12-7-2018

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Cultural Studies of Science Education, Vol. 14 (2019): 617-620. DOI.

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Abstract

This review essay addresses issues raised in Valerie Frède's paper entitled: *Comprehension of the nightandday cycle among French and Cameroonian children aged 7–8 years*.

As a research discipline, science education finds itself in a unique position in controversy over scientific or interpretive approaches to knowledge generation. The study of science education is itself a social science examining the processes, institutions, relationships and structures through which individuals and groups come to know natural science. Thus, although science education research is a social inquiry, its object is the learning of natural science. In response to the paper *Comprehension of the night-and-day cycle among French and Cameroonian children aged 7–8 years* we will summarize an ongoing conversation and consideration of possible purposes and uses of science education research. Our discussion is grounded in a consideration of Bent

Flyvbjerg's (2001) *Making Social Science Matter* and subsequent ontological scholarly pieces about the contribution and value of varied forms of social and natural sciences.

In the paper *Comprehension of the night-and-day cycle among French and Cameroonian children aged 7–8 years,* Valerie Frède attempts to mediate more contextual/interpretive and cognitive science/learning science perspectives on studying scientific learning. The author forefronts the impacts of differing cultural backgrounds on learning about astronomy, particularly whether modeling the solar system through a geocentric/topocentric (*termed in the article alternative or animistic*) or heliocentric (*termed in the article scientific*) model is more consistent with different cultures. After identifying specific differences in French and Camaroonian students' modeling of night and day cycles, the authors conclude that:

> Teaching of night and day cycle and more broadly of astronomical science should be done in the perspective where complexity is taken into account through linear but also nonlinear interactions between all the cultural, social and historical factors like initial knowledge, personal beliefs and mediation by tools or artefacts. This view nuances the universal view of the mental model approach and the cognitivist view of learning in favor of a more broadly socio-cultural approach in astronomy.

Understanding the cultural backgrounds of students and the potential influence that culture might have in their acquisition of abstract knowledge is an important and laudable concern for teachers, teacher educators, and education researchers, particularly for those focused on the education of students with backgrounds that differ from their own. The article's effort to nuance universal views of mental models through consideration of cultural contributions to students' conception of astronomy offers important background for teachers seeking to communicate complex concepts to students from varied cultures. Taking a more scientific approach to their research, the authors produce two typologies of culture from which teachers can begin to understand the backgrounds of their students. As such this article attempts to bridge a gap in more psychological versus socio-cultural approaches to science education research by nuancing the categorizations through which we might understand learning, thus accounting for cultural mediation within a largely predictive model. In this forum we will discuss the ongoing controversy between scientific and interpretive approaches to social inquiry and offer both support and caution for work of this type that attempts to combine the two approaches.

Our reaction to Frède's piece is shaped by Flyvbjerg (2001), who provided an influential discussion of paradigms that reframed the purview and purpose of social science (to illustrate see: Flyvbjerg, Landman and Schram 2012). The crux of Flyvbjerg's argument draws on distinctions between intellectual virtues outlined by Aristotle: techne—"technical know-how", episteme—"technical know-why", and phronesis—"practical knowledge and practical ethics" (Flyvbjerg 2006, p. 70).

Techne is best understood as being "oriented toward production" (Flyvbjerg 2006, p. 71). For the purposes of this discussion, science education scholarship associated with techne would most likely react to the article with a focus on developing curriculum or consulting to improve science test scores or mastery of a particular set of content. The products developed might be tailored to French and Cameroonian students' different backgrounds, or attempt to overcome possible learning differences in a single tool.

Episteme implies a use of generalizable analytical rationality typically associated with natural science and unveiling universal rules. In our view epistemic science education scholarship aspires to predict the influence of instructional variables on learning outcomes, thus, differences identified between French and Cameroonian children's development of Astronomic models might be used to predict the success with which students will be able to master more advanced content in the future.

Phronesis is defined as “deliberation about values with reference to praxis” (Flyvbjerg 2006, p. 71). The concept of phronesis prioritizes situational knowledge that informs action to address a problem in a specific context with respect to a particular set of ethics or values. Phronesis, according to both Flyvbjerg and Aristotle, is the most important intellectual virtue because it provides ethical grounding for the direction of episteme and techne, however, in modern academe phronesis is “marginalized” while “scientific and technological development take place without the ethical checks and balances that Aristotle… saw as all important” (Flyvbjerg 2006, p. 71). Flyvbjerg (2001) proposed five core questions to guide phronetic social research: Where are we going? Is this desirable? What should be done? Who gains, who loses? By which mechanisms of power? In our view the phronetic response to differences identified in the foundations for astronomical knowledge among French and Cameroonian children’s thinking revolves around the question of how this knowledge is used to accomplish what types of ends, as well as the role of context in making sense of learning differences.

Sociocultural learning theories encourage accounting for social, historical and cultural contexts in order to understand student learning, and we view efforts to make sense of the varied influences and foundations impacting student thinking and incorporating those into learning experiences as necessary and important for effective science teaching. In Frède’s article the term “occidental” is used as a proxy for “Western” or “European” to describe French children and is associated with a culture that values canonical, or mechanist scientific knowledge and cognitive skill. In contrast, indigenous Camaroonian children are referenced as “African” or “non-occidental” and drawing on an “animist” culture that prioritizes social skill and an “anthromorphic” worldview. While we acknowledge that the authors use of terms is in keeping with literature on the topic, we suggest that such language necessarily aligns “Western” cultural models with canonical science positioned at the center of conversations about science learning while displacing indigenous cultural models and associated scientific views to the margins. This positioning extends Gloria Ladson-Billings’s (1995) critique of studies that “seem to connote accommodation of student culture to mainstream culture” (p. 467), which associate cultural differences with learning deficits.

In addition to privileging Western modes of thought, marginalizing “non-western” cultural frames neglects the inherent contingency in all scientific knowledge, assuming that currently accepted models are truer representations of reality than alternatives, rather than currently dominant (Kuhn 1970) and contingent (Hacking 1999). Problems of fierce adherence to dominant scientific modeling are particularly visible in the case of astronomy since Einstein reconciled geocentric and heliocentric models as viable frames of reference through the Lorentz transformation (Shen and Confrey 2010). According to Ji Shen and Jere Confrey (2010), teachers’ fierce adherence to the heliocentric model stemmed from limited experience with astronomical observation and their own educative foundations that were limited to memorizing the heliocentric model. Teachers’ inability to acknowledge the geocentric model and to switch back and forth between the two frames of reference was viewed as evidence of the superficiality of their understanding of astronomy. Thus, the geocentric and observational foundation identified with the Cameroonian children in Frède’s study can be viewed as holding powerful potential to support a more robust and scientifically current concept of astronomy than a strict centering of the heliocentric view.

From a phronetic perspective we wonder if there is a way to delineate a variety of socialization, enculturation, and historicization within different spheres of knowledge, acknowledging potential influences that add both complexity and strength to varying models without stratifying and privileging dominant forms while marginalizing others. Taking the findings of the article, might we consider the strength and conceptual richness a more experiential and geocentric model might offer to the understandings of astronomy of both French and Cameroonian children? Identifying the conceptual depth that has not been developed in the centering of western scientific ways of knowing offers opportunities to consider other scientific arenas that could be conceptually enhanced by developing our abilities to move between frames of reference. Might we develop new

ways of understanding those whose cognitive approaches to knowledge of nature differ from our own and gain an appreciation of their perspective but also acknowledge those viewpoints as valid and relevant to enhancing the depth of our own scientific understanding?

To acknowledge the rather contentious context in which we compose this forum, currently immigration debates rage in the U.S. that have markedly denigrated non-western cultures, devalued the potential contributions of individuals from "non-occidental" parts of the world, and further illuminated blatant racial and cultural biases. We are concerned for the potential of efforts to understand cultural differences becoming tools for further marginalizing indigenous cultures, nations, and people. Thus, we ask; might we seek third spaces (Tan, Barton, Turner and Gutiérrez 2012) in which knowing astronomy and other scientific concepts helps us know one another and ourselves in new ways? Might we find ways use our knowledge of different approaches to learning about astronomy to develop scientific learning experiences that are "culturally responsive" rather than merely "culturally compatible"? (Ladson-Billings 1995). This approach could be termed "cosmopolitan" in the traditional sense (comfort and familiarity with many different countries and cultures), as well as according to Christopher Emden's (2008) usage, which "requires a retooling of the power differentials in the classroom so that all students can be a part of the science and of the process of teaching and learning" (p. 775). We believe that nuancing cultural learning differences within a cosmopolitan framework, in the contexts of specific classrooms and schools could contribute to both the learning of science and mutual understanding within, across and from cultural differences. Such an approach could avoid reinforcing existing biases and marginalization in both society and scientific teaching and learning, constituting an important and influential use of Frède's article from a phronetic perspective.

References

Emdin, C. (2008). The three C's for urban science education. *Phi Delta Kappan, 89*(10), 772–775. https://doi.org/10.1177/003172170808901018.

Flyvbjerg, B. (2001). *Making social science matter: Why social inquiry fails and how it can succeed again*. Cambridge: Cambridge University Press.

Flyvbjerg, B. (2006). A perestroikan straw man answers back. In S. Schram, S. F. Schram & B. Caterino (Eds.), *Making political science matter: Debating knowledge, research and method* (pp. 56–85). NYU Press.

Flyvbjerg, B., Landman, T., & Schram, S. (Eds.). (2012). *Real social science: Applied phronesis*. Cambridge: Cambridge University Press.

Hacking, I. (1999). *The social construction of what?*. London: Harvard University Press.

Kuhn, T. S. (1970). *The structure of scientific revolutions* (2nd ed.). Chicago: University of Chicago Press.

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal, 32*(3), 465–491. https://doi.org/10.3102/00028312032003465.

Shen, J., & Confrey, J. (2010). Justifying alternative models in learning astronomy: A study of K–8 science teachers' understanding of frames of reference. *International Journal of Science Education, 32*(1), 1–29. https://doi.org/10.1080/09500690802412449.

Tan, E., Barton, A. C., Turner, E., & Gutiérrez, M. V. (2012). *Empowering science and mathematics education in urban schools*. Chicago: University of Chicago Press.