2009

Culturally Responsive Applications of Computer Technologies in Education: Examples of Best Practice

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For more than a decade, scholars have identified culturally responsive pedagogy as a teaching method for improving the academic achievement of culturally and linguistically diverse students. Scholarly research on the intersection of culturally responsive teaching and educational technology, however, remains scant. The purpose of this literature review is to highlight research-based examples of culturally responsive applications and to provide recommendations for the design of technology-based learning environments.

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Introduction

For more than a decade, educators and scholars have identified culturally responsive pedagogy as a teaching method for improving the academic achievement of culturally and linguistically diverse students (Adams, 1995; Barba, 1993; Gay, 2000; Ladson-Billings, 1995a; Lee, 1997). Scholarly research on the intersection of culturally responsive teaching and educational technology, however, remains scant. While much of the education literature continues to focus on examining the four dominant uses of computers in schools—(1) drill and practice, (2) tutorial, (3) the computer as the subject of study, and (4) simulations (Harper, 1987; Streibel, 1998)—very little information exists on culturally responsive uses of technology in education.

The goal of this review is to examine the education literature in terms of the varying ways culture can be used to mediate how diverse learners might engage with various forms of computer technologies and digital environments to support instruction. The following sections highlight examples of culturally responsive teaching methods utilizing computers and related technologies. The models presented in this literature review represent exemplars of research-based, computer-based technologies, as well as a discussion on a new subfield in society and technology studies termed "ethnocomputing" (Eglash, Bennett, O'Donnell, Jennings, & Cintorino, 2006; Tedre, Kommers, Kähkönen, & Sutinen, 2006). A set of recommendations is offered for instructional designers to consider when creating culturally responsive software. We begin the review with a brief explanation of culturally responsive pedagogy.

Culturally Responsive Pedagogy

Culturally responsive pedagogy is an approach toward teaching designed to engage students intellectually, socially, emotionally, and politically by using cultural referents to develop knowledge, skills, and attitudes. The learner within this pedagogical paradigm is not merely a consumer of information, but rather s/he is a producer of knowledge intended to achieve academic success, cultural competence, and critical consciousness (Ladson-Billings, 1995b). Moreover, knowledge from a culturally responsive point of view is not static, but rather "shared, recycled, and reconstructed" (Ladson-Billings, 1995a, p. 481). What this means is: (a) the subject content must be presented enthusiastically, (b) scaffolds are used to facilitate learning, and (c) multiple methods of assessment are employed to acknowledge multiple forms of achievement (Ladson-Billings, 1994, 1995a, p. 481). In essence, culturally responsive teaching is counter to traditional teaching practices, such as rote memorization (e.g., tutorials), trial and error (e.g., drill and

practice), and the imparting of acontextual or abstract information. In the following sections, we identify meaningful uses of computer technology in education that are in accordance with culturally responsive pedagogy (Gay, 2000; Ladson-Billings, 1995b).

Culturally Responsive Computer-Related Technologies

The first example of a culturally relevant approach to computer related technology in education is *The Hispanic Math Project*, developed by the Technology Based Learning & Research Lab at Arizona State University. Funded by the National Science Foundation, *The Hispanic Math Project* was designed to teach 6th grade Latino migrant students introductory time, money, and geometric measurement concepts utilizing audio and video clips. Created to incorporate continual student-teacher feedback, this program introduces learners to constructs vis-à-vis extraterrestrial characters. In this instance, the culturally responsive design feature is the extended family in Latino culture, the student-option to view the tutorials in English or Spanish, and the lessons simulating real-world scenarios for learning and practicing concepts.

A second example of culturally relevant applications of computer technology in education is Nicole Pinkard's (2001) *Rappin' Reader*, which was created primarily for African-American males, and *Say, Say Oh Playmate*, which was created primarily for African-American females. Both programs were designed to use students' oracy as a scaffold for text. Students using *Rappin' Reader*, an interactive multimedia program, create individual rap lyrics for their favorite artist (see ***Figure 1***). Students' literacy is developed through reading, writing, and listening activities intended to emulate elements of the music production process. Using the "premiere room," students produce a music video containing an audio recording of their lyrics, along with clip art and captions of their lyrics to present to their fellow classmates (Pinkard, 2001). Pinkard (2001) discovered that all students experienced an increase in sight words. She also found that the percentage gain for Black students was higher than that of their White peers (19% for Black children vs. 13% for White children).

Say, Say Oh Playmate, on the other hand, consists of traditional handclap routines, such as 'Miss Mary Mack.' This software program requires students to reconstruct a familiar text and compose a song (see ***Figure 2***). In this instance, Pinkard (2001) found that learners made gains in their word-recognition skills and became motivated as a result of the culturally relevant interface. According to Pinkard (2001), students were motivated to learn because the program built upon their experiential knowledge and cultural experiences, which subsequently led to increased academic achievement and positive self-worth. In both cases the digital environment is an authentic reflection of the students' home and community environment. Moreover, the utilization of oral traditions (i.e., clapping routines) and Black vernacular (i.e., hip hop music) were relevant to the African-American community and assisted in the acquisition of sight vocabulary.

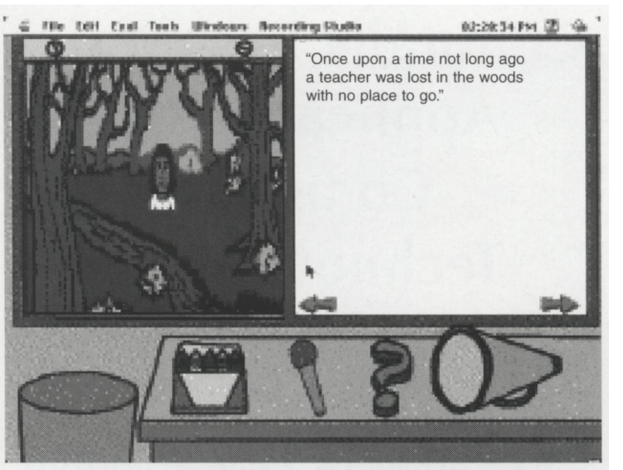

Figure 1. *Rappin' Reader:* The user is tasked to create a music video.

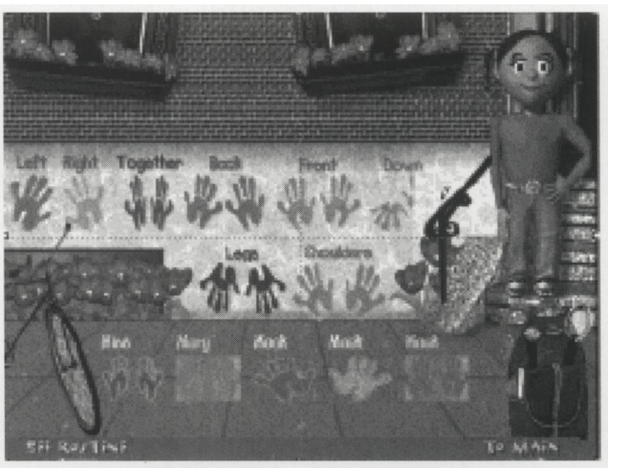

Figure 2. *Say, Say Oh Playmate:* Student reconstructs 'Miss Mary Mack' clap pattern.

Similarly, Tettagah (Tettagah, Bailey, & Taylor, 2007) developed *Clover*, a software application that constructs animated narrative vignettes (ANV). An authoring tool to lead students through the process of constructing two-dimensional ANV simulations, *Clover* provides learners with the opportunity to develop and support existing textual and visual literacy processes through storyboarding, scriptwriting, sketching characters, animating scenes and vignettes, and crafting

responses to existing peer vignettes (Tettegah *et al.*, 2007). The vignettes can be uploaded to a Website that supports additional learning by linking to supplemental resources. The interface between the student and computer supports culturally responsive learning because the content is based upon the learner and his/her classmates' school experience. This use of self-expression allows for these students to name their own reality. Teachers, in turn, are able to foster a space where their students' lived experiences are legitimized and incorporated into the "official" curriculum.

A fourth example of a culturally relevant computer-assisted program is *Riding the Freedom Train* (see ***Figure 3***). *Riding the Freedom Train* provides an excellent example of how students can learn about how people of African descent resisted enslavement and sought freedom. Containing 12 original digital images and a story about Sam, an African-American character who escapes a plantation in Maryland and travels the Underground Railroad, 3rd and 4th grade users are taught principles of math and science using the Underground Railroad as a culturally relevant context for content delivery (Leonard, Davis, & Sidler, 2005). In this case, Jacqueline Leonard developed a culturally responsive program utilizing African-American history and culture to establish a sociocultural context for students to explore and develop "interesting problems in mathematics and science that are culturally relevant, self-affirming, and grounded in prior knowledge" (Leonard *et al.*, 2005, p. 279). *Riding the Freedom Train* uses a Learning-for-Use (LfU) model, which is characterized by the development of a three-step process that involves motivation, knowledge construction, and knowledge refinement (Leonard *et al.*, 2005). Leonard discovered not only that students were extremely engaged and responded enthusiastically to the software, but also that this software supported achievement in the areas of science and mathematics.

Ethnocomputing

More recently, the study of the interaction between computing and culture, a burgeoning field of study, has led to the development of ethnocomputing. Ethnocomputing is rooted in ethnomathematics, the study of mathematical ideas and practices situated in indigenous cultures. Two of the leading researchers in this new field of study are Ron Eglash of Rensselaer Polytechnic Institute and Juan Gilbert of Auburn. Eglash's work has resulted in what he terms Culturally Situated Design Tools (CSDTs) (Eglash *et al.*, 2006), which are Web-based software applications that allow students in grades 4–12 to learn mathematics while creating computer simulations of indigenous and vernacular artifacts. Based on Native-American, African, African-American, and Latino culture, respectively,

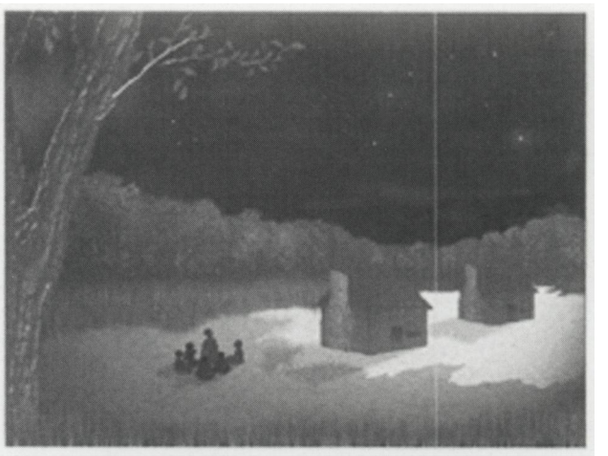

Figure 3. *Riding the Freedom Train:* Sam sits with elders of his community.

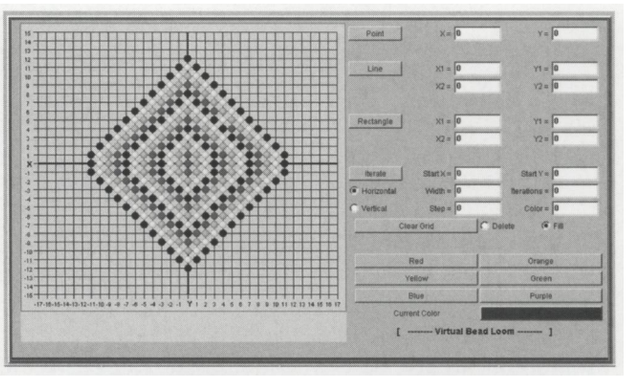

Figure 4. *The Virtual Bead Loom.*

these simulations and authoring tools allow students to explore the relationships between culture, mathematics, and technology using an anthropological approach to explain cultural and social change.

An example of CSDTs, is *The Virtual Bead Loom* (VBL), a Native-American Design Tool that connects contemporary Native-American culture's traditional heritage to the standard curriculum. The student-user enters x, y coordinates and selects colors to simulate traditional Native-American bead design or create new virtual designs (see ***Figure 4***). In this case, the designers use an interdisciplinary approach to engage learners in the fields of math and the practices of indigenous communities. Thus, students are not only being exposed to mathematical concepts, such as patterns and graphing, but are also able to apply these skills to real-life contexts, such as creating a Native-American bead design. As a result, students build cultural competencies around the practices of indigenous communities by re-creating and re-envisioning cultural artifacts. When used on multiple

Figure 5. *The African-American Distributed Multiple Learning Styles System.*

populations, the researchers found that diverse populations began to appropriate the software, in turn creating "hybrids in both the machines and people" (Eglash *et al.*, 2006, p. 356).

AADMLSS, or the *African-American Distributed Multiple Learning Styles System*, was created in the Human Centered Computing Lab at Auburn University under the guidance of Juan Gilbert, Associate Professor and Lab Director. Interested in the role of culture on learning and closing the digital divide, which many African-Americans continue to experience, the research on AADMLSS is intended to serve as a viable alternative e-learning tool for classroom instruction (see ***Figure 5***). AADMLSS, a Web-based learning tool, incorporates a range of culturally specific pedagogical agents that present contextualized content to the learner in a variety of ways, thus creating an adaptive instructional environment. In other words, several instructional agents using varying instructional delivery methods (lecture, student-led inquiry, multimedia, etc.) teach one learner, a many-to-one model (M–1). The learner receives instruction from each pedagogical agent and is assessed until the learner performs well, thus finding a delivery method that matches his/her particular learning style. Once found, the instruction will resume with the same agent and/or delivery method. The content delivered during the pilot study of AADMLSS was culturally responsive and collected from teachers who educate predominantly African-American students (Parks, Simmons, Sapp, & Gilbert, 2003). A key component of culturally responsive teaching is having knowledge and understanding of the different ways that students learn and manifest their knowledge. This notion is highlighted in this example, in which the architects of this software paid close attention to the varied ways that students learn. This Web learning tool differentiated the instruction, in turn creating an individualized plan to meet the needs of each diverse learner.

Lessons Learned Regarding the Design of Culturally Responsive Technologies

- **Realistic and Diverse Representation:** Designers of culturally responsive educational technology must construct salient representations of diverse communities to accurately reflect students' physical characteristics, cultural practices, and discourse patterns. Pinkard's design of *Say, Say Oh Playmate* and *Rappin' Reader* adheres to oral traditions and play rituals of her students' community. In addition, Pinkard's programs support student learning by incorporating aspects of their local environment. Therefore, having background knowledge of diverse communities, designers can present positive, authentic representations of images, to avoid pedagogical shortcomings such as invisibility, cultural bias, and misinformation commonly seen in many software applications.
- **Providing a space for students' voices and self-expression:** When designing culturally responsive computer technology, it is also important for the students to interact with technology in meaningful ways. For example, in the *African-American Distributed Multiple Learning Styles System*, the designers developed technologies that met the learning preferences of the student-user. In the case of *Clover*, students wrote about their real-life experiences. Computer technology, in this case, became a medium for legitimizing students' real-life experience and learning preferences in the school environment.
- **Building cultural competencies:** Designers should know and understand how historically and culturally rich content assists in advancing students' thinking and exposure to diverse communities. The culturally responsive design elements evident in the *Freedom Train* and the ethnocomputing technologies illustrate the importance of situating learning in a meaningful context in order to build cultural competencies. The historical events and experiences of diverse cultures could be used as a foundation in designing culturally relevant digital learning environments.
- **Open Source Platforms:** We believe that design features that include open source platforms similar to *Wikipedia* and *Facebook*, where teachers and students can build and expand upon one another's content-knowledge, exemplify culturally responsive pedagogy. This concept is reflected in Tettagah's *Clover* example of uploading student work to the Web and adding supplemental material. Here, knowledge has the potential to be shared, recycled, and reconstructed by both teacher and students. Teachers and students are provided with the heuristic tools to check for accuracy and authenticity by problematizing common-sense understandings.

Conclusion

For traditionally under-served constituents, such as African-Americans and Latino-Americans, access to quality learning opportunities that include computers and related technologies are essential to their involvement in the global economy. A key component to addressing this national challenge is the preparation of current and future teacher educators to design new technologies in culturally relevant and meaningful ways. Indeed, the Obama Presidency suggests that future education policy will foster a convergence between the human capital needs and technological demands of the 21st century—a fundamental departure from his predecessor. We believe that future educational programs and policies *must* emphasize the development of culturally responsive learning programs and models in order to meet the educational needs of an increasingly diverse student population. Such efforts are critical to ensuring that *all* students are equipped with the skills for full lives and sustainable employment in the global economy. □

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Fiftieth Anniversary of Magazine

In January, 2010, *Educational Technology* begins its fiftieth year of publication. Started in 1961 as a small newsletter, with a circulation of a few dozen individuals, the magazine grew to become the premiere international periodical in the field of educational technology — a field which the magazine itself helped to create. *Educational Technology* is now read in more than one hundred countries worldwide. It has been edited throughout its entire publication run by Lawrence Lipsitz, who initiated the magazine while serving as a high school teacher and doctoral student at New York University. He was intrigued by the potential of technology to improve education, and he decided to look into what was happening in the up-and-coming field, which, at that time, did not have the designation of "educational technology," a term later popularized by this magazine. He continues to serve as Editor and Publisher, as we look forward to beginning the fiftieth year of publication.

In 1969, the magazine began a book publishing program, and since that time Educational Technology Publications has published more than 300 books covering all aspects of educational technology. Other activities have included multimedia packages and recorded interviews with technology leaders. In addition, in 1971, the magazine hosted the First National Educational Technology Conference, held in New York, which attracted more than one thousand participants, who took part in one hundred workshops. Several additional conferences were held in later years.

The magazine has been at the center of the activities of Educational Technology Publications over these past five decades, and it continues in this role—serving the needs of everyone worldwide with a serious interest in the field of educational technology.