

## Culture and science education in the 21st century: Extending and making the cultural box more inclusive

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### **Abstract:**

We are pleased to introduce the Special Issue, *Culture and Science Education in the 21st Century*. In the past 20 years, the concept of culture has become more prominent and relevant in science education. The culture of science, culture of school science, culture of science classrooms, and cultures of individual actors in the science educative process are among the many ways in which culture has been cast and examined in the science education literature. Many studies described culture and examined its role in the participation in and the teaching and learning of science but fewer studies comprehensively entertained culture as a structure and mechanism that can inform research and policies developed to address the numerous challenges in science education.

**Keywords:** Education | Science Education | Culture | Teaching

### **Article:**

We are pleased to introduce the Special Issue, *Culture and Science Education in the 21st Century*. In the past 20 years, the concept of culture has become more prominent and relevant in science education. The culture of science, culture of school science, culture of science classrooms, and cultures of individual actors in the science educative process are among the many ways in which culture has been cast and examined in the science education literature. Many studies described culture and examined its role in the participation in and the teaching and learning of science but fewer studies comprehensively entertained culture as a structure and mechanism that can inform research and policies developed to address the numerous challenges in science education.

Approaching culture as structure necessitates thinking simultaneously about local and global settings and their micro- and macro-organizing frames as well as thinking holistically, placing

the local and global and the micro and macro within both historical and contemporary times. On one hand, thinking of culture as structure requires in-depth investigations that are rich and deconstructive in nature, two of many characteristics of cultural studies in science education over the past 20 years. On the other hand, if culture becomes a tool in addressing systemic issues in systemic ways then it is necessary for some research studies to be adaptable to large-scale economies. If both hands work together then culture can become a vehicle to not only advancing our understanding about an equitable, robust science education for the 21st century but for acting in systemic ways to create it. The articles contained in the Special Issue provide an impetus for continued conversations about the definition, relevance, and the visionary uses of culture.

We came to this co-editing endeavor with different ideas about culture. Our differences prompted interesting and provocative conversations between us. We are excited about this Special Issue because each article forwards a different approach to study culture and applies the concept to different problems of science education. We see this diversity of perspectives as a strength; it reminds us of the notion of *crystallization* discussed as a research strategy in texts about qualitative research methodology (Tracy, 2010). Rather than use data to come up with a more valid, singular truth, the goal of crystallization is to leverage multiple data, methods, and frameworks to “open up a more complex, in-depth, but still thoroughly partial, understanding of the issue” (p. 844). No one view of culture here, including our own, represents a thorough and complete understanding.

### **Conceptualizations of Culture**

Culture is a context- and time-dependent phenomenon that exists on multiple planes—local, global, micro, macro, historical, and contemporary to name a few. Whatever its essence as articulated via a multitude of conceptualizations in the literature, a compilation of views indicates that it spans time and space in a manner that connects humans and their development and behavior to the past, captures the fluidity of the present, and is a harbinger of what is predictably stable in the future. That is, culture enables us to derive meaning of events that happen in the moment while simultaneously planning for a somewhat expected future. Although culture is complicated, akin to the proverb of the three blind men who based their interpretations of the elephant on what they perceived from their exploration of one part of the elephant, our uses of culture in science education are typically restrictive. We foreground certain aspects and standpoints and background or ignore others. Although other lenses are included, conceptualizations from the disciplines of psychology and anthropology are more commonly represented in the corpus of science education literature and we, the editors of this Special Issue, pull from these disciplines in our own work. At times, science education researchers borrow the theoretical ideas about culture from other science education research, rather than directly from the disciplines themselves. We briefly provide an overview of the psychological and anthropological perspectives, frugally synthesized from the literature in psychology and anthropology, most commonly featured when definitions of culture are explicit in science education research and those evoked when conceptualizations are tacit. The closing commentary

of the Special Issue extends the cultural box in science education in a discussion constructed from a sociological perspective.

### **Perspectives From Psychology**

The American Psychological Association (2012) generally describes psychology as the study of the mind and behavior. Some branches of psychology primarily investigate aspects related to the psyche, others focus on behavior, and yet others treat mind and behavior as inseparable and examine both. The psychology-based conceptualizations of culture most often employed in science education research situate culture as psyche that influences behavior. That is, some science education researchers cast culture as a system of implicit and explicit beliefs and values located within entities (e.g., individuals, groups). This system influences the way individuals perceive and interact with the world. Many assumptive characterizations about the nature of culture from this perspective exist. These depictions include, but are not limited to the following: (1) the system of beliefs and values that constitute culture is bounded, coherent, static, unchangeable, and cumulative (i.e., beliefs and values are added over time), and (2) the system of beliefs and values, like hereditary traits, is transmitted from one individual or generation to another.

The view of culture as a system of beliefs and values that influences how individuals perceive and interact with the world is not the only conceptualization re-appropriated from psychology.

More recent work in science education draws from cultural psychology, a field that developed as a response to the schism between psychology and anthropology (Shweder, 1990). Consequently, cultural psychology is sometimes positioned as a subfield of psychology and as an interdisciplinary field separate from psychology.

Within the tradition of cultural psychology, culture is essential to human processes (e.g., development, cognition) and human processes are integral to culture; they dialectically exist (Miller, 1999). Equally important as the symbiotic relationship among culture and human processes, cultural psychology presumes a principle of intentionality, "...intentional persons, responding to, and directing their action at, their own mental objects or representations, and undergoing transformation through participation in an evolving intentional world that is the product of the mental representations that make it up" (p. 22, Shweder, 1990). This notion of dynamic co-construction and principle of intentionality undergird science education researchers' conceptualizations of culture that originate from cultural psychology.

Culture as a set of dynamic practices constructed and reconstructed through participants' engagement in activities of a community that is local to participants is the most prevalent employment of culture from a cultural psychological perspective in science education research. In contrast to the view of culture of as a system of beliefs and values, what is internal and external to entities dialogically exist. The actor (e.g., student), environment (e.g., science classroom), and acted upon (e.g., science learning) are transformed through interactions; these

transformations become the base of future interactions and so forth. As with the case of the general psychological standpoint on culture, some presumptive characterizations of culture as dynamic practices also exist. The characterizations which are not exhaustive include the following: (1) individuals lack neither consciousness nor intentionality about aspects of or the totality of their involvement; they are fully aware of and intentional about it, (2) practices are readily susceptible to change, and (3) individuals consciously and intentionally co-construct and reconstruct. In light of its development as a response to the split between psychology and anthropology, the cultural psychology perspective and anthropological views of culture utilized in science education research are similar.

### **Perspectives From Anthropology**

Culture, from a classic anthropological perspective, can be “defined as patterns in a way of life characteristic of a bounded social group and passed down from one generation to the next” (Eisenhart, 2001a, p. 210). Anthropologists often focus on some aspect of social life (e.g., uses of time, space, or language, beliefs and values, symbols, rituals, norms), looking for “culture as evidenced by patterns in the collective behaviors and central orientations of socially distinguishable groups” (Eisenhart, 2001a, p. 210). As we note below, this definition is heavily contested, but serves as the foundation for contemporary definitions that have been taken up in anthropology of education and science education.

*Cultural difference theory*, one corollary of the classic definition above, is based on the assumption that a group's patterned behavior emerges, over time, as a “successful adaptation to relatively stable social, economic, and political conditions” (Eisenhart, 2001a, p. 210) and “is learned through socialization in the home community” (p. 211). In this case, a group's position in relation to larger social structures prompts distinct patterns of behavior. This perspective on culture has been applied to schooling by emphasizing that the patterned behaviors, language use, arrangements of space and time, beliefs and values, and other aspects of the culture of schooling reflect the culture of the dominant class. Therefore, students from non-dominant groups, whose culture does not align with the culture of schooling, must learn and perform and/or take up the behaviors, values, beliefs, and language of a “second culture” to be successful (Aikenhead & Jegede, 1999; Eisenhart, 2001a). Cultural difference theory has been a dominant perspective for educational research in general and for cultural studies of science education in particular.

In anthropology of education, a conceptual alternative to cultural difference theory is *cultural production*. In this view, “culture can be viewed as a set of symbolic and material forms” or meanings, “affected but not determined by history and structure, actively appropriated or ‘produced’ in groups to bring order and satisfaction to experiences” (Eisenhart, 2001a, p. 213). A cultural production view of culture enables analysis of local meanings produced by groups in everyday practice that may reflect *or* contest the status quo, thus balancing micro- and macro-lenses and accounting for the possibility, no matter how slim, of challenging the status quo (Levinson, Foley, & Holland, 1996).

Cultural production maintains the significance of *collective* patterns of behavior, *taken-for-granted practices* that give rise to *groups'* meanings that, in turn, structure future behavior. The difference between cultural production and cultural difference is that cultural production attends to the relationships between local practice and larger social structures in much more fluid, dynamic ways. The local is shaped by and shapes (gives meaning to) larger social structures. The meaning of larger structures is not assumed a priori to be uniformly relevant to all members of a social group, as it is in cultural difference theory. When one considers cultural production, the outcomes (meanings produced by groups) are always in question. In science education, cultural production approaches have been less visible, but have appeared with growing presence for about a decade.

Some articles in this Special Issue overtly or tacitly situate culture within the previously summarized traditions of psychology, cultural psychology, and anthropology. Other articles critique one or more of these perspectives of culture and offer alternatives.

### **The Special Issue**

We received 21 articles in response to the winter 2011 *JRST* call for contributions. As a result of the peer review process, six articles are included in this Special Issue on culture. The Special Issue includes research articles and conceptual essays.

The research articles examine culture on several different planes. Like many culture-emphasis studies in science education, the articles consider the science education experiences of students within the immediate and formal settings in which science teaching and learning occur. Unlike many studies on culture in science education, the authors do not insularly entertain culture as only local but they contemplate the more distal influences that act upon culture as a phenomenon. The historical as a distal influence are included in the research articles authored by Ying, Oliver, and Venville and by Okebukola, Owolabi, and Okebukola.

The historical is also included in one of the three conceptual essays. Mutegi's essay foregrounds and centralizes the historical as constitutive of the cultural. Unlike the positioning of the historical in the two research articles, this essay advocates the inclusion of this plane of culture in our contemplations of and approaches to challenges in science education, particularly as they pertain to underrepresented minority groups in science. The last two essays written by Wood, Erichsen, and Anicha and Seiler propose alternative ways to view culture and prod the science education community to think differently as we move forward.

The Special Issue concludes with an essay written by George Noblit, a well-renowned researcher and scholar in the sociology of education. Spanning almost 40 years in academe, Noblit has published ground-breaking and paradigm-shifting work on a diverse array of topics that range from arts-based school reform to postcritical ethnography to race to social class. Integrating his depth and breadth of understanding of sociology and anthropology with criticality, Noblit offers provocative commentary on the articles contained in the Special Issue specifically and on the

field of science education generally. Noblit's views, somewhat dissonant or heretical when positioned within science education, are the kinds of views that may very well be the impetus for enlarging and making more inclusive the cultural box constructed by the science education community.

### ***Article 1: Teaching Science From Cultural Points of Intersection***

In their article, Grimberg and Gummer adopted a cultural difference perspective on culture that can also be considered a hybrid view, utilizing the perspectives of culture as a set of practices and as a system of beliefs and value. They investigated the impact of a teacher professional development program, devised to be culturally responsive to and culturally inclusive of American Indians, on teachers' science practices, teachers' beliefs, and the achievement of non-mainstream students in American Indian reservations. The study's findings are based on data collected from students in 25 K-8 schools and 36 teachers located in two different regions of Montana. The teachers participated, over a 2-year period, in a professional development program that resulted from the joint efforts of science and education faculty from institutions of higher education, and teachers and tribal elders highly esteemed by the involved communities. The professional development of teachers, the study's intervention, revolved around inquiry and the intersections among science content knowledge, science instructional practices, and tribal cultural knowledge. The researchers collected qualitative data to monitor and ascertain the fidelity of the professional development and quantitative data to investigate the program's impact on teaching practices, teachers' beliefs, and student achievement.

First, this article provides guidance on how to involve various communities and their capital, especially the population of interest, in the development of culturally responsive professional experiences for teachers. Second, it offers insight on how to balance, on one hand, the danger of essentializing racial and ethnic groups (i.e., making socially identified groups monolithic) and, on the other hand, the peril of ignoring commonalities of group members that are necessary in the development of policy or large-scale initiatives required for systemic transformation. Third, the article broadens our view on investigating the impact of culture especially in the conduct of research that policymakers deem palatable for decision-making.

### ***Article 2: A Comparison of Approaches to the Teaching and Learning of Science in Chinese and Australian Elementary Classrooms: Cultural and Socioeconomic Complexities***

The perspective of culture employed in the article written by Ying, Oliver, and Venville aligns with culture as a system of beliefs and values and with a cultural difference perspective. Ying, Oliver, and Venville explored the influences of different cultural contexts on the enactment of the elementary science curriculum. They conducted six case studies, three elementary schools in China and three elementary schools in Australia. They matched the schools according to socioeconomic type—high socioeconomic status, medium socioeconomic status, and low socioeconomic status. In these case studies, they examined the science curriculum in three forms:

formal, the official documented version; in-action, the instructional processes and practices implemented in the classroom; and experiential, the learning experiences perceived by students. Their findings, which feature between- and within-country similarities and differences, provide useful insights on the unique influences of national milieu and the seemingly universal influence of socioeconomic status on the transplantation of knowledge and curriculum reform across country borders. This research is especially timely as countries classified as developing and industrialized predicate their countries' educational policies on the science performance of their international counterparts.

***Article 3: Mother Tongue as Default Language of Instruction in Lower Primary Science Classes: Tension Between Policy Prescription and Practice in Nigeria***

Like Grimberg and Gummer, Okebukola, Owolabi, and Okebukola employed a hybrid view of culture as a belief and value system and as a set of practices which can also be considered as being aligned with cultural difference perspectives. Similar to Ying, Oliver, and Venville, a nation served as the canvass for culture. That is, Okebukola, Owolabi, and Okebukola examined what transpired in primary grade classrooms in science with respect to Nigeria's national policy on the use of mother tongue as the language of instruction. The authors situated language as constitutive of culture and language *as* culture. Utilizing observation methodologies dominant in the 1980s and re-emergent in the present day as policymakers in some countries seek means to connect teacher practices to student performances, Okebukola, Owolabi, and Okebukola conducted a total of 108 classroom observations that involved 36 teachers. These teachers instructed in rural and urban schools randomly selected from each of the educational districts in a federal capital territory in Nigeria. The authors used the classroom observations to examine the gap between what the Nigerian national language policy intended, 100% use of the mother tongue for teaching science in primary schools, and what was practiced.

The local and the global, the micro and the macro, and the historical and the contemporary (elements in our propositions about a view of culture as structure) seamlessly converge in this article. The authors elucidate the complexities inherent in multilingual environs in their descriptions of the research settings' local and national history, current conditions, and the stimulant for and development of the national language policy. Without diminishing the intricacies they captured in the backdrop for their study, the authors investigate a valued question in policy: is the policy being implemented? The simplicity of the question with respect to the complexities of language of instruction in a colonized society does not negate the importance of the question; a response to this fundamental question determines the nature of subsequent queries and related actions. In their work to address this fundamental question in policy as one step in informing policy, the authors introduce mapping and classroom language profiles as additional tools for the science education community to utilize in capturing and depicting language as culture in the teaching and learning of science.

#### **Article 4: “Life's First Need Is for Us to be Realistic” and Other Reasons for Examining the Sociohistorical Construction of Race in Science Performance of African American Students**

The historical provided the backdrop or context for phenomenon in the *Cultural and socioeconomic forces* and *Mother Tongue* articles. In Mutegi's essay, the historical is simultaneously the center and the foundation of Mutegi's thesis on science education and African Americans. With the socio-historical as a lens, Mutegi critiques the corpus of science education literature around African Americans of which a vast majority implicitly or explicitly examines culture. In accordance with his argument, Mutegi reveals deficit underpinnings; dissects the assumptive characteristics of the psychological perspectives on culture that science education researchers employed in studies; deconstructs the treatment of structures, particularly race, in cultural production/reproduction perspectives; and highlights misspecifications and mischaracterizations that emerge when race is absent in the science education research involving African Americans.

Mutegi argues that two genres comprise the science education literature on African Americans: disparity and invisibility. In the disparity genre, discrepancies between the science education of African Americans and the science education of their counterparts almost singularly comprise the foci. The invisibility literature obscures race by centering other identifiable groups (e.g., urban, at-risk, underprivileged) of which African Americans may be a subset. Contrary to the postmodernist position critical of the use of racial categories, Mutegi focuses on the meaning ascribed to them. Specifically, Mutegi confronts not the racial category of “Black” or “African American” but the historical and contemporary meaning of African American as an inferior other. Mutegi deconstructs one study to further explicate earlier contentions and concludes his constructive critiques with a series of insights on how to theoretically foreground race in science education research. Mutegi's essay constructively provokes the science education community to think more critically about the essentiality of race in science education.

#### **Article 5: *New Metaphors of Culture: Implication for Research in Science Teacher Preparation***

Seiler, in her essay critiques the prevalence and uses of cultural difference approaches in science education research, what she calls treating cultures as “pluralizable” (multiple, bounded, reproducible) and “discontinuous” (stressing distinctions and differences). Such views, she argues, may emphasize or even exaggerate differences between cultural groups, may run the risk of ignoring intra-group variation which can lead to essentializing and stereotyping, and can also perpetuate deficit-based notions of students whose cultural resources may be viewed as hindrances to science learning or may not be as privileged in schools. Further, treating cultures as pluralizable and discontinuous masks other, potentially powerful insights that could make a difference for science education reform; for example, the spaces of cultural *overlap* and the ways inequity is more than about correcting cultural mismatches, but also shaped by larger social, political, and economic factors.



In response to the shortcomings of a pluralizable, discontinuous view of culture, Seiler provides the field with an alternative concept that recognizes the fluid, porous, and emergent nature of the culture of social groups and the creativity and improvisation embedded in individuals' behaviors within groups as they appropriate resources from one setting to use in and potentially transform another setting. Her argument aligns with the cultural production tradition. She offers examples of three concepts in science education research that she argues promote a more emergent view of culture: funds of knowledge, third space, and figured worlds. In her essay, Seiler adeptly uncovers what is left traditionally unexamined in cultural studies of science education—the meanings of culture that undergird the work and the conceptual and practical implications of those meanings. The work fills a critical gap in science teacher education research, a field where discussions of culture are virtually absent.

### ***Article 6: Cultural Emergence: Theorizing Culture in and From the Margins of Science Education***

Wood, Erichsen, and Anicha raise some of the same concerns as Seiler about cultural difference perspectives and forward some of the same arguments about the need to acknowledge culture as an emergent phenomenon. Their discussion falls somewhat within the cultural production tradition, but they add elements of complexity theory, arguing for a view of culture as a system. The purpose of the essay is to introduce the field to a view of culture as a complex system that emerges through cultural bricolage, which they define as the iterative process of (re)application and adaptation of cultural tools to new contexts. The idea is that the use of cultural tools from one context creatively applied to another accounts for both the possibility of cultural reproduction and production. The authors thread two distinct and new-to-science education theoretical frameworks—cultural software and complexity thinking—to create their innovative conceptualization of culture as an emergent phenomenon. The result is a thought-provoking essay that provides ways of thinking about persistent problems in science education. Their emergent conception of culture is unique and powerful because it illuminates how individuals' behaviors, acting creatively alone or collectively with others, give rise to stable cultural forms. For example, why is reform in science education so difficult? Why do certain ideologies of schooling maintain relevance and hold sway over time? The authors' theory of culture challenges the ways curriculum theorists, anthropologists, sociologists, and science education researchers might answer those persistent questions. Another thought-provoking aspect of their definition of culture is the flexibility of culture as a conceptual tool. Culture can be viewed as an individual, group, and systems phenomenon whereby small changes at the individual level might lead to radical shifts at the systems level. This aspect of the essay gives us hope that cultural reproduction is not inevitable and provides us with a tool, if we are willing to think differently, that might help us work toward alternative realities.

### ***Closing Commentary: Culture bound: Science, Teaching, and Research***

Noblit provides a thoughtful and welcomed disruptive voice to these conversations of culture. As someone who is a self-professed newcomer to science education literature (but not to school science classrooms), Noblit reads these manuscripts with a fresh, critical eye, points out how culture is used and the implicit histories undergirding the work, and offers suggestive nudges for each article. Noblit's nudges are educative and intriguing and, if seriously taken up, should offer the field considerable pause and opportunities for reflection and dialogue. His critiques offer his perspectives on the state of science education with regards to culture—where it is and where it might go.

Further, Noblit reminds us of the darker side of the history of the study of culture (specifically anthropology), which arose out of colonialist roots in service of imperialist interests, invoked methods that claimed epistemological superiority, privileged Western thinking and forms of knowledge, and focused on processes of “othering.” He deftly argues how this troubling history is inescapable, even for contemporary cultural studies of science education that claim to do just that. In this sense, he argues, science education is “culture bound.” In another sense, culture offers science education new ways of thinking that are useful, productive, and might someday teach science education something about itself. In other words, science education is “bound” to arrive at a more self-reflexive turn, whereby science education researchers begin questioning what our representations and naming of cultures say about science education itself and about the researchers who study culture. Science education, as represented in the articles from this special issue, he says, is not there yet. Thus, in this sense also, science education is “culture bound.”

### **Where Do We Go From Here? Importance and Implications of Culture**

By now, it should be apparent that culture is a contested conceptual tool. Scholars have questioned the ideological and analytic functions of culture for decades. For instance, Said (1978) asked, “Is the notion of a distinct culture (or race, or religion, or civilization) a useful one?” (p. 325). In the 1970s, for instance, anthropology, sociology, and cultural studies saw an explosion of alternative constructs to address culture's perceived shortcomings and to problematize culture as straightforward; for example, Gramsci's (1971) hegemony; Foucault's (1972) discourse, Bourdieu's (1977) practice and habitus, Willis's (1977) cultural forms. Alternative constructs continue to crop up in more contemporary literature; for example, Lave and Wenger's (1991) communities of practice; Levinson et al. (1996) cultural productions; Holland, Lachicotte, Skinner, and Cain's (1998) figured worlds; and Gee's (1999) Discourse. It is as if we cannot give up on culture, but we dare not call it “culture” for fear of being associated with its troubled past. It is difficult to summarize the many critiques of culture because they focus on one or another conceptualization of culture and cover wide-ranging concerns (Brightman, 1995). Postmodern and critical ideas from philosophy, cultural studies, ethnic studies, and feminism pose serious and legitimate critiques about culture, troubling definition and status of truth and knowledge and skepticism about the notion of a bounded, distinct, coherent, and uniformly meaningful social group (Eisenhart, 2001b). Other critiques about research on culture focus on: its tendency toward framing social groups as monolithic and

essentializing them; its valorization of difference; its leanings toward determinism and under-examination of individual's agency and improvisation; its tendencies to make the individual *supra*, and to under-investigate macro structures and their stability across time and space; postmodern misgivings of representing culture positivistically as “out there” for researchers to discover; and, as Noblit points out, its colonialist history.

As a community, our work would benefit if we know about and ponder deeply how to respond to these challenges. We should critically reflect on our definitions of culture and the implications of those definitions for the groups we study, the endeavor of science education, and the quest for a more socially just science education and society. The authors in this volume wrestle with one or more of these reflexive acts. Less apparent in this Special Issue's articles are the methodological challenges implied by studying culture in 21st century science learning settings. As Noblit points out, cultural studies of science education are not yet there, methodologically speaking. What might a “new” cultural studies in and of science education look like? How do we use existing and emerging tools and methodologies when the past of many of these tools (e.g., ethnography) is entangled with colonialist aims? How do we take seriously the multicultural nature of classrooms, the changing nature of social life, the unstable nature of economic conditions, and increasing globalization? Where is “culture” amidst the varied and diverse personal and social relationships and networks in which we participate? (Eisenhart, 2001b). These social conditions make defining the group and the individual amidst the group in science learning settings an incredibly complex endeavor. We need new thinking and new tools to research culture to understand its relevance for improving science education toward a more just society. While the articles in this Special Issue provide a start to this conversation, there is clearly more work to be done, theoretically, methodologically, and with regards to practice and policy.

### **Why Culture?**

With all this troubled past, why bother with the concept? Noblit raises a similar question. He implies resignation about culture's staying power in his sentiment that we may not be able to do without culture. Noblit has engaged these ideas about culture for almost 40 years. Science education, on the other hand, is in its *infancy* regarding cultural lenses. It has only been within the last 20 years or so that science education has taken seriously the concept in empirical research, and the inclusion of “culture” in science education's policy conversations is just emerging (Lee & Buxton, 2010). We are hopeful about culture's relevance and explanatory potential for science education research. We are not done with it because we have just started with it, historically speaking.

For now, culture offers unique explanatory potential the field needs. Culture, as a focus on group- and society-level, patterned behaviors and intersubjective meanings, helps us understand aspects of the human experience that stay hidden and therefore, more easily unquestioningly perpetuated, with an over-emphasis on the individual. Eisenhart (2001a) warns against abandoning culture because:

The patterns and meanings that people take up and manipulate in particular places and with particular other people are consequential for them. They affect the way people interpret (or “filter”) their experiences, the concerns people feel, the preferences they have, the choices they make, and the identities they seek... Individuals are not free to choose for themselves any view of the world, any way of acting in class, any definition of success, or any identity. In practice, such choices are constrained by intersubjective understandings of what is possible, appropriate, legitimate, properly radical and so forth. That is, they are constrained by culture and the enduring social structures that culture mediates (p. 215).

This quote captures beautifully the value of maintaining culture as an explanatory construct for educational settings. Science education worlds are meaningful and structure activity in consequential ways; curriculum developers, teacher educators, policymakers, and science education researchers ignoring this fact are missing primary mechanisms by which reform is successful or not. We are attracted to the concept of culture because of its explanatory potential for the injustice and inequity tied up with science and science education's history and for science education's potential to use its power for the good of the people and the environment, and to challenge inequitable social structures. Science education, with cultural lenses, can be used as a tool for counter-hegemony (Hammond & Brandt, 2004). A balance of lenses and perspectives, unlike the three blind men in the proverb and as implied by crystallization, and their reflexive enactment may enlarge the cultural box in science education in productive, inclusive, and thoughtful ways.

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