Explorations of Educational Purpose 23

Bronwyn Bevan · Philip Bell · Reed Stevens · Aria Razfar *Editors*

LOST Opportunities

Learning in Out of School Time

Learning in informal settings is attracting growing attention from policymakers and researchers, yet there remains, at the moment, a dearth of literature on the topic. Thus this volume, which examines how science and mathematics are experienced in everyday and out-of-school-time (OST) settings, makes an important contribution to the field of the learning sciences. Conducting research on OST learning requires us to broaden and deepen our conceptions of learning as well as to better identify the unique and common qualities of different learning settings. We must also find better ways to analyze the interplay between OST and school-based learning.

In this volume, scholars develop theoretical structures that are useful not only for understanding learning processes, but also for helping to create and support new opportunities for learning, whether they are in or out of school, or bridging a range of settings. The chapters in this volume include studies of everyday and 'situated' processes that facilitate science and mathematics learning. They also feature new theoretical and empirical frameworks for studying learning pathways that span both in- and out-of-school time and settings. Contributors also examine structured OST programs in which everyday and situated modes of learning are leveraged in support of more disciplined practices and conceptions of science and mathematics. Fortifying much of this work is a leading focus on educational equity—a desire to foster more socially supportive and intellectually engaging science and mathematics learning opportunities for youth from historically non-dominant communities. Full of compelling examples and revealing analysis, this book is a vital addition to the literature on a subject with a fast-rising profile.

I believe that the studies represented in this volume will move our work forward as we seek to understand better which social ecologies support – indeed, ratchet up – learning and give meaning for youth, especially those from non-dominant communities.
Kris Gutiérrez, University of Colorado Boulder

For someone who has long been interested in afterschool educational activities as a promising supplement to formal, in-school education, this book provides rich opportunities to think about the promise and the problems that such programs offer to those concerned with the infusion of science into the learning and development of their participants.
Mike Cole, University of California San Diego

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Chapter 9
Discovering and Supporting Successful Learning Pathways of Youth In and Out of School: Accounting for the Development of Everyday Expertise Across Settings

Philip Bell, Leah Bricker, Suzanne Reeve, Heather Toomey Zimmerman, and Carrie Tzou

Documenting the Cultural Learning Pathways of STEM Expertise Development

A fifth-grade girl, born in Haiti and adopted into a Seattle family, talked at home about how she wanted to be a chemist or a paleontologist when she grew up. For 6 months, she spent portions of her Saturdays mixing perfumes, as a chemist might, with her mother. But her public schoolteacher, who is a seasoned professional with sophisticated teaching expertise, did not believe the girl always put forth her best effort and was surprised to see her become highly excited about and engaged in a science curriculum unit at the end of the year that the girl counted as "real science". A fourth-grade boy in the same school was often moved to the back of the classroom because he was "off task" and "resistant" to the school curriculum. He spent periods of his time in the back of the room mentally deconstructing the physical environment around him, "thinking in structures" as he put it. Unbeknownst to his teachers, the boy had been deepening his participation in a hobby—an elective vocation—since

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attending a summer design program at a local park when he was six years old. Outside of school he engaged in sophisticated design, construction, and building projects with all manner of physical and technological objects. It would be 3 more years before he came to understand that there is such a field as engineering and that it might be a good match for his interests. By that point it would be much more difficult to make his way along the typical academic path. To simply say that these youth may be "at risk" for making their way along academic pathways ignores the depth of their academic-related interests and developing expertise. It skirts the evaluation and positioning of them that occurred in different contexts based on a partial understanding of who they were at the time and who they wanted to become, and it severely discounts the complexities associated with them productively pursuing and becoming who they might wish to become. We argue that we need to discover and then support the successful learning pathways of youth across social settings over developmental time so that we can promote the development of interests and expertise that may lead to both academic and personal success.

Learners navigate a range of diverse social, material, and discursive contexts everyday—from the classroom to home, after-school programs, informal education institutions, and out into their communities—with a variety of purposes and value systems in place (Banks et al., 2007). Learning is accomplished across these diverse pathways of participation in activity and affiliation with cultural groups in ways that the field of education barely understands. Our empirical literatures tend to focus on the details of learning that occur (or fail to) within specific contexts (e.g., instructional-units-taught classrooms, programs offered by museums, or moments of elective activity in family life). We need more complex empirically informed theoretical models for how learning is accomplished and impeded across sociocultural contexts throughout the diverse social niches and networks of activity in society. We lack theoretical ways of accounting for the learning processes involved with extended pathways of deepening participation and expertise development across physical settings and social groups along developmental timelines. Toward these ends, this chapter describes and reports on a longitudinal study of child development as it occurs across the breadth of contexts present in the lives of diverse youth.

US society is becoming increasingly diverse in terms of ethnic and racial group membership, immigrant status, and linguistic variation. Some schools are now serving significant numbers of nonwhite youth or immigrant youth for the first time. Yet, as evidenced by a long history of inequitable outcomes in science education, few teachers or university professors are equipped to work effectively with all students. In our research, we give central attention to individuals and groups from historically nondominant communities, in order to expand scientific accounts of learning related to how all people learn. We continue to be in need of theoretical accounts of the learning worlds of nondominant groups, in order to understand the normal variation present in the circumstances of learning found in society writ large. Such an approach also helps to expand and develop our theoretical accounts in ways that have more direct benefits for society (Flyvbjerg, 2001).

Cultural and ecological perspectives are increasingly understood to be central in the scientific understanding of learning and development, and they have strong implications for educational practice (Banks et al., 2007; Bell, Lewenstein, Shouse, & Feder, 2009; Gutiérrez & Rogoff, 2003; Lee, 2008; Moll & Gonzalez, 2004; Rosebery, Warren, Ballenger, & Ogonowski, 2005). Scholars have made significant progress in describing how science learning is influenced by the cultural histories, practices, and values of learners and communities (Barton, Ermer, & Burkett, 2003; Bell, Bricker, Lee, Reeve, & Zimmerman, 2006; Lee & Luykx, 2007; Medin & Atran, 2004). In response to the complexities associated with taking a holistic view of how people learn across settings and the cultural variation in human activity present in society, we agree with Lee (2008) that a major program of interdisciplinary research in the field should focus on better understanding the multiple pathways associated with socially significant learning and development of youth.

Over the past several years, we have been developing a theoretical framework focused on everyday expertise development that seeks to account for the social and material dimensions of sophisticated domain learning as it relates to the interests and practices of individuals and their communities. More specifically, our empirical project has involved: (a) documenting the range of expertise that youth develop and apply in their lives that is personally consequential and meaningful to them; (b) understanding the learning pathways associated with the development of that expertise and the myriad sociocultural forces that give shape to those pathways; and (c) aiding in the systemic coordination of successful learning pathways that are meaningful to youth, their families, and their communities and studying the effects of those efforts. We are ultimately trying to understand the extended learning pathways of youth at this historical moment in order to shift and stabilize those pathways by recognizing and leveraging their developing competencies across the range of informal and formal learning environments in which they participate.

In this paper, we describe our efforts to engage the driving question: How do everyday moments—experienced across settings, pursuits, and social groups—result in expertise, sophisticated understanding, and expert identification? We have focused on theory development related to this question as a result of specific gaps in our literatures on learning and expertise development and given present opportunities for interdisciplinary research and synthesis on how, why, and where people learn science across settings over developmental timescales (Bell et al., 2006). As Bransford and Schwartz (2009) argue, “it takes expertise to make expertise,” acknowledging that the social processes that support expertise development are understudied and undertheorized. The ultimate explanatory goal of our effort is to better understand the extended learning pathways (e.g., related to the accomplishment of expertise development in science and other domains) that are culturally architected through complex sequences of contingent interaction and activity that occur across the breadth of everyday life.

Cultural learning pathways are conceptualized as a series of linked actions where individuals are positioned—or position themselves—in ways that deepen their participation in a practice amidst a myriad, and often competing, set of different systems of competency. These systems of competency operate throughout cultural experiences taking place across the breadth of social groups and settings in a learner’s life. These are complex processes. We pay heightened attention to the various social processes that shape learning, how stylistic forms of talk occur within and across different settings and influence learning, the affordances and constraints of material resources that help us understand the accomplishment and evaluation of situated performance, the multiple cultural meanings that circulate around specific domains of activity, and the linguistic forms of talk that shape and inform learning pathways (e.g., how sense-making gets accomplished by groups across social encounters). Before describing research findings related to this broad effort, we start by summarizing the study.

The Purpose of the Study: Documenting Life-Long, Life-Wide, and Life-Deep Learning Pursuits and Pathways

Our theoretical and empirical accounts of learning need to more directly mirror how people learn as they routinely circulate through the settings, activities, and pursuits of everyday life. Disparate accounts of learning and teaching that exist in balkanized literatures need to be brought together, juxtaposed, coordinated, and synthesized—or actively differentiated. The project described in this chapter is an attempt to more holistically account for human development and learning in cultural and cognitive terms by documenting the myriad of activity systems and consequential decisions that individuals and groups navigate and constitute as a fixture of social life. As we detail below, our conceptualization of *everyday expertise* involves a complex coordination of the personal meanings, cultural practices, identities, motives, underlying ideologies, and the specific learning resources that come to be intertwined, as learning pathways open up in conjunction with the development and application of personally meaningful or locally consequential expertise. The work has broad implications for understanding learning as a cultural and cognitive phenomenon that shapes, and is shaped by, a complex, interacting mixture of social forces associated with the formal, informal, and nonformal educational institutions present in the lives of youth. The approach sheds insight into the contributing and interfering influences of various formal and informal learning environments, and related institutional routines and systems, in the development and application of everyday expertise (Bell et al., 2006).

Building upon the broad conceptualization of learning developed in the consensus study of how people learn in diverse environments (Banks et al., 2007), we orient to the three conceptual dimensions of learning:

1. *Life-long Learning* refers to the acquisition of fundamental competencies and a facility with real-world information over the life course—from infancy to old age. Generally, learners prefer to seek out information and acquire ways of doing things because they are motivated to do so by their interests, needs, curiosity, pleasure, and sense that they have talents that align with certain kinds of tasks and challenges.
2. *Life-wide Learning* shows how learners navigate diverse social ecologies each day as they circulate through everyday activities and settings—from the classroom to

home, after-school programs to informal educational institutions, and into their communities and online spaces. Learning derives, in both opportunistic and patterned ways, from this breadth of human experience and the related supports and occasions for learning—in ways we do not really understand. As a result of the boundary-crossing nature of social life, people need to learn how to navigate the different underlying assumptions and goals associated with education and development across the settings and pursuits they encounter.

3. *Life-deep Learning* embraces religious, moral, ethical, and social values that guide what people believe, how they act, and how they judge themselves and others. In these ways, learning, development, and education are tied deeply to value systems—although frequently implicitly.

In the empirical and theoretical aspects of our project, we give primacy to "recovering persons" as causal agents in their own learning. In arguing for using ethnographic approaches to better detail human development, Jessor (1996) makes the development of ethnographic cases a scientific priority. This chapter theoretically frames, argues for, and empirically showcases how personally consequential science and technology learning is accomplished across the social ecologies of everyday life by youth and families within an urban, multicultural community.

Conceptual Themes of the Study

Over the course of 5 years, using a team-based ethnography approach, we have conducted a longitudinal study of youths' development and learning across the social settings of their lives. We have employed a mixture of ethnographic and experimental methods to help us navigate into the social lives of these youth, their families and friends, and their classmates and teachers in order to identify successful and unsuccessful learning pathways. We consider how specific pathways and associated outcomes can be viewed as successful (or not, or indeterminate) from both member-driven (emic) and analyst-driven (etic) perspectives.

To bind and focus the work, we have focused on four conceptual themes—or topical spaces of concentrated data collection and analysis—in this study:

1. *Personally Consequential Biology*: How do youth learn about the living world across social settings and apply that understanding in their own lives? The focus is on consequential topics: personal health, nutrition, and local environmental conditions.
2. *Everyday Argumentation*: What are the forms of argument youth engage with and construct across settings? How do they learn about and through argumentation?
3. *Images of Science and Self:* Based on the various accounts and images they encounter, what do youth count as "science" and why? How do these images influence their own identity formation?
4. *Technological Fluencies*: How do youth learn with and about digital technologies? How are technologies a focus of their learning or bound up in the learning of other domains of interest?

The Everyday Expertise Framework: How Significant Learning Is Accomplished Socially and Materially in Everyday Life

Although the expert/novice literature has shed significant insight into the nature of disciplinary expertise and competence, it has not given enough clarity to the everyday forms of significant competence rooted in social life. In contrast to more traditional mentalistic accounts of expertise, we conceptualize everyday expertise as a social construct that is given meaning and form within specific cultural ecologies of practice (Cole, 1996; Gutiérrez & Rogoff, 2003; Hutchins, 1995; Lave & Wenger, 1991; Saxe & Esmonde, 2005; Scribner, 1984). We give primacy to problem domains of everyday life where situated judgments, with corresponding meanings and consequentialities, are made (cf. Spradley, 1979). In this view, specific aspects of disciplinary domains are viewed not as end goals in the development of expertise, but as composite elements that serve to make up what are taken to be successful solutions to problems from the perspective of the learners and those in the local contexts in which they participate.

In contrast to a reductionist theoretical accounting, we are actively striving to understand the "buzzing complexity" of social life associated with learning pathways as they get architected, navigated, and renegotiated. In contrast to experimental traditions that might seek to develop *corridors of (parsimonious) explanation* across multiple levels associated with a phenomena (e.g., cognitive system neuroscience, perceptual/sensorimotor, cognitive behavioral), we actively seek to develop a scientific accounting of the *blankets of contextual explanation* that render the complex systems and interacting phenomena and features of social life associated with successful and unsuccessful learning pathways.

The Strands of Domain Proficiency: A Multifaceted Approach for Understanding Expertise Development

At the core of our framework for the development of everyday expertise, we focus on how people develop means of participating in science, technology, engineering, and math (STEM) domains in increasingly sophisticated ways. We leverage recent consensus reports from the National Research Council that summarize research on science learning and define six strands of science expertise development (or disciplinary proficiencies) (Bell et al., 2009; Duschl, Schweingruber, & Shouse, 2007), and we add a seventh, navigation knowledge. In situated moments of activity, the seven dimensions are intertwined in complex ways (e.g., symbolic knowledge is frequently learned and marshaled through social sense-making routines like argumentation; knowledge is leveraged and manifested in judgments and moments of material practices). But, each strand also represents an important and unique aspect of what is being learned associated with STEM practices. The seven strands, taken together, define the "outcome space" associated with sophisticated STEM learning (see the center of Fig. 9.1 below).

Fig. 9.1 Bridges and barriers in everyday expertise development in relation to the strands of domain proficiency

The seven strands of STEM proficiency and expertise we focus on are (1) personal interest in the domain, (2) social sense-making routines (e.g., forms of reasoning, explanation, or argumentation), (3) social and material practices (i.e., specialized ways of talking and acting), (4) symbolic knowledge (i.e., disciplinary facts, concepts, models, and explanations), (5) navigation knowledge (i.e., how people learn to support their own learning with resources and experiences), (6) knowledge of the enterprise (i.e., what counts as disciplinary work, how it relates to everyday life and society), and (7) a domain-linked identity (i.e., coming to think of oneself as someone who knows about, uses, and sometimes contributes to science). We take these seven strands as the focus of "what people develop" during STEM expertise development. Next we specify social and material influences on the development of these seven strands.

Social and Material Supports for Extended Learning: Bridges and Barriers in Everyday Expertise Development Across Encounters

What are the social, material, and cultural processes that shape the learning of these intertwined strands of proficiency? Our theoretical stance on expertise development builds upon the social, cultural, and material perspectives associated with situated perspectives on learning (cf., distributed cognition (Hutchins, 1995), situated learning (Lave & Wenger, 1991), the agency-identity framework (Holland, Lachiocotte, Skinner, & Cain, 1998), and critical feminist perspectives (Barton et al., 2003; Suchman, 2007)). These perspectives allow us to develop a theoretical and empirical understanding of the social and material influences on what is taken to be sophisticated learning and activity that occurs within and across social contexts. Such situated moments, exhibit significant cultural variation, are often contested among social actors, and are inequitably available to individuals and groups. The Everyday Expertise framework allows for an accounting of how moments of situated meaning and activity (e.g., how a child is positioned to have relevant expertise for an immediate task) are contingently related across a series of encounters influenced by multiple actor-networks operating with multiple systems of competency at a given moment (e.g., formal instruction shaped by high-stakes accountability pressures relative to actions related to peer youth culture). Within the range of efforts that focus on the cultural and material accomplishment of complex disciplinary activity, our approach resonates heavily with the actor-network theory view (Latour, 1987; Law, 1999). This perspective postulates that activities are best understood by examining how actors-in-activity create the operating material networks in which they are situated. In terms of equity dimensions of the analysis, we focus on how (in)equalities in participation and recognition are discursively manufactured and regulated in these situated moments and we highlight the broader, arranged actor-networks that influence such dynamics (e.g., how educational accountability systems shape the evaluation of what teachers count as relevant expertise in the classroom—and what expertise gets marginalized). Expertise is then taken to develop along extended cultural learning pathways that get architected across social encounters over the course of developmental time (Bell et al., 2006). Learning is afforded or constrained across settings through the material resources that are available to shape actions, the value systems that are operating to evaluate actions, and the specific bridge-and-barrier mechanisms that are in place to explicitly or implicitly connect the meanings and actions from one moment to prior one.

Methods and Data

The data utilized in our work were collected as part of a 4-year team ethnography. Researchers followed the same youth across the settings of their lives to study how these youth learn about science and technology, as well as develop various areas of expertise (Bell et al., 2006). In the spring of 2005, researchers formed a partnership with a local elementary school (pseudonym Granite), which caters to a student body that is diverse with respect to ethnicity, nationality, languages spoken, and socioeconomic status. In the fall of 2005, researchers began recruiting families into the ethnographic study. Thirteen families agreed to participate and the sample of focal participants from each of those families was balanced for age (six youth were in fourth grade and seven were in fifth grade at the beginning of the study) and gender (seven boys and six girls). Besides the focal participants and their immediate family members, extended family members (e.g., grandmothers, cousins), teachers, and peers consented to participate in the study.

This team ethnography charted the learning of 123 people—including 99 youth, 13 in great depth— over multiple years from an urban, multicultural, multilingual community with significant levels of poverty. We conducted thousands of hours of fieldwork over the first 3 years and have followed up with many of the participants at a lower level of fieldwork over subsequent years. After we developed a saturated accounting of our conceptual themes (and families participated in the study for 1–4 years based on their circumstances), primary data collection was pared back and analysis has been expanded in the latter years. Periodic visits to the homes of many families are still being conducted. Fieldwork in the school remains at a high level, although it has increasingly focused on research surrounding collaborative curriculum design research in science.

A guiding methodological principle of this research was to follow the same people as they moved across settings. The majority of the observations of the focal participants took place in school and at home. However, focal participants were observed participating in activities and interacting with others in many additional settings, such as religious institutions, after-school clubs, museums, sporting events, camping excursions/vacations, neighborhoods, and parks. Across these settings, data collection methods included (a) observation and participant observation; (b) interviews (both ethnographic and clinical); (c) self-documentation techniques, where focal participants were given digital cameras and asked to document various objects and phenomena (e.g., argumentation) and then answer questions about their photographs; and (d) document collection. Two surveys, designed to gather information about socioeconomic status and ethnic identity and participation in science respectively, were administered. Researchers also conducted analyses of public census tract data for the neighborhoods in which families lived.

The resulting data corpus was constructed from over 2000 hours of in situ video-recording and field-noting across dozens of social settings (homes, classrooms, neighborhoods, etc.). Data sources included (a) *field notes* of observations, interviews, participant self-documentation assignments, and documents collected; (b) *video- and audio-tape* of observations and interviews (when in settings that allowed video and/or audio taping); (c) *digital photographs* taken during observations and interviews; (d) *video and/or digital photographs* taken by participants as part of their self-documentation assignments; (e) *documents* collected during family visits (e.g., magazines, school work, writing samples from clinical interviews, written survey responses); and *survey results*.

Lines of Research

The compiled data set of people engaged in everyday expertise development supports a broad variety of analyses. We are currently pursuing the following lines of analysis and theory development in conjunction with the methodological approaches described.

Bridges and Barriers in the Learning Pathways of Everyday Expertise Development

Current analytical efforts are documenting *the multitude of cultural learning pathways* associated with expertise development that come into existence through a coordination of social and material influences across settings and over extended timescales of activity as people come to more deeply participate in a set of personally consequential social practices (Dreier, 2009). In collaboration with colleagues in the interdisciplinary Learning in Informal and Formal Environments (LIFE) Center, we have been identifying a set of socially occurring bridges and barriers that influence the learning along extended learning pathways of expertise development. Studies of early expertise development highlight the *multiple roles of learning partners* to cultivate expertise of individuals (Barron, Martin, Takeuchi, & Fithian, 2009; Bell et al., 2006; Crowley & Jacobs, 2002). Among these important roles is the recognition of early interest in the domain of the learner (e.g., by a parent) and ongoing efforts to *sustain interest by mediating and architecting subsequent choices*. For example, parents provide material resources to learners; they broker access to future learning experiences; and they arrange for more expert-others to teach their children how to improve their practice. Learning is also accomplished in situated moments of activity through an *exploitation of flexible learning arrangements* found in particular contexts—the leveraging of social and material resources to accomplish sophisticated action (Stevens et al., ~~gaming paper~~). We have also discovered that learning is accomplished across settings through *interdiscursive uses of language*—specific linguistic terms and styles of talk that connect multiple encounters. We have been able to analytically connect sense-making in one situated moment to that in prior moments in the developmental history of learners by attending to the linguistic details of participant talk.

Through a series of encounters with situated activity, learners often develop *social reputations* for these interests and subsequently as "developing experts" in the domain. Such reputations serve both as a marker and a maker of expertise. That is, social reputations denote developing expertise and also provide an entrée to subsequent related learning experiences (e.g., providing a youth with a social reputation as an expert in the Halo videogame can put him/her in more challenging gaming scenarios with other experts). Such reputations and opportunities to learn are strongly influenced by the local *positioning dynamics* (Harré, 2008) constructed through talk and action that assign and regulate the expertise-related rights and responsibilities of individuals within particular moments of activity (e.g., whether or not a young person is positioned as having relevant science knowledge related to classroom instruction). Often, these positions are influenced by *cultural stereotypes of domains* (or storylines) that circulate in the culture more broadly in relation to domain context and specific demographic groups of learners (e.g., whether women excel at doing science and whether girls should be encouraged in learning science). Such stereotypes and supportive positioning dynamics have a strong influence on whether learners come to personally identify with the domain. We have documented how negative positioning dynamics can keep significant STEM-related expertise from being recognized in specific learning environments, although it is rhetorically of interest (e.g., how youth with significant material competencies can be seen as not having relevant expertise for science instruction in school; Bricker & Bell, in review).

Documenting Children’s Understanding of Health

In the context of this team ethnography, we have documented the focal participants’ health-related beliefs and behaviors through the use of photodocumentation tasks, semi-structured interviews, and two case-study analyses (Reeve, 2009). Given the far-reaching consequences of health-related decisions and recent increases in childhood obesity, type II diabetes, and other serious conditions, everyday management of personal health is an area of expertise that must be better understood (Reeve & Bell, 2009).

Youths’ Understandings of “Healthy” and “Unhealthy”

We asked each participant to document in words and photos the range of things he/she believed was healthy or unhealthy (see Clark-Ibanez, 2004 for a background on self-documentation as a general method). In ethnographic interviews debriefing this activity, young people expressed a surprising breadth of meanings for the concept of health, including weight gain or loss; mental and emotional health; environmental health; organic or “natural” foods; health as determined by growth, strength, or color; cleanliness; and elements of the natural environment that help to sustain human life (e.g., trees that produce oxygen, air for people to breathe). Each participant also described health from multiple perspectives, often giving explanations that incorporated different definitions of health for the same object, or that described complex and nuanced ideas. The youths’ responses also revealed meanings that served specific functions for them and their families and were rooted in recurring home activities.

Semi-Structured Interviews About Health and Nutrition

We also interviewed each focal participant about his or her understandings of five areas related to health and nutrition: (1) staying healthy; (2) sickness and wellness; (3) questions the youth had about health or food-related topics; (4) images of medical careers; and (5) what food is and why people need it.

Again, these youth had multifaceted ideas about the five areas, showing that young people can simultaneously hold multiple ideas about scientific processes (cf. diSessa, 1988). Their responses also illustrated that explanations rooted in folk traditions or everyday experience do not necessarily signal the absence of more accepted understandings. For example, 7 of the 13 youth suggested that illness can be related both to transmission of germs and to temperature- and weather-related factors (e.g., playing in the rain without a jacket). Although Western science typically recognizes only the former explanation, science educators have a great opportunity to investigate young people's multiple ideas through discussing recent research on this topic (e.g., Johnson & Eccles, 2005; Lowen, Mubareka, Steel, & Palese, 2007) and through helping students think about different ways to evaluate evidence and the dynamic nature of scientific knowledge.

Young people's questions about health and nutrition, another area investigated in the interviews, largely focused not on *what* to do to stay healthy, but on *how* and *why* such behaviors work, as well as topics they had heard about recently or that were relevant to practices in their own families (e.g., where do diseases [bird flu, AIDS, etc.] come from? How does calcium help to build muscles?). Their questions suggest significant thought and curiosity about health-related topics, even at this relatively young age; current curricula and instruction would do well to listen to and address such complex questions that reflect young people's personal areas of interest.

Case Studies of Health Practices: Everyday Health Expertise and Cross-Cultural Forms of Health Care

Two case studies represent different kinds of everyday interactions with health and nutrition (cf. Flyvbjerg, 2001). Because of his mother's work as a home-based distributor for two health-related products, one boy's home became a unique learning environment that provided him with instrumental knowledge relative to managing his own health and shaping his future career goals. Bob (pseudonym) learned about health through hearing and taking up distinct types of discourse (e.g., sales claims); reading and hearing print, audio, and visual media; personal experience with serious illness (e.g., chronic food allergies); and the modeled behavior of his mother and her business associates. Despite his deep knowledge and experience, however, we rarely saw Bob make connections (either at home or at school) between classroom curriculum and his health- and nutrition-related home activities. Bob's case suggests opportunities for science curriculum and instruction to help young people see relationships between scientific content and issues that are important to them and their families (Banks et al., 2007; Korpan, Bisanz, Bisanz, Boehme, & Lynch, 1997).

A second boy, who immigrated with his family to the USA from the Philippines at the age of 6, grew up in a context of transnational health-care use (across the USA, Vietnam, and Canada). His family flexibly used professional health-care providers, home or over-the-counter remedies, and traditional folk treatments as they made health care decisions (cf. Chrisman & Kleinman, 1983). Luke's (pseudonym) home interactions with health also occurred in contexts of social, economic, and personal significance, such as a grandmother's serious illness. In sharp contrast to Luke's experiences, however, his formal science and health education focused only on Western systems of knowledge and largely separated out the social and economic factors that were closely intertwined with his family's everyday decisions.

These data lay the foundation for increasingly relevant, health-related science curriculum and pedagogy, and underscore the importance of taking nonschool experiences into account when designing and delivering health-related instruction, especially for vulnerable and historically marginalized populations who experience increasing health disparities (Agency for Healthcare Research and Quality, 2008; Lee, 2002; US Department of Minority Health Care and Health Disparities, n.d.). By incorporating health topics into instruction, science education has a golden opportunity to help young people make sound health decisions and increase their long-term quality of life.

Documenting the Everyday Argumentation of Youth

With respect to argumentation, we examined the argumentative practices youth utilize in their activity across settings and over time (see Bricker, 2008). We examined youth everyday argumentation within activity to better understand the learning affordances of this discourse practice and also to dialogue with the science education community, which currently proposes that youth in science classrooms should learn how to argue scientifically in order to mimic actual scientific practices in which argumentation plays a central role in knowledge construction (e.g., Duschl et al., 2007). Designs of learning environments meant to engage youth in school science with what it means to argue scientifically have to date not attended to the existing argumentation practices of youth,[1] although the field is strongly oriented to utilizing students' prior knowledge in instruction (e.g., Bransford, Brown, & Cocking, 2000; Linn & Songer, 1991). We have argued that curricula and instruction designed to engage youth with what it means to argue scientifically could be much better informed by youth's everyday argumentative competencies (e.g., Bricker & Bell, 2008).

We know that youth bring a rich set of argumentative practices to formal education (cf. Corsaro, 2003; Corsaro & Maynard, 1996; Goodwin & Goodwin, 1987; Kyratzis, 2004; Ochs, Taylor, Rudolph, & Smith, 1992). They routinely interpret

[1] For an exception, see the work of the Chèche Konnen Center at the Technical Education Research Centers (TERC) and publications from those Centers, such as Hudicourt-Barnes (2003).

and produce arguments as they navigate the social settings and activities of their lives but rarely, if ever, are these practices acknowledged and utilized by those designing argumentative learning experiences. To guide our investigations of youth everyday argumentation in order to add to the literature base and possibly inform the design of learning environments, we asked the following research questions: (1) What meanings do youth associate with argumentation and how do they describe aspects of their argumentation practices? (2) How do youth report learning how to argue and do youth argumentation practices help us understand how youth learn? (3) What are the relationships between youth, family, and community culture and argumentation?

Youth Understanding of "Argument"

What do youth associate with the word "argument" and how do they characterize their own argumentative practices? Findings indicate there is enormous variety with respect to youth ideas about argumentation and their accounts of their practices. Furthermore, youth appear quite capable of explicating the fine-grained details of their argumentative practices, some of which are quite sophisticated. We found, however, that without asking youth about their argumentative practices as associated with *specific* activity in *specific* settings, youth tend to associate the word "argument" with fighting, yelling, and inappropriate behavior in general, which has implications for engaging youth in school science with what it means to argue scientifically.

Cultural Grounding of Youth Argumentation

What are the relationships between argument, learning, and culture? Youth utilize culturally influenced frames associated with argumentative practices, such as argument as decision-making and/or problem-solving or argument as social/political protest, in order to make sense of those practices within activity. Findings also show that some youth identify argumentation as a learning practice (e.g., Billig, 1987/1996), highlighting its similarity to critique and its role in helping to make ideas visible so that others can learn from those ideas. This has important implications for utilizing aspects of and details about youth argumentative practices in curricular and instructional design.

Forms of Argumentation That Cross Settings

How do youth linguistically construct arguments that invoke life experiences from different settings and over time? Findings indicate that youth use linguistic elements (both verbal and nonverbal), such as discourse markers, evidentials, and indexicals when bringing evidence to bear on their claims (cf., Aikhenvald, 2004; Schiffrin, 1987).

Furthermore, findings show that some of these linguistic elements mark sources of evidence and are helpful in identifying when youth learn something in one setting and transfer it to another setting. Determining what aspects of youths' linguistic competencies are useful for curricular and instructional purposes and how those identified aspects should be utilized as curricular and instructional tools are important areas of future study.

Youth Perspectives on Argumentation in Science

Lastly, how do youth perceive the role of argumentation in the sciences and what are their thoughts about being asked to argue as part of their school science experiences? While many youth understand that argumentation is a critical practice in the sciences, many conclude that such efforts in science education are "strange" given that argumentation is not an activity they code as appropriate in school settings, save for specific exceptions (e.g., persuasive writing in English/language arts classes). Findings indicate that the culturally influenced frames associated with certain in-school activities, such as science class, for example, might inhibit youth from employing their argumentative practices during those activities, even when they routinely employ them as part of other activities across the settings of their lives.

Who Counts What as Science?

To explore the conceptual theme related to images of science and self, Zimmerman (2008) analyzed youths' ideas about science and their science-related talk and activities across school, home, and neighborhood settings. This line of work has two goals: how youth define science in consequential moments of their lives and how this definitional work relates to how youth participate in science-related practices across settings (McDermott & Webber, 1998; Stevens, 2000). Through this work, we empirically documented developmental trajectories that began to distance and disenfranchise youth from science and those that brought youth closer to science.

Youth Images of Science

Because of concerns about the decreasing interest that children show toward science as they move into middle school (e.g., Zacharia & Barton, 2004) and because so much of the research imposes an external framework which judges children's views on science (cf. Driver, Leach, Millar, & Scott, 1996), an analysis was conducted to give voice to how the youth perceive scientific practices in their daily activities. To accomplish this, we developed a game-like task, called the Science Activity Task (SAT) where the focal participants rated the frequency of the activities that they did and then reflected how these activities connected to scientific knowledge, practices, and tools (Zimmerman and Bell, in review). The analysis of the SAT found that youth participated in scientific practices and saw science in their homes and community activities as well as in school. We identified design principles such as *build science activities from the learner's preexisting connections to science* (i.e., mixing things together, conducting informal experiments at home, and understanding how iPod® and like devices work) rather than traditional home–school connections often featured in curriculum. For example, the youth, as a group, did not see science connections to building with Lego® or to sports.

Youth Participation and Identification with Science

Developmental biographical accounts of learning showed how science practices were embedded in the activities and practices of two young women, Penelope and Raven, and how these crossed multiple social settings. These accounts examined how youth performed science practices within activities and how youth crafted different pathways toward science for personal goals. Both girls reported scientific people as doing certain scientific practices like observing, teaching, and measuring. For Penelope, science was when she was engaged with content around nature, technology, or school science. For Raven, science was when something changed from one thing into another (i.e., when a seed grows into a plant) and when a person discovered something as in an archeologist. In both cases, a tension was present between participating in science and having their participation not be seen as negative by peers or having a negative impact on time to be spent on other personal goals.

Raven and Penelope were recognized for their science work in elementary school, yet they both stopped participating in science-related out-of-school programs in middle school. Raven found her academic enrichment program overwhelming and prohibitive of her nonacademic pursuits. She projected that if she remained in the enrichment program during the sixth-grade school year, it would adversely affect her ability to make honor roll in middle school—her personal goal. Penelope participated in a science after-school club during the academic year offered by a sixth-grade science teacher, yet she also ultimately disengaged from this club. Penelope expressed concerns about enrichment programs as having too much work. Penelope and her mother Eve agreed that school is important, but they stressed that a balance is needed; getting good grades without time for fun is not a fair exchange.

Social Supports for Science Learning

In looking at who youth tapped as learning partners, Raven and Penelope were assisted in science by people that would not be normally classified as scientific. Their social networks included a guardian's golfing partner, nurse's aides, owners of home businesses, pet shop workers, godparents, farming grandparents, former teachers, peers, and more.

Results (Zimmerman, 2008) have implications ~~to~~ assumptions we make about youth and their development, to learning theory, and to the development of design principles for program developers of informal spaces and formal education curriculum. First, the youth in this study had complex practices in their homes related to science in multiple domains as well as school. Second, children's interests in science were not always aligned to the school science content, pedagogy, or school structures for participation, yet youth like Raven and Penelope found ways to engage with science despite these differences—through crafting multiple pathways into science. A positive outcome was that the youth who did not connect to science at school found a space at home to participate in science in their hobbies and other personal pursuits. Third, urban parents were active supporters of STEM-related learning environments through brokering access to social and material resources. The brokering involved a full deployment across the social network, bringing in fellow church parishioners, family members, godparents, retail workers, and friend within and outside of formal science connections. A final result was that the natural world was a relevant context for urban youth to learn about science, albeit in nontraditional ways. The connections with houseplants and animals as pets provided opportunities to integrate cultural understandings, build competencies with scientific practices, and develop expertise relevant to peer and community groups.

Connecting Repertoires of Practice Across Home, Community, and School Boundaries: The Micros and Me Science Curriculum

For many students, learning science in school is like learning another culture (Aikenhead, 1996). Students may not see themselves or their ways of knowing reflected in the practices of science in school. We argue for the need to diversify the images of science that students encounter in school so they may come to see themselves as people who can do science, based on images that reflect actual scientific practices and their own culturally based ways of knowing. Gutiérrez and Rogoff (2003) argue that we need to see individual students as having their own experiences and histories that are influenced rather than dictated by their membership in certain cultural groups. In this way, we can start to see students as coming to the classroom with various repertoires of practice, or areas of everyday expertise, that stem from their membership in multiple groups—peer, cultural, community, and family, just to name a few.

This section describes a design-based research effort aimed at constructing learning pathways between students' culturally based *repertoires of practice* (Gutiérrez & Rogoff, 2003) around health and school science. We asked two questions: (1) How can we *elicit and make visible* students' everyday expertise around health in science instruction? (2) How can we *deeply connect* this expertise to authentic scientific practices? In the unit, we used the self-documentation technique described earlier in this paper to elicit students' repertoires of practice and leverage them in classroom science instruction. Our findings showed that self-documentation shows promise in both eliciting and complicating culturally based practices in classroom instruction.

In this study, we designed a ~~7~~-week curricular intervention for fifth grade that was studied across four enactments called *Micros and Me* (Tzou & Bell, 2010).

This curriculum attempted to (a) make science more personally consequential to students' lives, and (b) connect authentic scientific practices deeply with students' areas of everyday expertise. In this unit, we attempted to elicit and leverage students' repertoires of practice around health in order to motivate their study of microbiology and the connection between microbiology and health. Through this series of design experiments, we explored a set of interlocking design principles for culturally responsive instruction.

Overlapping Science Curriculum with the Lives of Youth

Youth should be engaged in classroom science investigations heavily focused on the social practices they participate in as part of family and community life outside of school. We extend a classic Deweyan ideal (Dewey, 1902) by leveraging instructional approaches (e.g., youth documentation of everyday life) to systematically overlap the curriculum with the social practices of the youth and their communities (McDermott & Webber, 1998). In this way, we attempt to bridge youths' social practices from their informal environments into the reflective context of formal instruction with the hopes of better understanding and, perhaps, informing family and community practices.

Building Upon Prior Interests and Identity

Agency in learning should be supported as a coordination of the interests of youth (and their communities) and the goals of science education as they relate to providing equitable access to capital in society. We pursue agency as a relational construct that is developed and regulated between the learner and other actors in the learning context (Holland et al., 1998). Instructional strategies need to intentionally position youth as having interests and identities relevant to the societal roles of science (Tzou & Bell, 2010). We do this, in part, by supporting youth in developing a capacity to interpret and conduct research focused on the interests of their community.

Supporting Extended Learning Pathways by Building on Developing Expertise

The social and material capacities being developed by youth should be sanctioned and leveraged in instruction. Extending the research base on culturally responsive instruction to issues of science learning (e.g., Bell et al., 2009; Nasir, Rosebery, Warren, & Lee, 2006), our current work focuses on surfacing and leveraging the social and material capacities of youth in relation to the goals of the unit. This involves leveraging the sense-making routines (e.g., around argumentation) associated with specific cultural group membership.

Conclusions

People routinely learn—or fail to successfully learn—across the breadth of their life experiences in ways that we barely understand (Bell et al., 2009). As Lemke (2000) has noted, it is important to engage in a documentation of how people learn across multiple settings over extended time periods. Many research efforts have served as direct influences and provided theoretical inspiration to the effort reported on in this chapter. We have oriented to the theoretical perspectives associated with this prior work and have worked to develop a culturally and cognitively oriented theoretical framework that is specifically tailored to our scientific purposes and commitments. We are seeking to parcel out the social and cultural influences that shape the development of locally meaningful and personally consequential expertise. The research summarized in this chapter highlights the variegated pathways of human development that exist in diverse communities and the range of bridges and barriers associated with extended learning pathways. Current analytical work continues to document the barriers and bridges associated with the extended learning pathways of everyday expertise development. Current design research is attempting to architect successful pathways as students position themselves and are positioned to participate in activity across the breadth of their life experiences and settings. We hope that such forms of culturally responsive instruction will help engage all youth in meaningful learning experiences and promote more equitable access to desirable futures.

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References

Agency for Healthcare Research and Quality. (2008). *2007 National healthcare disparities report* (AHRQ Publication No. 08–0041). Rockville, MD: U.S. Department of Health and Human Services, Agency for Healthcare Research and Quality.

Aikenhead, G. S. (1996). Science education: Border crossing into the subculture of science. *Studies in Science Education, 27*, 1–52.

Aikhenvald, A. Y. (2004). *Evidentiality*. Oxford, UK: Oxford University Press.

Banks, J. A., Au, K. H., Ball, A. F., Bell, P., Gordon, E. W., Gutierrez, K., Heath, S. B., Lee, C. D., Lee, Y., Mahiri, J., Nasir, N. S., Valdes, G., & Zhou, M. (2007). *Learning in and out of school in diverse environments: Life-long, life-wide, life-deep*. Seattle, WA: UW Center for Multicultural Education.

Barron, B., Martin, C., Takeuchi, L., & Fithian, R. (2009). Parents as learning partners and the development of technological fluency. *The International Journal of Learning and Media, 1*(2).

Barton, A. C., Ermer, J. L., & Burkett, T. A. (2003). *Teaching science for social justice*. New York: Teachers College Press.

Bell, P., Bricker, L. A., Lee, T. R., Reeve, S., & Zimmerman, H. T. (2006). Understanding the cultural foundations of children's biological knowledge: Insights from everyday cognition research. In *Proceedings of the seventh International Conference of the Learning Sciences (ICLS)* (pp. 1029–1035). Mahwah, NJ: Lawrence Erlbaum.

Bell, P., Lewenstein, B., Shouse, A. W., & Feder, M. A. (Eds.). (2009). *Learning science in informal environments: People, places, and pursuits*. Washington, DC: National Academies Press.

Billig, M. (1987/1996). *Arguing and thinking: A rhetorical approach to social psychology* (new ed.). Cambridge, UK: Cambridge University Press.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Bransford, J., & Schwartz, D. (2009). It takes expertise to make expertise: Some thoughts about why and how. In K. A. Ericsson (Ed.), *Development of professional expertise: Toward measurement of expert performance and design of optimal learning environments* (pp. 432–448). New York: Cambridge University Press.

Bricker, L. A. (2008). *A sociocultural historical examination of youth argumentation across the settings of their lives: Implications for science education*. Unpublished doctoral dissertation, University of Washington, Seattle, WA.

Bricker, L. A., & Bell, P. (2008). Conceptualizations of argumentation from science studies and the learning sciences and their implications for the practices of science education. *Science Education, 92*(3), 473–498.

Bricker, L. A., & Bell, P. (in review). "*I want to be an engineer*"*: Network, framing, and positioning dynamics associated with youth STEM learning and expertise development in and out of school.*

Chrisman, N. J., & Kleinman, A. (1983). Popular health care, social networks, and cultural meanings: The orientation of medical anthropology. In D. Mechanic (Ed.), *Health, healthcare, and the health professions* (pp. 569–590). New York: Macmillan.

Clark-Ibanez, M. (2004). Framing the social work with photo-elicitation interviews. *The American Behavioral Scientist, 47*(12), 1507–1527.

Cole, M. (1996). *Cultural psychology: A once and future discipline*. Cambridge, MA: Belknap.

Corsaro, W. A. (2003). *We're friends right? Inside kids' culture*. Washington, DC: Joseph Henry Press.

Corsaro, W. A., & Maynard, D. W. (1996). Format tying in discussion and argumentation among Italian and American children. In D. I. Slobin, J. Gerhardt, A. Kyratzis, & J. Guo (Eds.), *Social interaction, social context, and language: Essays in honor of susan Ervin-Tripp* (pp. 157–174). Mahwah, NJ: Erlbaum.

Crowley, K., & Jacobs, M. (2002). Building islands of expertise in everyday family activity. In G. Leinhardt, K. Crowley, & K. Knutson (Eds.), *Learning conversations in museums* (pp. 333–356). Mahwah, NJ: Lawrence Erlbaum Associates.

Dewey, J. (1902). *The child and the curriculum*. Chicago: University of Chicago Press.

diSessa, A. A. (1988). Knowledge in pieces. In G. Forman & P. B. Pufall (Eds.), *Constructivism in the computer age* (pp. 49–70). Hillsdale, NJ: Lawrence Erlbaum Associates.

Dreier, O. (2009). Persons in structures of social practice. *Theory & Psychology, 19*(2), 193–212.

Driver, R., Leach, J., Millar, R., & Scott, P. (1996). *Young people's images of science*. Buckingham, UK: Open University Press.

Duschl, R. A., Schweingruber, H. A., & Shouse, A. W. (2007). *Taking science to school: Learning and teaching science in grades K-8*. Washington, DC: National Academies Press.

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

Goodwin, M. H., & Goodwin, C. (1987). Children's arguing. In S. U. Phillips, S. Steele, & C. Tanz (Eds.), *Language, gender, and sex in comparative perspective* (pp. 200–248). Cambridge, UK: Cambridge University Press.

Gutiérrez, K. D., & Rogoff, B. (2003). Cultural ways of learning: Individual traits or repertoires of practice. *Educational Researcher, 32*(5), 19–25.

Harré, R. (2008). Positioning theory. *Self-Care, Dependent Care & Nursing, 16*(1), 28–32.

Holland, D., Lachiocotte, W., Skinner, D., & Cain, C. (1998). *Identity and agency in cultural worlds*. Cambridge, MA: Harvard University Press.

Hudicourt-Barnes, J. (2003). The use of argumentation in Haitian Creole science classrooms. *Harvard Educational Review, 73*(1), 73–93.

Hutchins, E. (1995). *Cognition in the wild*. Cambridge, MA: MIT Press.

Jessor, R. (1996). Ethnographic methods in contemporary perspective. In R. Jessor, A. Colby, & R. A. Shweder (Eds.), *Ethnography and human development: Context and meaning in social inquiry* (pp. 3–14). Chicago: University of Chicago Press.

Johnson, C., & Eccles, R. (2005). Acute cooling of the feet and the onset of common cold symptoms. *Family Practice, 22*, 608–613.

Korpan, C. A., Bisanz, G. L., Bisanz, J., Boehme, C., & Lynch, M. A. (1997). What did you learn outside of school today? Using structured interviews to document home and community activities relating to science. *Science Education, 81*(6), 651–662.

Kyratzis, A. (2004). Talk and interaction among children and the co-construction of peer groups and peer culture. *Annual Reviews of Anthropology, 33*, 625–649.

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*. Cambridge, MA: Harvard University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, MA: Cambridge University Press.

Law, J. (1999). After ANT: Complexity, naming and topology. In J. Law & J. Hassard (Eds.), *Actor network theory and after* (pp. 1–14). Hoboken, NJ: Wiley-Blackwell.

Lee, C. (2002). Environmental justice: Building a unified vision of health and the environment. *Environmental Health Perspectives, 110*(Suppl. 2), 141–144.

Lee, C. D. (2008). The centrality of culture to the scientific study of learning and development: How an ecological framework in education research facilitates civic responsibility. *Educational Researcher, 37*(5), 267–279.

Lee, O., & Luykx, A. (2007). Science education and student diversity: Race/ethnicity, language, culture, and socioeconomic status. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 171–197). Mahwah, NJ: Lawrence Erlbaum.

Lemke, J. L. (2000). Across the scales of time: Artifacts, activities, and meanings in ecosocial systems. *Mind, Culture, and Activity, 7*(4), 273–290.

Linn, M. C., & Songer, N. B. (1991). Cognitive and conceptual change in adolescence. *American Journal of Education, 99*(4), 379–417.

Lowen, A. C., Mubareka, S., Steel, J., & Palese, P. (2007). Influenza virus transmission is dependent on relative humidity and temperature. *Public Library of Science (PLoS) Pathogens, 3*(10), 1470–1476.

McDermott, R., & Webber, V. (1998). When is math or science? In J. G. Greeno & S. V. Goldman (Eds.), *Thinking practices in mathematics and science learning*. Mahwah, NJ: Erlbaum.

Medin, D., & Atran, S. (2004). The native mind: Biological categorization, reasoning, and decision making in development and across cultures. *Psychological Review, 111*(4), 960–983.

Moll, L. C., & Gonzalez, N. (2004). Engaging life: A funds-of-knowledge approach to multicultural education. In J. A. Banks & C. A. M. Banks (Eds.), *Handbook of research in multicultural education* (2nd ed., pp. 699–715). San Francisco: Jossey-Bass.

Nasir, N. S., Rosebery, A. S., Warren, B., & Lee, C. D. (2006). Learning as a cultural process: Achieving equity through diversity. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 489–504). New York: Cambridge University Press.

Ochs, E., Taylor, C., Rudolph, D., & Smith, R. (1992). Storytelling as a theory-building activity. *Discourse Processes, 15*, 37–72.

Reeve, S. (2009). *Health beliefs and practices of young people in a multicultural community: Findings from a child-centered ethnography.* Unpublished dissertation, University of Washington, Seattle, WA.

Reeve, S., & Bell, P. (2009). Children's self-documentation and understanding of the concepts 'healthy' and 'unhealthy'. *International Journal of Science Education, 31*(14), 1953–1974.

Rosebery, A., Warren, B., Ballenger, C., & Ogonowski, M. (2005). The generative potential of students' everyday knowledge in learning science. In T. Romberg, T. Carpenter, & F. Dremock (Eds.), *Understanding mathematics and science matters* (pp. 55–80). Mahwah, NJ: Erlbaum.

Saxe, G., & Esmonde, I. (2005). Studying cognition in flux: A historical treatment of “fu” in the shifting structure of Oksapmin mathematics. *Mind, Culture, and Activity, 12*(3&4), 171–225.

Schiffrin, D. (1987). *Discourse markers*. Cambridge, UK: Cambridge University Press.

Scribner, S. (1984). Cognitive studies of work. *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 6*(1 & 2), 1–42.

Spradley, J. P. (1979). *The ethnographic interview*. Belmont, CA: Wadsworth Group/Thomson Learning.

Stevens, R. (2000). What counts as math? Emergent and assigned mathematics problems in a project-based classroom. In J. Boaler (Ed.), *Multiple perspectives in mathematics teaching and learning* (pp. 105–143). New York: Elsevier.

Suchman, L. (2007). Agencies in technology design: Feminist reconfigurations. In *Human-machine reconfigurations: Plans and situated actions*. New York: Cambridge University Press.

Tzou, C., & Bell, P. (2010). Micros and me: Leveraging home and community practices in formal science instruction. In K. Gomez, L. Lyons, & J. Radinsky (Eds.), *Learning in the disciplines: Proceedings of the 9th International Conference of the Learning Sciences* (Vol. 1, pp. 1127–1134). Chicago: International Society of the Learning Sciences.

U.S. Department of Minority Health and Health Disparities. (n.d.). *Eliminating racial and health disparities*. Retrieved June 30, 2009, from http://www.cdc.gov/omhd/About/disparities.htm

Zacharia, Z., & Barton, A. C. (2004). Urban middle-school students’ attitudes toward a defined science. *Science Education, 88*(2), 197–222.

Zimmerman, H. T. (2008). *Everyday science and science every day: Science-related talk and activities across settings*. Unpublished dissertation, University of Washington, Seattle, WA.

Zimmerman, H. T., & Bell, P. (in review). *Where children see science: Youth’s activities as connected to science.*