustice, and sustainability, while using methodologies that afford research being ethical and catalytic, thereby mediating cultural enactment and disrupting deleterious cycles of reproduction.

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