Toward A Framework for Culturally Responsive Design in Multimedia Computer Environments: Cultural Modeling as A Case

Carol D. Lee

School of Education and Social Policy
Northwestern University

This article offers a framework for the design of learning environments that takes culture explicitly into account. This article situates a rationale for the framework based on research in the learning sciences, cultural psychology, and cultural–historical-activity theory. The Cultural Modeling Framework is offered as an example of a culturally responsive approach to design. This article makes an explicit argument for the function of culturally responsive design in computer-based tools. It illustrates culturally responsive design in technology and its consequences for student learning.

The challenge presented in this article is for designers of learning environments to consider how cultural practices, especially among student populations of color and those living in poverty, may offer opportunities to improve the design of learning technologies. *Learning technologies* are here defined to include computer as well as non-computer-based tools, language use, and routine practices. This challenge is under-conceptualized in the field and under-represented in the array of learning tools available or under design. Most computer tools developed under the banner of constructivism honor the specific discipline into which students are being apprenticed, but assume a homogenous form of motivation that applies to any students, anywhere, anytime. Whereas there is a certain kind of efficiency to this approach, I argue there are also limitations. Equally important, there is little evidence that such tools are being used in schools serving students of color or students living in poverty. And where such tools may be used with students of color or students living in poverty, little attention is given to the impact of culture on how these tools are appropriated, especially in ethnically mixed groupings.

DESIGN AS A CULTURALLY RESPONSIVE PRACTICE

Design as a culturally responsive practice involves both the design of learning environments, broadly speaking, as well as computer-based tools to support learning. Design here takes as one of its goals apprenticing novices into expert-like ways of reasoning and problem solving. I position

---

culture at the center of such design because current perspectives view learning as changes in the quality of participation in cultural practices (Cole, 1996; Rogoff, 1990). These practices are historically inherited as traditions that are reinforced through institutions, such as the family, the church, the school, and the workplace (Brofenbrenner, 1979). These practices are also socially mediated and negotiated through interpersonal relationships among individuals in pairs and in groups (Lave & Wenger, 1991; Rogoff, 1994; Salomon, 1993). Traditions of cultural practices usually inhere in-group formations that have a historical character. Such group formations may be defined by ethnicity, language use, or occupation, among others. Although research in cognition and cultural-historical-activity theory have attended to cultural practices that eminate from disciplinary communities and work place settings (Engeström, Miettinen, Punamaki, 1999; Hutchins, 1995; Rogoff & Lave, 1984), very little attention has been paid to cultural practices based on membership in ethnic and language communities (exceptions include Cole, 1998; Cole & Scribner, 1981; Gutierrez, Baquedano-Lopez, & Tejeda, 1999; Lin, 1999; Nasir, 2000; Saxe, 1991; Serpell & Boykin, 1994). One goal of this article is to incorporate an attention to ethnicity and language use within our conceptions of principles of learning and by extension to principles of design.

RATIONALES FOR DIVERSITY IN DESIGN

There are at least four reasons for attending to cultural diversity in the design of learning tools. The label "culturally diverse" refers not only to nonWhite persons. All peoples have multiple communities and cultural worlds to which they belong, and it is important to consider their views and beliefs from their various points of view. The challenge for designers is to learn, much like anthropologists, what a target audience—majority or minority—knows and believes relevant to the learning objectives. However, in light of political inequities, this article emphasizes the importance of attending to the cultural worlds of students who have been traditionally underserved by public education and have been largely denied access to new computer-based technologies being developed to support complex problem solving. To illustrate each of the four rationales, I use examples grounded in funds of knowledge (Moll & Greenberg, 1990) embedded in cultural practices of African–American and Latino–American communities.

Rationale # 1: Building on Prior Knowledge

Both the cognitive and sociocultural literatures attest to the importance of prior knowledge. Activities are enriched when the learner can make connections between a new task and prior knowledge. Such connections help the learner to build more stable and situated understandings, increasing the likelihood that the learner will have resources to draw on in a conscious way when she meets an unfamiliar but related task.

Capitalizing on the prior knowledge of potential learners is no simple matter. In the Cultural Modeling Framework (Lee, 1997) that is discussed later in this article, we attempt explicitly to draw on the prior knowledge of speakers of African American English Vernacular (AAEV) in making links to specialized strategies and concepts in the domain of literary interpretation. The argument I make here is that there are valuable cultural funds of prior knowledge (Moll & Greenberg, 1990) that students of color and students living in poverty bring from home to the task

of learning in school, but they frequently go untapped in the design of learning environments using computer-based tools.

Designers of computer-based environments can learn from the work of sociocultural researchers who have explicitly examined the cognitive consequences of participation in everyday practices and how that affects knowledge construction in school-based practices. This research includes, but is not limited to, my work in Cultural Modeling (Lee, 1993, 1995); the work of Pinkard (2000) discussed in a following section; Fuson's work in designing math curriculum at the primary level that nurtures funds of knowledge of Latino children (Fuson, Smith, & LoCicero, 1997); Moses and collegues' work in the Algebra Project which helps students make connections between everyday practices like riding an urban transit system and the nature of the rational number system necessary for transitions from arithmetic to algebra(Moses, Kamii, Swap, & Howard, 1989); the work of Saxe (1991) and of Nunes, Schliemann, and Carraher (1993) in examining the mathematical knowledge of poor children on the streets of Brazilian cities selling candy; the work of Rosebery, Warren and Conant (1992) in helping students make connections between community language practices and scientific reasoning; and the work of Moll and Greenberg (1990) in helping teachers make connections between the cultural funds of knowledge of Mexican American students and academic learning.

Often prior knowledge is viewed as generic and culturally neutral. I acknowledge the importance of naïve concepts or misconceptions. Such naïve concepts or misconceptions in physics, for example, may not be attributable to any ethnic group (at least within the borders of the United States), but are certainly useful in reform views on the teaching of physics concepts (Carey & Gelman, 1991; Minstrell, 1989). Thus this category of prior knowledge does not have to include a culturally specific focus. On the other hand, the studies cited in this section demonstrate that prior knowledge can be culturally sensitive. This view of prior knowledge is captured explicitly in the next rationale for culturally responsive design.

Rationale # 2: Cultural Models as Socially Constructed Ways of Knowing

Cultural models represent socially constructed ways of knowing. Our knowledge is organized as cultural models, with implicit ideas, attitudes, and values (D'Andrade, 1987; Rumelhart, 1980; Schank & Abelson, 1977). For example, our use of the phrase "going out to a restaurant" implies knowledge about how one carries out tasks, like getting seated, ordering, eating, and paying. People who share common cultural practices are likely to understand these cultural models and so there is no need, except for children and new comers to the culture, to explain them. Whole subdomains within academic disciplines try to understand these cultural dimensions of knowing. Fields like ethnomathematics (Ascher, 1991), ethnobotany, and ethnoastronomy have emerged in the last few decades in order to study systematically the relationships between the way peoples in different cultures conceptualize mathematics, botany, astronomy, and so forth; and what those conceptualizations say about their belief systems, that is, their cultural models of the world.

Black psychologists Jones (1980), Nobles (1980), and Boykin (1994) described cultural models that they argue persist in the African–American community and have African (particularly West African) roots. These researchers assert that African belief systems can inform the design of learning environments for African–American students. Boykin, for example, argues that African–American youngsters achieve well—that is, they are engaged and more likely to persist in

learning—in environments designed to be responsive to what he calls an Afro-cultural ethos. I take the position in the Cultural Modeling Framework that as African American students engage in signifying talk (such as playing the dozens, i.e., "yo mama so skinny she could do the hoola hoop in a cheerio"), they invoke a set of strategies for comprehending and producing metaphors, irony, satire, and so forth. However, they also invoke certain habits of mind, including attitudes about language play as an aesthetically pleasing end, in itself. Thus, signifying for speakers of African–American English vernacular represents a cultural model about language use linked to literary constructs and strategies as well as a set of beliefs and attitudes. They come packed together. Understanding this package is important for thinking about design.

Rationale # 3: Supporting Engagement and Motivation

Perhaps the most widely used argument for attending to diversity in the design of learning environments is to support engagement and motivation in learning. Engagement and motivation are connected; they are displayed as a willingess to persist with effort. Mere opportunity to participate does not mean students will know how to participate. Nor does it mean that the roles and activities available will be sufficiently meaningful for students to want to persist. Much of this argument grows from Sociolinguistic research from the 1970s documenting the ways that discourse styles in classrooms limited forms and levels of participation by students whose community language differed from the so-called academic mainstream (Cazden, 1988; Cazden, John, & Hymes, 1972). With the new opportunities for forms of representation and communication afforded by new computer-based technologies, it may well be quite useful for designers to consider the implications of this work for communication opportunities within computer-based environments.

Rationale # 4: Supporting Social, Civic and Political Empowerment

Ladson-Billings (1994) said that education should teach students (a) to become culturally competent members of their communities of origin and (b) to learn civic consciousness; that is, to have a critical consciousness about how to work for power within our democracy. These goals are especially important for students living in poverty and students of color. Those who study gender in uses of technology (Bryson & de Castell, 1996; Kafai, 1996), identify equity as a goal of their interventions. Designers like Alan Shaw (1996) have explicit interests in empowering communities through use of computer technology. A recent report by the Benton Foundation (Goslee, 1998) shows the gap in educational uses of technology between low-income students and their more affluent peers. Again, the work of designers of noncomputer-based learning environments may well have important lessons for designers of computer-based learning.

CULTURAL MODELING DESIGN FRAMEWORK

Here I describe the Cultural Modeling Design Framework to illustrate how designers of educational activities might embody the rationales for culturally responsive design I have articulated. This framework has been used both to design curriculum that is not computer based and to design

computer-based tools. I make this point to emphasize that the rationale for culturally responsive design is applicable with and without computer-based technologies. The rationale includes attending to prior knowledge and cultural models as ways of knowing to support engagement and motivation, as well as social and civic empowerment. In Table 1, I match each design step in Cultural Modeling with one or more of the rationales for culturally responsive design.

First, Cultural Modeling (Lee, 1993, 1995, 2000) requires a careful analysis of an academic domain and the relationships among kinds of problems within that domain. What content, strategies, and/or habits of mind are required? For a given sequence of tasks, what prior knowledge is required?

Second, those involved in design must consider what *prior knowledge* (including content, strategies, or habits of mind) do novices already have that may be related to what is involved in carrying out the task? What prior assumptions do they have about the activity structures and modes of interaction within the site of the practice? In the case of underachieving black and brown students as well as students living in poverty more generally, these last two questions are salient. When the curricular focus includes complex problem solving, the default hypothesis in public schooling is that such students bring few resources for learning disciplinary knowledge. This position is embodied in low expectations of teachers and institutional practices such as tracking. What forms of community funds of knowledge (Moll & Greenberg, 1990) that may be applicable to problem solving in the domain are rarely considered or even conceptualized?

In addition, student resistance to rigorous constructivist- teaching may be influenced by students' prior experiences in school (Hodges, 1998; Kindred, 1999; Matusov, 1996). Students who

TABLE 1
Cultural Modeling Design Principles

	Generic Design	Culturally Responsive Design Rationale		
	Task Analysis	Prior Knowledge & Cultural Models as Ways of Knowing	Engagement & Motivation	Social & Civic Empowerment
Cultural modeling design steps	• Analyze generative constructs in the domain. • Analyze problem solving based on expert-novice differences.	• Analyze cultural practices of target group and look for comparable models, analogies, naïve concepts, or misconceptions related to the academic problem to be solved. • Use existing cultural models, scripts, and schemas as models, analogs, or counter-examples to be interrogated by students.	• Structure learning activities in ways that invite students to be meta-cognitive, making their tacit thinking public. • Structure instructional talk using community based discourse norms, while incorporating discipline specific modes of reasoning.	• Identify content for tasks that invite interrogation of community and/or personal needs.

have worked in school for 5, 8, or 10 years have very well grounded beliefs about what people do in school. In contrast to current rigorous standards and focus on authentic project-based work, underachieving black and brown students and students living in poverty often have experienced school as a place where one is not required to think, to work hard, to raise questions, to take responsibility for one's own learning, or to challenge peers and teachers intellectually. Thus, the Cultural Modeling Framework requires that the nature of tasks, the sequence of tasks, and the nature of activity structures must take into account a wide variety of forms of prior knowledge and expectations that students bring.

Third, designers should consider the *motivational potential* of instructional discourse. In Cultural Modeling, we structure metacognitive instructional conversations. Because the assumption is that we are structuring activities that help students to make public to themselves and to others tacit strategies they already use outside of school, the focus is on talking about one's thinking. Although such conversations are difficult to manage, the idea is that undersanding how one reasons is inherently motivating. That is, based on motivational theories of self-efficacy, understanding what one is doing increases the likelihood that one will want to do it (Bandura, 1994; Weiner, 1985). In addition to metacognitive instructional conversations, the Cultural Modeling Framework also calls on designers explicitly to draw on community-based norms for discourse. Earlier work by Phillips (1983) and others (Cazden et al., 1972) demonstrates how norms for who can talk, how, when, and about what help to construct roles for participants to play. Lack of congruity with community-based norms for talk (including use of different national languages—such as Spanish; language varieties—such as African–American English Vernacular [AAVE]; or registers) has been shown to result in lack of participation in classroom talk. Rosebery, Warren, and Conant (1992) have repeatedly shown ways of apprenticing English as a second language (ESL) students into scientific reasoning by drawing on community based language practices and cultural models as anchors for instruction.

Finally, Cultural Modeling involves the strategic selection of the content of tasks. The task should be structured according to the cognitive demands of the domain. The content should also address community and/or personal issues, which if confronted, may open up doors for a sense of *empowerment*—personally, civically, and socially. The spirit of this objective is taken very seriously, for example, in the Algebra Project where mathematical literacy is viewed as a civil right (Moses & Cobb, 2001).

In the section that follows, I demonstrate the application of the Cultural Modeling Framework to the design of a high school literature curriculum that includes the use of a computer-based tool included as *one* of the artifacts in the curriculum design.

Reading Comprehension in Response to Literature: A Case of Cultural Modeling Prior Knowledge and Cultural Models as Ways of Knowing

In this application of the Cultural Modeling Framework, I elected to link a focus on prior knowledge with cultural models as described by D'Andrade (1987). In the rationale for culturally responsive design, I distinguished these two. In some reading research, for example, prior knowledge is viewed as generic knowledge structures. Such structures can include knowledge of strategies or tasks, none of which are associated with any particular ethnic group. On the other hand, in the rationale I also emphasize those knowledge structures that are associated with particular ethnic and lan-

guage groups. Most curricular reforms today consciously consider students' prior knowledge, but rarely take into account cultural knowledge of particular groups.

Prior knowledge is a crucial element of reading comprehension. In the case of literary texts, particularly works of fiction, the prior knowledge may consist of any of the following categories of knowledge:

- Authors—their lives, styles of writing, other texts.
- Related texts.
- Traditions of criticism and the interpretive procedures attached to each.
- Allusions to real world events or images, symbols, etc. from other texts or media.
- Cultural assumptions about routine scripts of everyday life and social or psychological causes affecting the internal states of humans.
- Epistemologies about what response to literature entails.

Interpretations of literature may be enhanced or constrained by limitations in any of these forms of prior knowledge.

The Cultural Modeling Framework pays special attention to issues of prior knowledge and literacy teaching. One of the fundamental precepts of the framework is that culturally diverse students, often speaking devalued vernacular language varieties or first languages other than English, routinely use strategies for interpreting figurative language, irony, and satire as part of speech acts in their everyday communications. The current implementations of this framework have focused specifically on African–American adolescents and specific characteristics of the AAEV. There is a strong body of sociolinguistic research documenting the creative aspects of communication within the AAEV speech community (Mitchell-Kernan, 1981; Smitherman, 1977). I have claimed that, through participation in speech acts involving signifying, speakers in this community routinely interpret metaphor, simile, hyperbole, satire, irony, and shifts in point of view (Lee, 1993, 1997). Signifying is a form of talk that involves double entendre, indirectness, and is rich in figurative language, irony, and satire. However, as speakers of AAEV interpret these rhetorical tropes in common dialogues, they use tacit strategies. I have argued that the strategies are the same as those used in the interpretation of literature. As part of the routines in this framework, students are given what are called cultural data sets to analyze. These data sets may include stretches of signifying dialogue, lyrics from rap and R&B music, or videos (for example rap videos) with literary qualities. In each case, the cultural data set is one for which the students are presumed to have significant prior knowledge and which requires the analysis of some rhetorical trope or intepretive problem analogous to those that students will encounter in works of fiction in the curriculum.

METACOGNITIVE INSTRUCTIONAL CONVERSATIONS AS ENGAGEMENT AND MOTIVATION

A central activity structure within the Cultural Modeling Framework is the coordination of metacognitive conversations (Forman & Larreamendy-Joerns, 1998; Lee, 1999). These are discussions in which students are supported in making public the strategies they are employing as well as the evidence and reasoning they are using. In addition, such conversations involve interaction structures in which students initiate ideas, questions, and challenges, where instructional conversa-

tions are not solely directed by teacher's intentions. These modes of reasoning (i.e., publically articulating how you came to a position and evaluating your evidence) and modes of interaction (i.e., more than one person initiating ideas, questions and challenges) characterize avid readers of canonical literature. The norms for talk often involve overlapping multiparty talk, consistent with many AAEV discourse norms in speech events such as signifying, loud talking, and testifying (Smitherman, 1977). The initial modeling activities in units of instruction in the framework are intended to (a) draw out relevant prior knowledge of diverse underachieving students, and (b) socialize students into specific modes of reasoning and of interaction.

Many examples of modeling in the educational literature (Cazden, 1988; Palinscar & Brown, 1984) involve students observing a more capable expert reason and use strategies. In the modeling phase of the Cultural Modeling Framework, students actually participate in the form of problem-solving characteristic of the domain while they are still novices to the academic content. In this case, it means that students actively engage in interpreting symbols, irony, and satire (e.g., in rap lyrics) before they know what symbols, irony, or satire are, and before they are able to apply strategies for identifying or interpreting these literary tropes in canonical literature.

Task Content as a Bridge Toward Social and Civic Empowerment as well as Engagement and Motivation

African–American fiction provides the base of the curriculum because students are presumed to have relevant prior knowledge about their themes. The text sequence within any given instructional unit moves from modeling with cultural data sets, to texts of African–American fiction, and finally to texts from other traditions. All works share either interpretive problems or themes taken from the African–American core. The assumption here is that there are at least two categories of problems in response to literature. One involves knowing what kind of interpretive problem you are seeing in a text and having strategies available to generate a warrantable interpretation. The second involves making sense of the social codes in a text; that is, understanding, having some empathy (even if one eventually rejects the social codes) for what motivates characters to act as they do. Rabinowitz (1987) called this category assuming the role of the authorial audience, the audience the author assumed would know the social world the characters occupy. The initially selected African-American texts invite students to grapple with dilemmas related to racism, self-concept, and resiliency in the face of danger. Offering potential lessons for today, these texts provide spaces for students to explore the ways that African Americans have historically sustained themselves.

With this as a description of the kinds of experiences students had in the Cultural Modeling Response to Literature Curriculum, I turn to describe the Collaboratory Notebook (CBN), one of the tools that provided space and supports for their literacy learning. The culturally responsive curriculum and the CBN were part of an intervention in an underachieving African–American urban high school (Lee, 1993, 1995, 2001).

Cultural Modeling in the Design and Appropriation of a Computer-Based Tool to Support Literary Response

The CBN is a software tool originally designed by Daniel Edelson and Kevin O'Neill of Northwestern University for use in science education (Edelson & O'Neill, 1994). Professor Edelson and I cooperated on the redesign of the tool to meet the needs of the Cultural Modeling Project. The

CBN fulfills several functions. First, it provides hypertext links to sources of prior knowledge that can enrich the range of warrantable interpretations students may construct. Second, the CBN tool provides a structured environment for argumentative reasoning. Students are asked open-ended interpretive questions with explicit supports for articulating a claim, evidence for, as well as potential evidence against, a position taken. Third, the CBN tool supports collaborative thinking among students. In the first iteration of the tool, students were able to view responses to key questions made by other students and to respond to positions taken by others. The value of its use as a tool is that it is capable of including content that is relevant to different communities of students. Both the tool and the routines in Cultural Modeling classrooms presuppose that students will reason systematically, tackle complex problems, and collaborate. Both place the student at center stage, with the teacher's role as a keen observer of student thinking, one who shapes an environment, scaffolds students, and provides them with support flexibly as needed. Students do not begin to work in the CBN until after they have worked through the modeling activities using rap and other culturally familiar data sets and have begun to read the canonical texts.

USING CBN TO SUPPORT TACKLING INTERPRETIVE PROBLEMS IN *BELOVED*

The CBN is intended to make accessible to students a text-rich environment. Rabinowitz (1987) argued that expert readers use knowledge of the world and knowledge of other texts. The underachieving high school readers for whom these notebooks have been designed have not developed the disposition to read their worlds into canonical texts. For novice readers, this is especially true when referents in the literary work involve symbolism, irony, satire, or structural devices such as stream of consciousness or use of unreliable narrators. Our design of the CBN makes available to novice readers relevant associations for a section of a literary work. Students can then hypothesize meaningful relationships between the referent and its associations, using both the texts and their own personal knowledge as anchors for warranting their positions. Figure 1 includes the model for the rich text environment of the CBN.

Text passages are chosen because they pose a difficult problem of interpretation. They are ironic, satiric, dense with figurative language, or invoke an unreliable narrator. In any of these in-
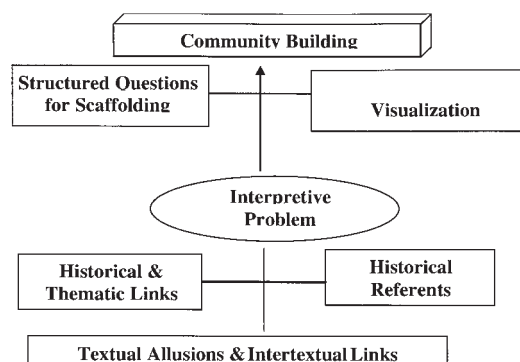

FIGURE 1   Building a rich text environment.

stances, a literal interpretation of the passage must be rejected and a warrantable explanation must add new layers of meaning beyond what is apparent. Although a range of interpretations is possible, any old reading will not do. A student must be able to justify her claim. She must link that claim to the wording of the text. The reasoning must reflect norms of literary criticism.

In the example, which follows, a stretch of text from Toni Morrison's (1987) *Beloved* is chosen. In this example, the protagonist, Sethe, describes her memories of having been raped and beaten during the African Holocaust of Enslavement. The scars on her back are described as a tree. Morrison also dramatizes the depth of Sethe's defilement from the rape and beatings. Sethe emphasizes how the rapist took her baby's milk, rather than her own defilement. She concentrates on the milk of the baby whom she would later kill to keep the innocent child from being taken back into enslavement. The CBN here focuses on images of the tree on Sethe's back, the scars on her back, and the relationship of Sethe as a nursing mother to her child, Beloved.

What follows then are linked pages, each with an image. Students are asked to hypothesize possible relationships between the selected text from *Beloved* and the linked images. They are also asked to provide information from the text that supports the associations they have made. They are asked to provide information from their knowledge of the world that explains why they made particular associations.

The ability to visualize while reading is an important skill (Sadoski & Paivio, 2001), especially in literature. The first linked page of an enslaved African in America with a scarred back provides students with a vivid visual image of Sethe's scars (see Figure 2). In addition, the metaphor of the scars looking like a tree takes on realistic and historic meaning when students see an actual human being living during the period of the African Holocaust of Enslavement who experienced the same savagery as Sethe. After each linked image page, an interpretive question is posed, asking students to hypothesize a warrantable link between the linked page and the text passage.

The second linked image is a West African Baobob tree. Its roots are so big they grow above ground (see Figure 3). The question attached to the picture of the African Baobob tree is what might this tree have to do with the tree on Sethe's back. There is no simple right or wrong answer, but, again, any old answer will not suffice. Whereas there is no evidence that Morrison had an African Baobob tree in mind when she constructed the metaphor of the tree in the novel, this particular image opens up interesting interpretive possibilities. This investigation may be viewed as an ill-structured complex problem. The strategies for solving this problem of connecting the Baobob tree to the text describing Sethe's back are applicable to other problems of symbolism.

The third linked page has a picture of a West African Nuba woman. The Nuba use ritual scarification for personal adornment and as initiation rites that signify to both the individual and the community that the initiate is a valued member of that community and ready to assume the responsibilties of adulthood, including parenting (see Figure 4). The Nuba woman in this picture is nursing her baby. On her bare breasts are scars, but unlike Sethe, these scars are signs of beauty. The scars signal her membership in the community. As a second ill-structured problem, the students are asked what might this Nuba woman have to do with Sethe and the tree on her back.

All the linked allusions just described involve pictures. The technology also makes it easy to use video images. In one part of the novel, Sethe remembers her early childhood when she had been separated from her mother. In her childhood memory, someone pointed out a woman wearing a hat and she was told this woman was her mother. At the same time Sethe is also remembering when she was about to deliver her youngest child, Denver, in the woods while escaping from the Sweet Home plantation. Sethe was in great physical pain. Her only help was a young White girl,

Amy Denver, who was also escaping from indentured servitude. Sethe describes the baby moving around in her womb like an antelope. In the next sentence, Sethe recalls herself as a child seeing her own mother and others on the plantation doing an African dance called the Antelope. In one of the links to this passage, the students view a short video of an African dance troupe. On the page with the clip is a description of the role that dance plays in traditional African cultures. Dance is a practice that reinforces a sense of belonging to a community. Ritual dance communicates and reinforces beliefs about human and spiritual relationships. Students are then asked what this video might have to do with Morrison's use of the antelope in the text. Such a problem provides students with additional supported practice in attacking ill-structured problems of symbolism in the text.

In each of the examples, we have been able to make use of unique capabilities of multimedia computer technology. Because the CBN is a tool, teachers, curriculum designers, or researchers can create content and interfaces that are responsive to the community of students and the particular demands of the texts. The Cultural Modeling Framework on which this curriculum is designed is culturally responsive in its conceptualization. This framework demands that tools, which sup-
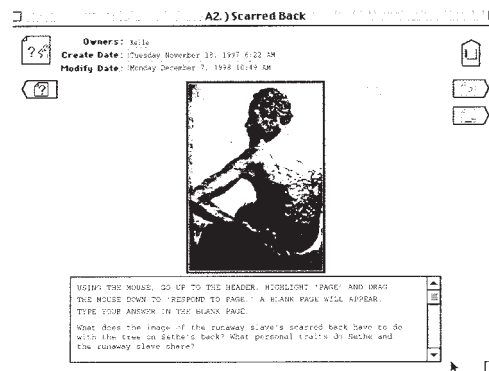

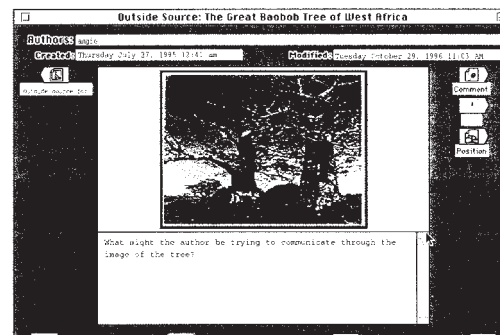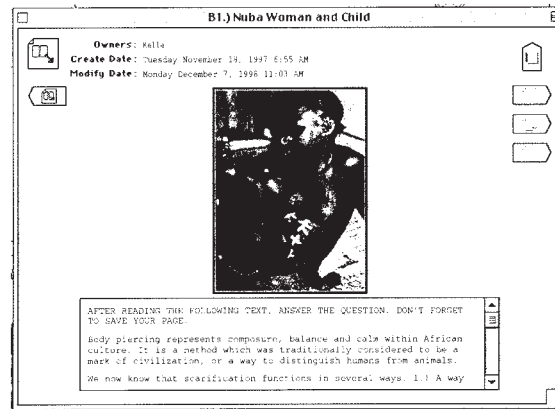FIGURE 2   *Beloved* Collaboratory Notebook – Tree Symbol Link 1.

FIGURE 3   *Beloved* Collaboratory Notebook – Tree Symbol Link 2.

FIGURE 4   *Beloved* Collaboratory Notebook – Tree Symbol Link 3.

port it be culturally constituted. The tool itself is inherently flexible because it is simply a structure on which differing content and interfaces can be built. Secondly, the tool allows students to negotiate its use and their pace individually.

Interpretive questions were constructed in the CBN as a nexus of text passages, multimedia referential data, and one or more questions. The ways students used the CBN were enriched by the narrative nature of the multimedia data sets (i.e., pictures, songs, and videos that told stories) as well as the cognitive resources they were learning to draw on in the Cultural Modeling classrooms. Students often responded to these interpretive problems in culturally specific ways.

Sociolinguists (Smitherman, 1977) described the following features of AAEV discourse styles: use of direct address and conversational tone; verbal inventiveness, including unique nomenclature; rhythmic, dramatic and evocative language; use of sermonic tone and cultural referents. The literature on learning styles (Shade, 1982) describes African–American students as often field dependent, that is, interpreting a phenomenon from a more relational perspective. Table 2 includes examples of responses from students using the CBN *Beloved* notebook that reflect these AAEV discourse features. The particular statements reflecting each feature are underlined.

The placement of text passages, multimedia referential resources, and interpretive questions provided a problem space with special semiotic potential. The visual imagery in pictures and videos provided students with a hook on which to place what they imagined while reading. For example, one student writes, "In my head I could picture how Sethe's back would be and here I could see how it really looks. I see how it looks like branches." In the organization of their responses, one tends to see a procedural approach to writing about the links between the visual images, their imagination, their prior knowledge—either personal or historical—and the text. It is as if the organization of these problem spaces provides a kind of procedural and conceptual scaffold to help students work through the process of thinking through their responses. Although the image of the enslaved man's scarred back is a more direct link to the text, the image of the Baobob tree requires a more indirect, and therefore complex, inferencing to link to the text. The following response by one student provides a revealing example of how students thought out loud as they worked through the interpretive problems:

TABLE 2
African American Discourse Features

Direct address conversational tone

"Slaves ran away not only to be away of the cruelty they were suffering, but to be free. Slaves were considered chattel so nobody was human to the white man. For nearly 400 years, our ancestors paid the price for refusing to work, running away or trying to learn so they can be more than just a piece of property. When the fugitives slave laws was in effect the risk of getting caught for running away was very high. *Just in case you were wondering, at times they grabbed a free Negro and declaimed them as the escaped slave. Can you imagine yourself being whipped with cowhide.* A lot of slaves did not survive their whippings and others were completely traumatized for probably the rest of their lives."

"*In my head I could picture how Sethe's back would be and here I could see how it really looks.* I see how it looks like tree branches I would say they both got it by the whip maybe because they did something out of order or the slave owners probably had nothing else to do. So they did it for fun."

Verbal inventiveness, unique nomenclature

"Sethe and the slave share the same personal traits, because they were both whipped a lot in their life. *Sethe was messed with* just because she was pregnant, and the Slave was whipped just because he was a slave and for running away."

Rhythmic, dramatic evocative language; Sermonic tone; Cultural references

"I believe that Sethe was crazy personally because *ain't man on God's green earth going to scare me to the point I try to take my children's life.* Also I think after killing your child, seeing your son's eye come out of his head and his tongue chewed up, it ain't going to get you. Sethe seemed kind a sane on the outside but when you learn about her past you could understand why things don't bother her like they should. I think what drove her crazy is when schoolteacher had the boys take her milk."

Field dependency, involvement with the immersion of events and situations; personalizing phenomenon

"*I would compare Sethe to my mother.* The reason I use my [mother] is because she would do anything to help us from getting in trouble, or to let something bad happen to us. Just like Sethe killed Beloved, so that she would not become a slave."

The two-type of trees are very different to me, because the Baobob tree branches shows life all the years it has blossom[ed]. In the picture the tree shows kind of a hardship image. So in a way I have proved myself wrong, because now that I think about it the tree do remind me of Sethe's back. (CBN log H99; March 11, 1999).

The careful logic students used to construct warrantable links between the Baobob tree and the scars on Sethe's back, are exemplified in the following response by another student:

The similarities between Sethe and the tree's homeland is that they are both from West Africa. Sethe's roots also grow above the ground. Her ancestors were originally from Africa and they were taken from their native land and brought to America. Seeing that her ancestors were black that made fertile soil for her roots to spread, not that it was voluntarily, but her roots probably spread across the country, which is how she came to be in Kentucky.[1] Sethe is a leaf on her mother's branch.

If you compare all of this to the tree on Sethe's back, I guess you can say that the roots of the tree were a symbol of the pain and anguish that she endured in her life as a slave. You can also say that the

---

[1]The setting is actually Ohio, not Kentucky.

branches of the tree on Sethe's back were a symbol of the strength that she gained due to the pain and anguish she endured. (CBN log, H99; March 5, 1999)

First, it is clear that this student has continued to make links from the picture of the enslaved man's scarred back to the second Baobob tree referent. The CBN made it easy to move back and forth between data sets and to revisit one's answer to each question. Second, this student maintains across the answer an analogic stance that connects the two images and the text. She reasons metaphorically, as when she powerfully remarks, "Sethe is a leaf on her mother's branch." The student has clearly entered the cultural practice of literary response in her ability to hold simultaneously two competing, but complimentary interpretations; that is, the scars are both a symbol of pain or anguish as well as a symbol of strength.

The CBN allowed our team to make use of unique semiotic potential of digital technologies. First, the architecture of the tool allowed us the flexibility to create content that was culturally responsive to the students who would use it, while constraining a cognitive focus on argumentation. In addition, the process of creating that content itself sparked a learning process for teachers and university-based researchers together. This is consistent with the inherently dialogic nature of tool use (Cole, 1996; Vygotsky, 1987; Wertsch, 1991). We learned, students learned, the original designers of the tool learned, and the tool itself became appropriated in ways not originally considered by its designers. Something as simple as the sometimes satiric, sometimes metaphoric nature of passwords students created became interesting windows into the ways they personally appropriated the tool: *Mr. Big Boss, Infinite Dreams*. Second, the tool allowed students to manipulate media that would be difficult to access outside a digital environment. In those cases where students responded to video and audio data, they were able to control their access in ways not achievable if the teachers were showing the video using a VCR or music on a tape recorder. Of particular interest was how students exerted the flexibility of moving back and forth between cases, between multimedia data sets, in essence controlling their access in ways very different from what we saw in face-to-face discussions. This became particularly useful for students who had more difficulty in class or who would not compete for the sometimes competitive floor of classroom discussions. Students would literally talk aloud to themselves and to the computer screens, using a kind of egocentric speech in the Vygotskian sense (1987) to direct their internal problem solving processes.

OTHER CULTURALLY RESPONSIVE DESIGNS IN TECHNOLOGY USE

The New London Group (1996) calls for 21st century multi-literacies because the medium through which much information is communicated is multimedia. Students must understand the hidden messages and points of view in visual, spatial, and audio media, with special sensitivities to language use and gesture. The group calls for conscious design work that attends to elements that are linguistic, audio, spatial, gestural, and visual. The group says that students must learn to take on multiple perspectives, to critique and understand competing points of view.

In many respects, Pinkard's (2000, 2001) position that we need to consider the cultural implications (i.e., engagement, taking on points of view, invitations for participation) of *interface design* is very relevant to the propositions of the New London Group. In the interface of "Say, Say, Oh Playmate," Pinkard (1999) addressed all five of the design elements raised by the New London

Group. What is communicated by this interface does seem to impact how, for example, little African–American girls see themselves within the subjunctive world constructed inside "Say, Say, Oh Playmate." See Figure 5 for an opening screet shot of "Say, Say, Oh Playmate."

In field tests of "Say, Say, Oh Playmate," Pinkard (1999) reported the response of two African–American girls working together with the program. Vernae and Shonda describe Sam, the imaginary little girl standing in front of the housing project on the screen in Figure 5:

> Vernae: Who's that girl? …
> Shonda: That's Vernae ain't it? …
> Vernae: She's pretty so it's going to be me (she points to herself and she has a big smile on her face).

Later in the same dialogue, the girls propose entering the imaginary house on the screen (based on the public housing project in which they lived):

> Nichole [Pinkard]: What you gonna do inside?
> Vernae: Eat (laughter). I did all of this work. Now it is time for you to feed me; then do my homework.
> Abby: You want to do your homework?
> Vernae: Yeah. What you think she [referring to Sam on the screen] has her bookbag for?

In addition to the interface, culturally responsive design should also consider the semiotic potential of the *activity structure*. Activity structures in our designs can be responsive to cultural diversity. Activity structures (Leontiev, 1981), including discourse patterns that are enacted within such structures, help to socialize participants into knowing what game is being played and what roles they are expected to play. What students' think they are doing has much to do with how they participate, how much effort they exert. For example, Gutierrez and colleagues (Gutierrez, Baquedano-Lopez, & Tejeda, 1999) acknowledged that one of the appeals in the Fifth Dimension Project (Cole, 1996) is that students see themselves playing games. Play is a powerful activity
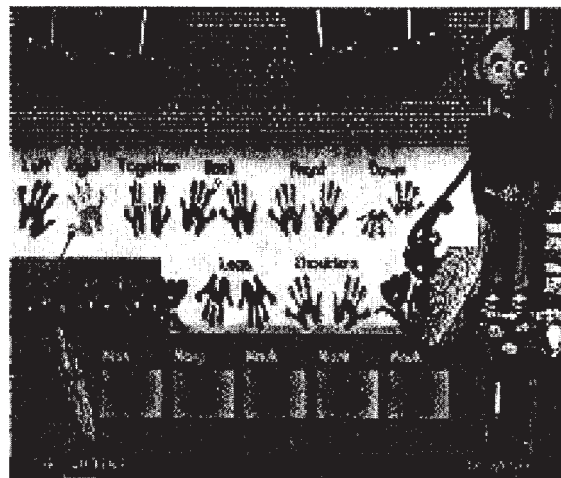

FIGURE 5   Screen shot from Interface *Say, Say, Oh Playmate* (Pinkard, in press).

structure for children. Certainly the developmental literature and many best practices in early childhood education make this claim. Using the framework of goal-based scenarios (Schank, 1992), Pinkard's design in "Rappin Reader" and "Say, Say Oh Playmate" draw on activity structures that students from African–American low income urban centers engage in as routine practice, and which such students value as engaging. For "Rappin Reader," students are asked to reconstruct rap lyrics and to write their own raps based on patterns of songs in the system. For "Say, Say, Oh Playmate," students are asked to reconstruct clapping songs, such as Miss Mary Mack. Both programs teach early phonemic and word recognition skills. In field-testing both programs, students made statistically significant pre-post gains in sight vocabulary recognition.

In another sense, tools that are designed to help students program, such as versions of Logo and many of the programmable robots and tools being created at the MIT Media Lab (Papert, 1993; Resnick, 1994), also are based on the assumption that activity structures make a difference, especially in game format for children. Paula Hooper (1996) demonstrated the ways that students adapt such tools in culturally responsive ways. In Hooper's study, children brought their cultural models as resources to construct objects and represent people in an imaginary narrative world they created. Hooper conducted longitudinal research in an African centered elementary school in Boston where students used Logo Writer to develop programming skills and strategies in order to construct and animate stories they wrote. Hooper documented how students appropriated collaborative practices based on the principles of the Nguzo Saba[2] as resources in how they made programming decisions. In addition, Hooper has documented the AAEV discourse norms and cultural scripts the students incorporated into their narratives, including how they chose to animate characters and scenes. Hooper's research provides a fascinating example of the ways in which the openness and the power of the tool to support imagination can be culturally responsive. Students from very different backgrounds can all use Logo Writer to design representations of stories they want to tell in culturally specific ways, while they all are able to explore a common array of mathematical and programming ideas and procedures. This way of thinking about design relates well to Pinkard's (2000) argument for a common cognitive structure in the architecture of a computer-based environment, while allowing for diversity in terms of activity structures and interface. This is precisely what she has done with the Lyric Reader Architecture that underlies "Rappin Reader" and "Say Say Oh Playmate." The Lyric Reader Architecture allows designers to reinforce the same cognitive supports using different activitiy structures and different interfaces that are responsive to different audiences of users. This is different from a purely constructivist approach to design which implies that active engagement in open-ended activities are inherently engaging.

IMPLICATIONS

The argument of this article that the design of learning environments, including the use of computer-based tools, needs to take issues of culture into account is important for several reasons. First, a cultural orientation in educational design can contribute to our efforts to build situated theories of

_____

[2]The Nguzo Saba are seven principles that form the foundation for the celebration of the African American holiday of Kwanzaa: Unity, Self- Determination, Collective Work and Responsibility, Cooperative Economics, Creativity, Purpose, and Faith.

learning. From the perspective of theory building, current orientations assert that participants, context, and task are important if we are to understand the complexity of learning and that our designs should take that complexity into account. The dominant cognitive research literature on educational design rarely specifically addresses the significance of whether players are African American, Puerto Rican, Mexican American, or Laotian, whether those players are speakers of English or persons for whom English is a second language or who speak a "nonstandard" variety of English. However, I argue that who these people are, how they culturally identify themselves, is not an irrelevant consideration in our design decisions. What we are to make of culture as experienced through ethnicity, race, and language variation—what knowledge, beliefs, goals emerge from these group based experiences—is not clearly understood. It is very important to acknowledge that the discipline of Black Psychology has addressed such issues for almost 30 years (Boykin, 1994; McAdoo & McAdoo, 1985; Nobles, 1980).[3] However, unfortunately, the dominant literature in the cognitive sciences acts as though this body of research simply does not exist. Very rarely do major "mainstream" texts with a cognitive orientation even cite researchers from the traditions of Black Psychology.

Second, this argument is important not only for the design of learning environments broadly speaking, but especially for the design of educational computer tools. There are a number of examples across disciplines of designers who have taken issues of culture into account, but do not involve uses of technology (Ball, 1992; Fuson, Smith, & Lo Cicero, 1997; Lee, 1993, 1995; Mahiri, 1998; Moses, Kamii, Swap, & Howard, 1989; Silver, Smith, & Nelson, 1995; Tharp & Gallimore, 1988; Zavlasky, 1996). However, there are few exemplars that involve the design or uses of computer-based educational tools (Hooper, 1996; Pinkard, 1999; Shaw, 1996). We know there are serious issues of equity in terms of computer uses in schools serving students of color and students living in poverty. Such students are more likely to have less access to high-end hardware and are more likely to use computers for low-level tasks. Yet, to assume that the many sophisticated constructivist, knowledge-rich, computer-based tools currently being used in schools are culturally neutral may steer us to miss important basic questions.

Third, the methods by which we evaluate how such computer-based tools are appropriated and their impact on learning, on the whole, do not take into consideration differential effects for groups that differ by ethnicity, race, language use, or class. It is quite possible that the tremendous funding being invested in the development of such computer-based tools in education may be simply reinforcing current inequities in opportunities to learn, unintentionally widening the achievement gap.

Finally, I want to respond to an often cited critique of culturally responsive approaches—that is, that it is cumbersome, if not impossible, to address the breadth of cultural diversity, for example, within the United States. In this case, computer-based technologies offer unique opportunities. Computer-based tools can provide underlying architectures that allow for multiple forms of modeling, of ways that learners can represent their understanding, and multiple routes for interactivity and appropriation. In the case of tools such as the Lyric Architecture developed by Pinkard (2000) and the CBN described in this article, teachers, for example, can create content, structure tasks, and in some cases create interfaces that can be adapted to local audiences. In the case of such tools as Logo Writer, as demonstrated by Hooper (1996), students can appropriate the

---

[3]The *Journal of Black Psychology* has been a major source for publishing research in Black Psychology.

tools for representation—sounds, images, opportunities to create colors and shapes, and so forth—and methods of interaction that are responsive to cultural differences.

The proposition for design as a culturally responsive practice and the example of the Cultural Modeling Framework are intended to at least suggest that our fundamental understandings about learning and about uses of technology to support learning can be expanded meaningfully by at least placing the question of culture at the center of our practice.

ACKNOWLEDGMENTS

REFERENCES

Ascher, M. (1991). *Ethnomathematics: A multicultural view of mathematical ideas*. Pacific Grove, CA: Brooks/Cole.

Ball, A. F. (1992). Cultural preferences and the expository writing of African-American adolescents. *Written Communication, 9*(4), 501–532

Boykin, A. W. (1994). Harvesting culture and talent: African American children and educational reform. In R. Rossi (Ed.), *Educational reform and at risk students* (pp. 116–138). New York: Teachers College Press.

Brofenbrenner, U. (1979). *The ecology of human development: Experiment by nature and design.* Cambridge, MA: Harvard University Press.

Bryson, M., & de Castell, S. (1996). Learning to make a difference: Gender, new technologies, and in/equity. *Mind, Culture, and Activity, 3,* 119–135.

Carey, S., & Gelman, R. (1991). *The epigenesis of mind: Essays on biology and cognition*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Cazden, C. (1988). *Classroom discourse: The language of teaching and learning.* Portsmouth, NH: Heinemann.

Cazden, C., John, V. P., & Hymes, D. (1972). *Functions of language in the classroom.* New York: Teachers College Press.

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

Cole, M. (1998). Can cultural psychology help us think about diversity? *Mind, Culture, and Activity, 5,* 291–304.

Cole, M., & Scribner, S. (1981). *The psychology of literacy*. Cambridge, MA: Harvard University Press.

D'Andrade, R. (1987). A folk model of the mind. In D. Holland & N. Quinn (Eds.), *Cultural models in language and thought* (pp. 112–147). New York: Cambridge University Press.

Edelson, D. C., & O'Neill, D. K. (1994). The co-vis collaboratory notebook: Supportive collaborative scientific inquiry. *Proceedings of the National Educational Computing Conference* (pp. 146–152). Eugene, OR: International Society for Technology in Education.

Engeström, Y., Miettinen, R., & Punamaki, R.-L. (1999). *Perspectives on activity theory*. New York: Cambridge University Press.

Forman, E., & Larreamendy-Joerns, J. (1998). Making explicit the implicit: Classroom explanations and conversational implicatures. *Mind, Culture, and Activity, 5*, 105–113.

Fuson, K., Smith, S., & LoCicero, A. (1997). Supporting Latino first graders' ten-structured thinking in urban classrooms. *Journal for Research in Mathematics Education, 28,* 738–760.

Goslee, S. (1998). *Losing ground bit by bit: Low-income communities in the information age*. Washington, DC: Benton Foundation.

Gutierrez, K., Baquedano-Lopez, P., & Tejeda, C. (1999). Rethinking diversity: Hybridity and hybrid language practices in the Third Space. *Mind, Culture, and Activity, 6,* 286–303.

Hodges, D. C. (1998). Participation as dis-identification with/in a community of practice. *Mind, Culture, and Activity, 5,* 272–290.

Hooper, P. K. (1996). "They have their own thoughts": A story of constructivist learning in an alternative African-centered community school. In Y. Kafai & M. Resnick (Eds.), *Constructionism in practice: Designing, thinking, and learning in a digital world* (pp. 241–255). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

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

Jones, R. (1980). *Black psychology*. New York: Harper & Row.

Kafai, Y. B. (1996). Electronic play worlds: Gender differences in children's construction of video games. In Y. B. Kafai (Ed.), *Constructionism in practice: Designing, thinking, and learning in a digital world* (pp. 97–124). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Kindred, J. B. (1999). "8/18/97 Bite me": Resistance in learning and work. *Mind, Culture, and Activity, 6,* 196–221.

Ladson-Billings, G. (1994). *The dreamkeepers*. San Francisco: Jossey-Bass.

Lave, J., & Wenger, E. (1991). *Situated learning*. New York: Cambridge University Press.

Lee, C. D. (1993). *Signifying as a scaffold for literary interpretation: The pedagogical implications of an African American discourse genre* (Research Report Series). Urbana, IL: National Council of Teachers of English.

Lee, C. D. (1995). A culturally based cognitive apprenticeship: Teaching African American high school students' skills in literary interpretation. *Reading Research Quarterly, 30(*4), 608–631.

Lee, C. D. (1997). Bridging home and school literacies: A model of culturally responsive teaching. In J. Flood, S. B. Heath, & D. Lapp (Eds.), *A handbook for literacy educators: Research on teaching the communicative and visual arts* (pp. 330–341). New York: Macmillan.

Lee, C. D. (1999). *Supporting the development of interpretive communities through metacognitive instructional conversations in culturally diverse classrooms.* Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Canada.

Lee, C. D. (2000). Signifying in the zone of proximal development. In C.D. Lee, & P. Smagorinsky (Eds.), *Vygotskian perspectives on literacy research: Constructing meaning through collabative inquiry* (pp. 191–225). New York: Cambridge University Press.

Lee, C. D. (2001). Is October Brown Chinese? A cultural modeling activity system for underachieving students. *American Educational Research Journal*, 38(1), 97–142.

Leontiev, A. N. (1981). The problem of activity in psychology. In J. V. Wertsch (Ed.), *The concept of activity in Soviet psychology* (pp. 37–71). Armonk, NY: Sharpe.

Lin, X. (1999). *Cultural continuity and technology artifacts: A case study of a 5th grade Hong Kong classroom*. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Canada.

Mahiri, J. (1998). *Shooting for excellence: African American and youth culture in new century schools.* New York: Teachers College Press and National Council of Teachers of English.

Matusov, E. (1996). Intersubjectivity without agreement. *Mind, Culture, and Activity, 3,* 25–45.

McAdoo, H. P., & McAdoo, J. L. (Eds.). (1985). *Black children: Social, educational and parental environments.* Beverly Hills, CA: Sage.

Minstrell, J. (1989). Teaching science for understanding. In L. B. Resnick & L. E. Klopfer (Eds.), *Toward the thinking curriculum current cognitive research* (pp. 129–149). Alexandria, VA: ASCD Books.

Mitchell-Kernan, C. (1981). Signifying, loud-talking and marking. In A. Dundes (Ed.), *Mother wit from the laughing barrel* (pp. 310–328). Englewood, Cliffs, NJ: Prentice Hall.

Moll, L., & Greenberg, J. B. (1990). Creating zones of possibilities: Combining social contexts for instruction. In L. Moll (Ed.), *Vygotsky and education: Instructional implications and applications of sociohistorical psychology* (pp. 319–348). New York: Cambridge University Press.

Morrison, T. (1987). *Beloved.* New York: Alfred A. Knopf.

Moses, R. P., & Cobb, C. (2001). *Radical equations: Math literacy and civil rights.* Boston, MA: Beacon.

Moses, R. P., Kamii, M., Swap, S. M., & Howard, J. (1989). The algebra project: Organizing in the spirit of Ella. *Harvard Educational Review, 59*(4), 423–443.

Nasir, N. (2000). "Points ain't everything": Emergent goals and average and percent understandings in the play of basketball among African-American students. *Anthropology and Education Quarterly*, *31,* 283–305.

Nobles, W. (1980). African philosophy: Foundations for Black psychology. In R. L. Jones (Ed.), *Black psychology* (2nd ed., pp. 23–36). New York: Harper & Row.

Nunes, T., Schliemann, A. D., & Carraher, D. W. (1993). *Street mathematics and school mathematics.* New York: Cambridge University Press.

Palinscar, A., & Brown, A. (1984). Reciprocal teaching of comprehension- fostering and comprehension-monitoring strategies. *Cognition and Instruction, 2*(2), 73–109.

Papert, S. (1993). *The children's machine*. New York: Basic Books.

Phillips, S. U. (1983). *The invisible culture: Communication in classroom and community on the Warm Springs Indian Reservation*. New York: Longman.

Pinkard, N. (1999). *Learning to read in culturally responsive computer environments*. Ann Arbor, MI: Center for the Improvement of Early Reading Achievement.

Pinkard, N. (2000). Lyric reader: Architecture for creating intrinsically motivating and culturally relevant reading environments. *Interactive Learning Environments, 7,* 1–30.

Pinkard, N. (2001). Rappin' Reader and Say Say Oh Playmate: Using children's childhood songs as literacy scaffolds in computer based learning environments. *Journal of Research on Computers in Education, 25*(1).

Rabinowitz, P. (1987). *Before reading: Narrative conventions and the politics of interpretation.* Ithaca, NY: Cornell University Press.

Resnick, M. (1994). *Turtles, termites and traffic jams: Exporations in massively parallel microworlds.* Cambridge, MA: MIT Press.

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford University Press.

Rogoff, B. (1994, Fall). Developing understanding in the idea of communities of learners. *Mind, Culture, and Activity, 1*, 209–229.

Rogoff, B., & Lave, J. (Eds.). (1984). *Everyday cognition: Its development in social context*. Cambridge, MA: Harvard University Press.

Rosebery, A. S., Warren, B., & Conant, F. R. (1992). Appropriating scientific discourse: Findings from language minority classrooms. *The Journal of Learning Sciences, 2*(1), 61–94.

Rumelhart, D. (1980). Schemata: The building blocks of cognition. In R. Spiro, B. Bruce, & W. Brewer (Eds.), *Theoretical issues in reading comprhension*, (pp. 33–58). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Sadoski, M., & Paivio, A. (2001). *Imagery and text: A dual coding theory of reading writing.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Salomon, G. (1993). *Distributed cognitions: Psychological and educational considerations*. New York: Cambridge University Press.

Saxe, G. (1991). *Culture and cognitive development: Studies in mathematical understanding*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Schank, R. (1992). *Goal-based scenarios (Technical Report No. 36).* Evanston, IL: Institute for the Learning Sciences/Northwestern University.

Schank, R., & Abelson, R. (1977). Scripts, plans, goals, and understanding. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Serpell, R., & Boykin A. (1994). Cultural dimensions of cognition: A multiplex, dynamic system of constraints and possibilities. In R. J. Sternberg (Ed.), *Thinking and problem solving* (pp. 369–408). San Diego, CA: Academic.

Shade, B. (1982). Afro-American cognitive style: A variable in school success. *Review of Educational Research, 52,* 219–244.

Shaw, A. (1996). Social constructionism and the inner city: Designing environments for social development and urban renewal. In Y. Kafai (Ed.), *Constructionism in practice: Designing, thinking, and learning in a digital world* (pp. 175–206). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Silver, E., Smith, M. S., & Nelson, B. S. (1995). The QUASAR Project: Equity concerns meet mathematics education reform in the middle school. In W. Secada, E. Fennema, & L. B. Adajian (Eds.), *New directions for equity in mathematics education* (pp. 9–56). New York: Cambridge University Press.

Smitherman, G. (1977). *Talkin and testifyin: The language of Black America*. Boston: Houghton Mifflin.

Tharp, R., & Gallimore, R. (1988). *Rousing minds to life: Teaching, learning, and schooling in social context*. New York: Cambridge University Press.

The New London Group. (1996). A Pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review, 66,* 60–92.

Vygotsky, L. (1987). *Thinking and speech.* New York: Plenum.

Weiner, B. (1985). An attributional theory of achievment motivation and emotion. *Psychological Review, 92,* 548–573.

Wertsch, J. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.

Zaslavsky, C. (1996). *The multicultural math classroom*. Portsmouth, NH: Heinemann.