Exploring the Effects of Learners' Cultural And Social Histories on the Practices of Learning Scientists

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Abstract: Research on how learner's cultural and social histories mediates opportunities to learn with computer-based learning tools is seriously under-conceptualized in the field of learning sciences. I argue, that in order for learning scientists to create theories of learning and/or learning tools that provide equitable opportunities to learn for all learners, the field needs to rethink how learners' social and cultural histories impact the conceptualization of questions we explore, the population of users upon which we study the phenomena we are exploring, our process of design and or methods of analyzing the effectiveness of our designs. All facets of our research process need to be reexamined to ensure that our theories and designs are inclusive of the nuances of human experiences influenced by learners' social and cultural histories.

Some people believe it possible to draw on aspects of cultural experience to facilitate some form of teaching and learning. When we try to do this, however, it's a shot in the dark. We don't really understand what that nexus is about. It would be incredibly important to have a kind of cultural analysis, a linguistic analysis, even collaboration from the worlds of entertainment and design, to help us think about how to design systems that make meaningful contact to cultural experience so that people learn better. (Louis Gomez in an address to the National Science Foundation)

Problem

Below I argue, that in order for learning scientists to create theories of learning and/or learning tools that provide equitable opportunities to learn for all students, the field needs to rethink how learners' social and cultural histories impact the conceptualization of questions we explore, the population of users upon which we study the phenomena we are exploring, our process of design and or methods of analyzing the effectiveness of our designs. All facets of our research process need to be reexamined to ensure that our theories and designs are inclusive of the nuances of human experiences influenced by learners' social and cultural histories.

As a learning scientist by training and a socialcultural researcher in training I have often been torn by the theoretical overlapping of ideology but disconnect in practice that exists between these two research communities. As a learning scientist I am concerned with creating learning environments that are pedagogically sound, enhance learning and build upon children's prior knowledge. As a sociocultural researcher, I am focused on understanding how who we are as people influences how we learn and interact and make sense of the world and the tools that we use to mediate our interaction in the world. In theory these two research communities appear to have common concerns. However, a deeper analysis of the practices of these research communities reveals that because each starts from a different unit of analysis, their research findings never quite inform the practices of each other. In this paper, I argue that, particularly for the field of learning sciences, as more and more of the learning science research moves from the laboratory to the diversity of real-word classrooms, there are lessons to learn from sociocultural theory that can enable technologies designed by learning technologists to speak to all students in the classrooms in which we enter.

Different Unit of Analysis

Issues of culture as defined by race, ethnicity, gender, and nationality have not figured heavily in learning sciences research because the paradigms upon which most learning sciences research are developed do not intently regard issues of culture as foundational factors influencing all aspects of teaching and learning. Zerubavel (1997) in Social Mindscapes argues that research exists on a continuum from focusing on what makes us unique as individuals to what binds us a human beings. Where a disciplines focus is placed on this continuum dictates the research questions that researchers in that discipline find worth focusing. A discipline focused on understanding what makes us unique as individuals does not explore questions about what we all have in common while a discipline interested in what binds us a human beings does not explore what makes us unique.

As a Learning Sciences graduate student, cognitive science, computer science (artificial intelligence) and education formed the three pillars of my interdisciplinary training. I was taught to design innovative technologies (computer science) that combined theories of how humans learn (cognitive science) with pedagogically sound educational instructional theories. Through this training, I learned to observe human behavior in hopes of abstracting away the commonalities of human thinking in order to develop generalizable rules and procedures to form the basis of new learning tools. In essence to design new systems I looked for what was most common in human action not what was different. This focus on the common, I argue, is a component of the learning science because the field of learning sciences is a product the fields of cognitive science and artificial intelligence. Artificial Intelligence and Cognitive Science has traditionally focused on how humans "think" in order to develop tools (both theories and technologies) that can simulate the human thinking process. As a result of having the end goal as the development of tools that can simulate thinking, research in these fields have focused on the commonalities of the human mind in order to ascertain generalizable principles that can serve as the basis of theories and computer-based learning environments.

I argue that because Learning Sciences comes out of the disciplines of Artificial Intelligence and Cognitive Science that there is still a focus, albeit unconscious at time, on how we are alike rather than how we are different. I contend that this focus leads to the development of technologies that are geared toward the cultural and social mainstream of society, present themselves as designed for all. When terms such as culture are used they are often used at more of a meta level such as classroom culture, scientific culture, that allow learning scientist to still think about the commonalities of students within a context. As a learning scientist, I didn't realize that my view of "common human action" was predicated on the cultural and social composition of the student whom I observed. While my learning science training made we aware of the important of the "context" in which I situated learning, it did not make me as conscious of the importance of examining the differences in people who were situated within these "learning context". As an African American female designer, I designed learning technologies based upon my experiences. So while I designed technologies for audiences with similar experiences, I did not consciously think about how these experiences were different from other social and cultural groups. Nor did I consciously attempt to understand the implications of these differences on the design process. My conscious awareness and exploration of these differences and their implications came about based upon my readings of sociocultural theory.

As a sociocultural researcher I am concerned with understanding the relationship between human mental functioning and the cultural, institutional, and historical situations in which mental functioning occurs (Wertsch, 1995). Thus, I am acutely focused on differences in how members of different social and cultural groups approach a problem, become engaged with a problem and understand a problem. In essence, I want to examine how our cultural and social affiliations are influencing our interactions. The sociocultural frame of reference leads me to examine questions related both to understanding the mediating influence of culture on the design, use, and evaluation of educational technologies, and to how educational technologies can serve as tools to enable teachers to use students' cultural and social histories as instructional aids.

In this paper, I explore the ways in which research conducted to understand the mediating role of culture in learning and teaching, can inform the design and implementation of computer-based learning tools. First, I will define my use of the word "culture". Second, I explore the invisibility of culture in the

design and implementation of learning tools. Third, I explore the causes and consequences of culture being invisible in the design and implementation process. Fourth, I reflect on how I infused culture into the design of Lyric Reader applications, a tool to build beginning literacy computer-based learning environment. Finally, I put forward a beginning list of guiding questions that designers could ask themselves when developing learning tools to become cognizant of their own cultural assumptions.

Definition of Culture

Cultural is a set of practices. These practices are historically inherited as traditions that are reinforced through institutions, such as family, church, schools, communities, and workplaces. As well, these practices are socially mediated and negotiated through interpersonal relationships, among individuals, in pairs, and in groups (Cole, 1996). At the level of the individual, such practices also may be mediated as goals of the individual that lead to an interaction with tools (e.g., hammers, computers, television). These practices incorporate beliefs (e.g., conceptual models, schemas, scripts) and values (e.g., habits of mind, likes, dislikes). Most of the time, these practices are mediated through language use (be it oral or silent use of natural language, or use of symbolic language systems, such as mathematics, or musical notation, or graphic conventions in the visual arts). Traditions of cultural practices usually inhere in group formations. Such group formations may have historical character. These group formations may also be defined by ethnicity, race, language use, gender, social economic status, and/or religion (Lee, 1994).[1]

Culture As A Mediating Tool

The importance of explicitly considering culture in the design of computer-based learning tools is a critical issue to ponder. A review of the histories of technological interventions reveals that new technologies often serve as vehicles for the silenced and disempowered to express their voice. For example, the advent of the printing press provided opportunities for the masses to learn to read and for ideas to be shared beyond the confines of space and time. If a class is given a book report assignment today, the probability of students turning in a report on the same book is minimal because students have choices. The diversity in their backgrounds, interests, and prior experiences combines to lead students, given choices, to select different books. Students' idiosyncratic cultural backgrounds influence not only book choices but also music, movie, food, and dress choices. For example, the invention of records, radio, and MP3 has created new choices in music. The invention of first, broadcast television; later, cable; then, satellite; and now, the Internet has increased our television viewing options. Today, when I want news, I can pick from a range of options, from local to national channels. If I want to watch a NBA basketball game, I have the choice of watching my favorite team via a local channel or subscribing to the NBA-only basketball channel. In essence, technological advances have enabled the creation of technological tools to serve as mediums through which individuals can select programming that fits their cultural preferences.
I would argue that while many advances have been made in computer-based learning tools, the field has not progressed to the point of allowing all individuals to select and use learning tools that are based upon their cultural backgrounds. Using the television analogy, if a student wants to learn math, in most classrooms there is only one channel (learning tool) available. Therefore, the student is left without choices, because changing the channel is not an option. The student can either continue to interact with the software program that is not designed around his or her cultural background or turn off the channel. Neither option is an optimal learning environment.

As the field of educational technology matures, we need to move beyond the one channel and begin to provide students with choices. However, the creation of more channels requires an examination of how culture is and should be infused throughout the design and implementation process.

Culture and the Design Process

There are many different metaphors used to describe the Design Process. In this paper, I will use Schön's (1987,1990) metaphor of "reflective conversation with the situation" to describe the design process. According to Schön, the reflective conversation, or dialogue, begins when the designer makes an initial interpretation of the design situation. Schön calls this the "framing" of the problem. The framing of the problem drives the designer's generation and selection of "design proposals," or options for subsequent actions. Working from the interpretation of the situation, the designer then *acts* on the situation (i.e., manipulates the design representation, such as a drawing or model), and then *reflects* on that action. The

designer must again assess the situation to determine a next action. Hence, this view emphasizes the ways in which the designer perceives and interprets the situation.

I argue that as designers engage in reflective conversations, their actions are implicitly influenced by their cultural histories. Because these decisions are based within designers' cultural histories they often go unnoticed and therefore their impact, both positive and negative, are not critically examined in our research studies. An analysis of educational technology journals finds few if any articles that explore the question of how the culture(s) of the designer and/or user affects the development, design, and implementation of computer-based learning tools. One might ascertain from this silence that the cultural diversity represented in classrooms is irrelevant to the design process or that learning tools are being developed to be culturally neutral. However, I argue that the concept of culturally neutral computer-based learning tools is an oxymoron, since throughout the design process, all learning tools are shaped by implicit cultural assumptions made by the design team regardless of whether the design team is aware of the cultural assumptions. I argue that as designers, we often take the cultural connection between learners and our learning tools for granted and that consequently, not all learners are afforded optimal learning opportunities. In addition, because we take cultural connections for granted, issues related to the cultural influences on learners' ability to use our tools to mediate learning are often not included in our discussions regarding the effectiveness of our learning tools. When issues of culture are discussed, they are often discussed in relation to social factors, such as the context in which our learning tools are embedded or how teachers use our learning tools to engage all learners. Many times our learning tools are treated as black boxes around which teachers, learners, and environment must adapt. Pea (1983) in reflecting on how design decisions constrain learners' use of Logo stated:

> Considerable intelligence has been built into these interpart relations as a means of constraining what actions are possible with the parts in combination. We often can see teacher's interventions (a kind of social distribution of intelligence contributing to the learner's achievement of activity); the designers' interventions (a kind of artifact-based intelligence contributing to the learner's achievement of activity) are not seen, were somehow not viewed as affecting the terms of the constructionist argument. The learner was not engaged in solitary discovery, he or she could be scaffolded in the achievement of activity either explicitly by the intelligence of the teacher, or implicitly by that of the designer's now embedded in the constraints of the artifacts with which the learner [is] playing.

In essence, implicit cultural assumptions held by designers invisibly constrain how students and teachers interact with our technologies. Thereby, they limit our ability to engage in conversations about the ways in which *who* we are as designers and students influence the ability of the tool to serve as a learning mediator. The distributed cognition literature tells us that embedded design assumptions influence greatly what a user is able to accomplish with learning tools. According to theories of distributed cognition, intelligence is not just in the individual but is distributed between the learner and the tools in his or her environment. Thus, care must be taken to ensure that the learner's surrounding environment is embedded with tools and resources that he or she can use to mediate thought and actions. Explicit in this definition of distributed cognition has to be the notion of embedded cultural affordances into tools and resources. After all, a tool is an embodiment of cultural practice. The successful use of the tool presupposes a cultural connection between the user and the tool, and the successful use of the tool as a mediating artifact is dependent on the user's understanding of the tool's affordances.

Consequences of Invisible Design Decisions

The consequences of a lack of awareness by researchers and designers of their cultural assumptions and the framework for how culture can influence design can result in a cultural disconnect between designers of learning tools and their intended audiences, which leads to unachieved learning goals and lack of student engagement. Research shows that students use their cultural prior knowledge to make sense and use of the tools that mediate their interactions with the world (Rogoff,1995; Vygotsky, 1978). Therefore, the more the mediating tools draw from the cultural prior knowledge of the student, the more likely the student is able to use the tool for its intended purposes. However, given the growing diversity in classrooms and the continued silence regarding culture and design, it is highly possible that learning tools

perceived as designed for all by the design team are perceived as "designed for some" by students. Pinkard (2003), in a software preference study conducted in an urban elementary school, found that second grade boys and girls seldom perceived software as culturally neutral. Students perceived software as designed either for boys or for girls. Seldom did students perceive software as designed for both boys and girls. These gender perceptions of software influenced students' software preferences. Favorite software titles for girls were programs that they viewed as designed for girls. None of the programs favored by girls were viewed by them as designed for boys. The same holds true for the boys' favorite programs. That software is not culturally neutral is also reflected in the continued gap in the number of women and minorities taking computer-related courses in high school and pursuing computer-related majors in college and graduate school.

I argue that because researchers' and designers' cultural assumptions are not placed on the table when trying to understand why a learning tool successfully or unsuccessfully mediates student learning, the object of the question becomes students, teachers, and the environment. This is evidenced through research questions, such as:

> Did students find learning tool engaging?
> Did students understand task?
> Did students' prior knowledge enable effect use of the tool?
> Did teachers effectively integrate learning tool into instruction?
> Are teachers' teaching practices aligned with the pedagogy of learning tool?

In each of these questions, the learning tool is held constant and the actions, beliefs and practices of the student and or teacher are examined for answers as to why the learning tool was successful or unsuccessful. I argue that an approach that makes visible the designers' design decisions would alter the questions to ask the following:

> Did the learning tool engage the student?
> Did the learning tool effectively scaffold the student through the tasks?
> Did the learning tool pull from student prior knowledge?
> How did the learning tool map onto the teachers' instructional practices?
> Did the learning tool scaffold teacher in adapting new approach to teaching?

By asking the questions in this manner, design decisions become more visible and debatable. For instance, if one attempts to answer these questions after looking at girls and boys used a learning tool, one might get different answers to the question of whether the learning tool engaged the student. Such diverse answers can foster conversations as to which design decision led to differences in engagement between boys and girls.

Unfortunately, reflective conversations regarding culture and design decisions are few. Instead, our journal articles describe the theoretical framework of our learning tools, show snapshots of how the finished products relates to the framework, and then describe studies of learners (including learners of color) using the learning tools. Seldom do we wrestle in writing with our design tradeoffs or our attempts to design products for a diverse audience. Our discussions of our studies seldom reflect on software design decisions that have had a negative impact on learner learning. If our subjects do not achieve prescribed learning objectives, we seldom point to our design choices. Thus, designers[2] choices and tradeoffs remain invisible or unquestionable. I would argue that some of the most powerful lessons from our designs are embedded in our invisible design decisions. Making these design decisions visible and explicit can serve several goals, such as to develop design principles, to make designers cognizant of their implicit design decisions, and to establish conversations around how specific design decisions foster intended or unintended outcomes for all learners.

Examples of how to Make Culture Visible

To concretize how learners cultural and social histories can influence the design, use and evaluation of learning environments, in this section, In this section, I attempt to provide an example of how culture informs the design and development process regardless of whether it receives explicit or implicit

focus by examining the design and development of *Lyric Reader Authoring Tool* and it applications, *Rapping Reader, Camp Reader, Choral Reader, Animal Song Reader, Say, Say Oh Playmate (SSOP)*. While I am unable to step back in time to articulate my conceptual framework at the beginning of the design process, I am sure however, that while I have always viewed culture as a important design component, my understanding of the mediating power of culture has grown and developed greatly through the process of design and reflection.

Lyric Reader: An Example of Culturally Mediated Design

SSOP is built with the Lyric Reader Authoring Tool. It is designed to use the prior knowledge and conceptual models of girls who engage in playground games as scaffolds to develop their beginning literacy skills. While SSOP was designed to appeal to all girls, particular focus was given to its on appeal to African American girls. SSOP situates the literacy task within the familiar world of clap routines by having learners teach animated characters how to sing and clap those traditional clap routines. As students progress through the system, they are able to use SSOP to create original routines and to share their routines with girls from around the world through the SSOP Web site.

Examples of Culture as a Cognitive Scaffolds within Lyric Reader

Lyric Reader applications are based on the premise that children's existing oral language can serve as a powerful scaffold to develop beginning literacy skills. While reliance on familiar text can be a detriment in traditional methods of teaching children to read (Johnston, 1999), familiar text can serve as a powerful cognitive scaffold in Lyric Reader because of the design of the literacy activities. Lyric Reader applications are designed to have students use oral knowledge of how a song sounds to self-check their written representation of the lyrics. Specifically, the student's task is to place the lyrics of the song in order. Whatever configuration of lyrics the learner creates, the system "plays" back. So if a child using SSOP creates the line "Miss Mary black black black" the system will sing that line to the learner. We hypothesize that a student familiar with lyric can self-scaffold when they hear a song sung incorrectly because they will experience and expect failure and recognize that the song sounds wrong. In essence, their oral knowledge provides the cue that the lyrics are incorrectly constructed. Students who are not familiar with the lyrics will not be cued that the lyrics are incorrect. It is important to note that the SSOP system has other methods in place to scaffold students when their cultural capital is not able to act as an effective scaffold.

Studies of students using Lyric Reader applications have revealed different patterns of use by students familiar and unfamiliar with the song (Pinkard, 1998, 1999, 2001). Analyses of video and computer trace data revealed that students use SSOP differently depending on their familiarity with songs. All students needed to use cognitive scaffolds to construct lyrics successfully. However, the type of scaffolds used varied. Students familiar with songs were more likely to use their oral language as a scaffold, as demonstrated by the numbers of times students sang aloud lyrics. As demonstrated by transcript analysis, students familiar with songs were more likely to self-correct upon hearing the lyrics sung incorrectly. Students familiar with song were twice as likely to self-correct errors than students unfamiliar with the song.

Students unfamiliar with a song made use of scaffolds built into all Lyric Reader applications. For example, SSOP allows students to request to hear the entire song, segments of songs or individual words. Analysis of transcripts revealed that students unfamiliar with a song rely on an animated character for guidance by clicking to hear her sing the song. In addition, students unfamiliar with a song are less likely to self-correct upon hearing the song performed incorrectly. Instead, their correction of the lyrics were motivated by visual feedback received upon having the system check work.

It is important to note that although SSOP was built for students who are familiar with clap routines. Thereby, we expected students to be able to use their existing culture as cognitive scaffolds. We explicitly designed into SSOP scaffolds for students who come to SSOP without the necessary cognitive scaffolds.

Examples of Conceptual Models Embedded into SSOP

I have argued that as African American students engage in language play games (such as rapping, jump rope, and clapping), they invoke not only a set of strategies that can be adapted for learning to read written text, but also certain habits of mind and attitudes about language play. SSOP draws on a learner's familiarity with these activity structures. For instance, in the construct-a-clap-routine component of SSOP, learners who are familiar with clap routines apply different problem solving techniques than students unfamiliar with routines. Students familiar with routines understand that clap routines have a pattern. Certain claps are likely to appear together and the "together" clap often follows every clap. Students who are familiar with clap patterns often begin by placing a "together" clap in every other square and then focusing their energy on determining which claps belong in the other squares. Video footage of children interacting with SSOP with a partner show that learners often work through clap routines off-line before simulating their routines online.

It is important to note that the decision to include the construct-a-clap component in the design of SSOP was influenced by an understanding of the conceptual model. While reconstructing a clap routine is not central to developing beginning literacy skills, I believed that not including the clapping component would limit the cultural affordances of the system. We reasoned that to keep SSOP culturally meaningful, we needed to keep the agency for creating clap routine lyrics. Why create clap routine lyrics if no one is going to clap the routine?

Examples of Culture as a Vehicle for Increasing Engagement and Motivation

Lyric Reader applications were designed to engage children who often are viewed as uninterested in reading. Specially, the design task was to find culturally meaningful oral text to use as beginning literacy text. We hypothesized that engaging children in the act of reading text drawn from their cultural heritage would result in an increase in learners' motivation to engage in the act of reading the targeted text and, over time, develop students' agency to engage in the reading of all text. In essence, we wanted learners to begin to view reading as a necessary task that crosses all cultural barriers by helping them to see that the ability to read is a necessary skill for many culturally meaningful activities-even rappers need to know how to read.

Studies of Lyric Reader have revealed that decisions about *who* is represented in the interface have a profound impact on learners' engagement with the software. Analysis of videos shows that children try to make connections between themselves and the characters. Upon seeing the opening screen, two young African American girls ask a question about who is the character on the screen. The transcript below reveals their attempt to assign an identity to the character. Later, when completing the first task of reconstructing the lyrics, the girls engage in a conversation about going inside the house depicted on the screen. As the transcript below reveals, upon assuming the identity of the animated character, Vernae continued this identity throughout the program. Her decision to do her homework was predicated on the fact that the online character had a book bag, which meant that the character was planning to do homework. To further understand the effects of this video in current Lyric Reader studies learners were given the opportunity to create their own guide characters. Formative analysis of students' characters revealed that of 90 learner constructed guide characters 92 percent created same gender guide characters and 89 percent created same completion guide characters.

Conclusions

Making design decisions visible can foster conversations that lead to reflections and changes in design practices. One need only examine the resulting design discussions and reflections that sprang from Norman's *(1988) Psychology of Everyday Things*. Since reading this book, on several occasions when meet with poorly designed artifacts, such as doors and phones, I am instantly reminded of Norman's book. Often, instead of just accepting the poor design, I work on solving the problem of how the designer could have designed the system differently. For me, the awareness of how design constrains or affords actions and the reality that designers often get designs wrong, has shaped my approach to the design of learning tools. Instead of assuming that my designs are correct, I begin with the assumption that my designs are flawed. I

believe that this mindset leads to several design iterations and to my perspective that no one design is effective for all users.

However, I have found developing this mindset in my educational technology design students to be difficult. They seldom have a window into a designer's portfolio, rather they learn design by reflecting on the *successful* finished products rather than on a combination of the *successes* and the *failures*. While students are quick to point out weaknesses in others' designs, they are seldom willing to discuss openly the limitations of their own designs. I have found that only through my efforts to make my design successes and failures visible are students willing to engage in this reflective activity about their own designs and begin to see design as a process rather than as an end product.

I argue that the Learning Sciences community needs to begin to open our portfolios and share our design processes, including our successes and failures, in order to move the field forward in developing optimal learning environments. I emphasize that a component of making our design portfolios visible is open discussion of how we address issues of race, ethnicity, and language variation in our designs. The lack of an explicit consideration of the role of race, ethnicity, and language variation in design can lead to the development of learning tools that do not provide optimal learning opportunities or to research conclusions that mistakenly attribute difference in learning outcomes to students rather than to culturally disconnected learning tools.

References

Cole, M. (1996). Cultural psychology: a once and future discipline. Cambridge, Mass: Belknap Press of Harvard University Press.

Lee, C.D. (2003). Literacy, Technology and Culture. Giyoo Hatano & Xiaodong Lin (Special Guest Editors), Technology, Culture and Education, Special Issue of Mind, Culture and Activity.

Lee, C. (1994). "Signifying as a Scaffold for Literary Interpretation." Journal of Black Psychology 21(4): 357-81.

Lee, C. (1995a). "A Culturally Based Cognitive Apprenticeship Teaching African American High School Students Skills in Literary Interpretation." Reading Research Quarterly 30(4): 608-30.

Johnston, F.R. (1999). Word learning in predictable text. Journal of Educational Psychology. 92, 248-255.

Norman, D. (1988) Psychology of Everyday Things. New York : Basic Books

Pea, R. D. (1993d). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.). Distributed cognitions. New York: Cambridge University Press, pp. 47-87.

Pinkard, N. (2001) Rappin' Reader and Say Say Oh Playmate: Culturally Responsive Beginning Literacy Computer-based Learning Environment. Journal of Educational Computing Research, 25(1).

Pinkard, N. (2000) Lyric Reader: Architecture for Creating Intrinsically Motivating and Culturally Relevant Reading Environments. Interactive Learning Environments.

Pinkard, N. (1999) Learning to Read in Culturally Responsive Computer Environments. Center for the Improvement of Early Reading Achievement Report #1-013

Pinkard, N. (1998). Leveraging Background Knowledge to Build Beginning Literacy Skills. Education. Evanston Il, Northwestern University.

Rogoff, B. (1995). Observing sociocultural activity on three planes: participatory appropriation, guided participation, and apprenticeship. Sociocultural Theories of Mind. P. d. R. James V. Wertsch, & A. Alvarez. New York, NY, Cambridge University Press.

Schön, D. A. (1987). Educating the Reflective Practitioner. San Francisco: Jossey-Bass Publishers.

Schön, D. (1990). The design process. In V. Howard (Ed.), Varieties of Thinking (pp. 110-141). New York: Routledge.

Vygotsky, L. S. (1978). Mind in society. Cambridge, MA, Harvard University Press.

Wertsch, J. (1985) Culture communication, and cognition: Vygotskian perspective. New York : Cambridge University Press

Zerubavel E., (1997) Social mindscapes: an invitation to cognitive sociology. Cambridge, Mass. : Harvard University Press

Endnotes

(1) In a full paper, I will explain in more detail the definition of culture on which this work is based. Please see Lee (2003) for a rich description of the affordances of culture for design.

(2) Edelson's 2002 Journal of Learning Sciences article entitled *Design research: What we learn when we engage in design* provides an example of reflection on the design process.

(3) I do agree that designers reflect upon design decisions, however, we do not often make these reflections public. I argue that this lack of visible reflection is a constraint of our publication mediums.