Red-Eared Sliders and Neighborhood Dogs: Creating Third Spaces to Support Ethnic Girls' Interests in Technological and Scientific Expertise

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Comment on this Field Report

Abstract
Girls and women, especially if they are people of color, supposedly do not like computer technology or science. Myriad reports and studies document their limited interest and participation in these fields, both in school and at work. This article reports some preliminary results from an after-school intervention intended to increase urban, African-American middle school girls' interest and participation in computer technology and science. The intervention program was designed by university researchers, community developers, and local residents to correspond to state curriculum content standards and to be flexible enough to accommodate the girls' own interests and values. Participant observation and interview data about the course of the intervention and the girls' responses to it were collected and analyzed for the 2000-2001 school year. Using semantic domain analysis and case examples, the authors illustrate the kinds of technological activities these girls wanted to pursue and some of the ways they appropriated school-based technology and science to contribute to "third spaces" of productive hybridity (after Bhabha 1994; Moje et al. 2004) in which they were motivated to develop and display new skills and competencies.

Keywords: **after-school education**, **technology and science**, **African-American girls**

Introduction

The research reported here was conducted in an after-school program in computer technology and science for African-American middle school girls living in a low-income, urban neighborhood in the western U.S. The neighborhood has historically served as a rich cultural resource for the African-American community, but it is economically and educationally poor. In the late 1990s, 98 percent of students were poor enough to qualify for free or reduced lunch in school (Piton Foundation 2000); due to the economic downturn since then, it is likely that even more qualify. The several elementary schools, two middle schools, and one high school serving the area have been rated as “low-achieving” since school report cards were first given in 2000.

The teenage girls who participated in our program were not likely candidates to do well in science or computer technology. They are from a segment of the population whose lack of interest and participation in science and technology is a major concern of U.S. federal education policy. As girls, low-income minorities, and low performing students, the odds against the girls succeeding in science or technology were high (American Association of University Women 1998; 2000; National Science Foundation 2001; 2003). This is not the kind of community that ordinarily turns out young people, especially girls, with expertise in technology or science.

Our work began in 1999 when a community organizer approached the School of Education at the University of Colorado in Boulder for help. He wanted the school to sponsor after-school programs for teenagers in a Denver, Colorado neighborhood. At the time, Eisenhart, a professor of educational anthropology in the School of Education, had just completed an academic book on young women in science (Eisenhart and Finkel 1998). Edwards was a doctoral student in the school’s science education program, with a background in biology and experience teaching biology and computer technology. We offered to try to design an after-school program in science and technology that would appeal to the girls in this community.

Although we had some relevant academic expertise, we were new to the community. We did not know them, and they did not know us. The two of us are white, middle-class and middle-aged women; we live in the suburbs.[1] The community is comprised primarily of low-income, urban African-Americans and Mexican-Americans of all ages. In the manner of cultural anthropologists, we decided to spend the first six months introducing ourselves and getting to know the people. We also used that time to interview girls, parents, teachers, and community leaders about (a) the girls’ general interests and priorities, and (b) their previous experiences—positive or negative—with science and computer technology. At the same time, we surveyed the community for science- and technology-related resources.

One of the first things we learned was that teenage girls in this community said they were not very interested in computers or science. In informal conversations, they told us they had experience with computers and science but only at school. They said they didn’t like either science or computers, and they weren’t good at them. Most families did not have computers at home, and most parents were not computer-literate.

We also learned that community adults wanted girls to learn skills and competencies that could benefit them economically and intellectually in the future. Most people knew there was an explosion of well-paying, technology-oriented jobs in the surrounding metropolitan area– many of which were going unfilled at the time. They thought that these jobs presented an economic and professional opportunity that young people could seize with the right skills, yet they did not think the schools were reaching these girls. Because the girls were already alienated from school, no one thought they would respond well to school-like activities. Thus we decided– in principle—to try a community-based approach that would build on the girls' own interests and values– that is, on their cultural resources, including youth culture.

Relying on previous anthropologically-informed studies that stress the importance of making curricula culturally relevant (e.g., Gonzalez et al. 2001; Heath 1983; Ladson-Billings 1994; Lee 2000; 2001; 2003; Moll et al. 1992; Warren et al. 2001) and on educational psychology since Dewey has stressed the importance of stimulating learning by building on students' prior knowledge (National Research Council 2000), we reasoned that we might spark some enthusiasm for computers and science if we could tie them to topics and activities in which the girls were already interested. Thus, our primary research question became: What are topics of interest to the teenage girls in this community and how can these topics be used to teach technology or science?

In this article, we describe the approach we took to answering this question and the results we got. What we have learned is that we can stimulate participation in computer technology and science on the part of these apparently uninterested girls by finding, constructing, or allowing for the creation of what we call "third spaces" of productive hybridity (after Bhabha 1994; Moje et al. 2004). These third spaces are primarily metaphorical and discursive, but they require the organization and mobilization of physical and social spaces. They are spaces in which girls can appropriate technical skills and scientific knowledge to do things they value and, at the same time, to demonstrate academic competencies and confidence they had not previously displayed.

Previous Research

The approach we took to answering our primary question proceeded from the research tradition that views culture as a generative resource for learning. From this view, background cultures, peer cultures, and youth cultures are "funds of knowledge" that young people bring to formal learning opportunities (as in schools or other institutions), not barriers that must be overcome before formal learning can take hold (e.g., González et al. 2001; Lee 2000; 2001; 2003; Moje et al. 2004; Moll et al. 1992; Vélez-Ibáñez and Greenberg 1992; Warren et al. 2001; Warren et al. 2005). For curricula to be successful with respect to culture, they must continuously and productively draw on, develop, and contribute to funds of knowledge acquired outside of school. Historically in the U.S., formal curricula that effectively establish and maintain a continuous relationship between learning inside and outside of school have been rare, especially for children and young people from non-mainstream culture (Moll 2000).

Previous research in this tradition has suggested two strategies for designing curricula that enable this continuous relationship. One focuses on identifying outside-of-school conceptual (knowledge) resources that can be connected, either directly or by analogy, to school-based knowledge; the other focuses on linguistic resources (e.g., ways of verbally arguing or reasoning) learned outside of school that have analogous representations in school knowledge. Although researchers have tended to focus on one or the other in their studies, the two approaches are not exclusive, and may be most successful when considered together.

Conceptual resources have been the long-term focus of research conducted by Luis Moll, Norma González and colleagues on "household funds of knowledge" in the families of low-income and minority students in Tucson. This research group defines funds of knowledge as "the historically accumulated bodies of knowledge and skills essential for household functioning and well-being" (González et al. 2001, 116). They describe their work as follows:

> *The basic premise has been that classroom learning can be greatly enhanced when teachers learn more about their students and their students' households. In our particular version of how this can be accomplished,… [t]eachers venture into their students' households and communities, not as teachers attempting to convey educational information, but as learners seeking to understand the ways people make sense of their everyday lives….[Teachers] are not given secondhand generalities about Latino, African-American, or Native American culture by academic researchers; they are learning, as ethnographers, directly from interviews and other firsthand experiences…. By building on students' strengths, in whatever area, teachers could lay a foundation for higher order content-based learning* (116-118).

This research group has demonstrated the effectiveness of their strategy for raising teachers' expectations of their students, fostering closer ties between parents and teachers, and altering language arts and social studies curricula. However, the effects on student learning, motivation to pursue academic work, or other academic outcomes remain unclear.

The work of Carol Lee (2000; 2001; 2003) has focused on African-American linguistic resources. Lee has found that discursive forms characteristic of African American English Vernacular (AAEV) can be used to scaffold opportunities for African-American students to learn complex language arts skills in school. For example, she writes:

> *I take the position…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…. [T]hey also invoke*

> *certain habits of mind, including attitudes about language play as an aesthetically pleasing end, in itself* (2003, 45).

Once these strategies and habits of mind (tacitly learned and used primarily outside of school) are identified and made explicit for both students and teachers, they can be used to structure in-school tasks, such as discussions of metaphor or irony, in ways that allow the bridging, transfer or application of skills from one setting to the other. In a series of articles, Lee has demonstrated the feasibility of making these kinds of connections between inside- and outside-of-school learning, and she has documented some learning gains in school knowledge.

The Algebra Project, developed by Robert Moses (Moses and Cobb 2001) and used in a number of urban communities, is another example of a similar program. The Algebra Project is a middle school curriculum that begins by explicitly introducing students to the relationship between algebra concepts and everyday experiences. Once clarified, this “common culture” serves as the basis for developing abstract (algebraic) conceptualizations of experience and for applying the abstractions back to experience. Minority student achievement as measured by standardized test scores, advanced placement courses, and mathematics proficiency rates have been associated with use of the Algebra Project, although other explanations for these successes cannot be ruled out.

Beth Warren (Warren et al. 2001) and Elizabeth Moje (Moje et al. 2001) head two research groups that have extended this line of research to science curricula for minority students. Similar to Lee, Warren et al. searched for culturally valued styles of argumentation—what they call “scientific sense making”—among Haitian Creole students and helped teachers learn how to use the styles discovered to facilitate students’ formal science learning. They report achievement test score gains and deeper understanding of scientific phenomena by the students. Moje et al. (2001) illustrated how students’ culturally-based notions of water quality could be linked with scientific ideas of water quality to enhance science learning.

Culture, conceived as a generative resource, has received very little attention in research on technology curricula. Although the evidence is solid that minorities, especially African-Americans, are less likely than whites (even when controlling for income) to have or use computers (Jackson et al. 2001), neither specific cultural content nor cultural analogs have been studied as means of addressing this problem in the teaching of technology. In a small study, Jackson et al. (2001) found that African Americans’ use of the Internet exceeded whites’ only when motivated to seek personally relevant information. In a follow-up study, these authors plan to introduce the Internet in “ways that take into account the importance of interpersonal communication, personally relevant information, and self-expression as motivations for Internet use” (p. 2040). But, to our knowledge, the results of this follow-up have not been reported.

In summary, this tradition of research has laid a foundation for developing curricula that are responsive to culture in various subject matter areas, including science and technology. These culturally responsive curricula depend on first identifying analogs between formal academic knowledge and "everyday" knowledge and then constructing spaces for moving back and forth across the formal/everyday figurative boundary to highlight the similarities in content, processes, or goals. Teachers or curriculum developers must be able to draw on their knowledge and resources to create spaces in which students can bring existing interests, values, competencies, and resources into contact with the kind of knowledges that are privileged and rewarded in school (Lynch and Macbeth 1998; O'Connor, Godfrey and Moses 1998). In principle this approach honors both the prior (or everyday) knowledges of non-mainstream students and the knowledges required in school, and it makes "travel" between their respective spaces more likely and more productive. Those who have conducted the previous research in this area have demonstrated that non-mainstream young people have a lot of knowledge (conceptual and linguistic resources) that can be connected to school-based funds of knowledge. They have successfully demonstrated the feasibility of linking cultural knowledge and school knowledge for the purpose of improving school-based learning for non-mainstream students. They have not, however, looked at another side of this situation: What do young people do with their school-based knowledge outside of school? Certainly, the school-based education of non-mainstream students needs to be improved, but it is not just for school or tradition or grades that we want students to master school knowledge. We also want them to use this knowledge outside of school for their own needs and purposes. Building on the tradition of research described above, our work demonstrates the potential in learning more about what non-mainstream students can do with school-based knowledge when they are not constrained by school.

Our initial idea for the after-school program was to find or design spaces in which the academic content we thought important and the interests the girls thought important could come into contact. Our approach led us to look for room to add science and computer technology to the interests and identities that the girls brought into the setting where we interacted together. We were able to do this in part because our curriculum did not have to be implemented within the organizational structure and demands of school; it was much easier for us to be flexible about interests to pursue than is usually the case in school.

Methods

Our methods for curriculum development and data collection resembled a "design experiment" (after Brown 1992) in which features of the curriculum are implemented, assessed, and then revised based on the participants' responses, researcher reflections, current research findings, and ideas from community members. Data for assessments and revisions came primarily from ethnographic field techniques of participant observation and open-ended interviews.

Curriculum Development and Sample

Our procedures for developing culturally responsive curriculum consisted of four steps. First, we interviewed parents, guardians, community leaders and girls in the community to elicit information about their current interests and things they wanted to learn more about. Commonly mentioned topics were fashion design, graphic arts, health, how the body works, and computer skills. Second, we designed some initial activities consistent both with the information gathered from these sources and from our knowledge of the science and computer literacy standards in the school district. For example, given the girls' interest in fashion design, we investigated the existing computer programs for this. We discovered that these programs are expensive and quite complex. We realized that the girls would not be able to use the fashion design software until they mastered some basic computer skills. We then thought about ways to honor the interest in fashion design with a simpler computer-based activity. We decided to try teaching basic graphic design skills by having the girls take digital pictures, modify them on the computer, print images to iron-on transfer sheets, and then iron the images onto plain t-shirts. We hoped that the girls' interest in designing their own t-shirts would motivate them to learn and practice the computer skills of graphic sizing, coloring, adjusting, etc. Third, after we implemented the activities, we observed how the girls responded to them, and interviewed them for their reactions. In the graphic design example, we found that the girls were excited about the activity but not precisely for the reason we expected. They were excited to make the t-shirts primarily because they could give them to friends and relatives as gifts, not because they could engage in fashion design. Fourth, we revised the activities in light of the girls' responses to them. Then we repeated the implementation, review, and revision as needed to identify activities that worked well with these girls. For example, we moved the t-shirt activity closer to the holiday season so that gift-making had specific utility. Over time, we have developed a repertoire of eight curriculum units involving graphic design, animation software, web-based searches, how the eye works, how the heart works, bacteria and viruses, and human reproduction. We now use these units with some confidence with girls from this neighborhood.

The results reported in this article are based on data about technology and science activities in one group of six African-American girls (12-15 years old) as they participated in the after-school program during the 2000-2001 school year, along with their white instructor and two white researchers. The program was housed in a storefront on the main street of the business district in the heart of the African-American community. Girls were recruited from nearby middle schools, churches, and word-of-mouth in this low-income community. Girls were selected on a first-come, first-served basis until a class was full. The girls were asked to get to and from the program on their own; however, we provided transportation when necessary. Classes were kept intentionally small due to the number of computers and trained instructors available.

The six girls in the group reported on here had family incomes low enough to be eligible for free or reduced lunch in school. When they began the program, they had C averages or below in school. They entered the program on their own or at the urging of their parents in order "to have something to do after school." When asked about science and technology at the beginning of the program, the girls told us they were not very interested in those areas.

During the first half of the 2000-2001 school year, the students were guided to develop technology skills necessary for mastering basic software programs (skills such as keyboarding and scanning), and they used the programs to create small, unconnected projects. During the second half of the year, the girls extended their activities to include graphic design, video and audio file manipulation, use of the Internet, animation, and multimedia projects. Science topics provided the subject matter content for some of the technology activities.

Research Methods

Because we did not know in advance what to expect, primarily ethnographic (qualitative) data were collected about the girls' actions and statements as they participated in the program. One researcher and the instructor made observations and participated in each class. Audiotapes were made of each class and some activities were videotaped. Each student was interviewed individually, and tapes of the interviews were fully transcribed. Student work was collected, and some of the computer programs allowed us to keep a log of user interactions which we printed and analyzed for time and nature of on-screen engagement.

The findings we report come from analyses of field notes, audio transcripts, student work, and instructor's journals collected from September 2000 through August 2001. These data cover 63 class meetings and events (approximately 190 hours of data collection and 1100 pages of typed notes). During this time, we were lucky to have the same small group of six girls participate regularly.

The data were analyzed in two different ways. The first analysis addressed the question: To what extent were the girls' gender and ethnic identities represented in the technology activities they engaged in, and what did this suggest about the conditions for successful work with these girls? To address this question, we used Spradley's (1979; 1980) procedures for semantic domain analysis. Semantic domains (or participants' units of meaning) and items that constitute them (constituents) are identified and coded by applying nine universal semantic relationships to the data texts. Spradley's semantic relationships include:

- x *is a kind of* y
- x *is an attribute of* y
- x *is a step in* y
- x *is a reason for* y
- x *is a place in* y
- x *is a place for doing* y
- x *is a result of* y
- x *is used for* y
- x *is a way to do* y

Using each semantic relationship to link domains and constituents results in (1) an index of the size and complexity of domains, the amount of evidence for each, and the density of links to other domains; and (2) a semantic map of the data from participants' perspectives. In this article, we focus on three domains that reveal how the girls marked gender identity, ethnic identity, and technological expertise: (1) kinds of girls' statements and actions regarding interest in computers and technology; (2) kinds of girls' statements and actions regarding gender identity;

and (3) kinds of girls' statements and actions regarding African-American identity. By reviewing the contents of each domain and then examining the overlap between domains 1 and 2 and domains 1 and 3, we obtained a general picture of how markers of gender and ethnicity intersect with activities involving technology.

The second analysis addressed the question: What were particularly good examples of occasions when the girls seemed motivated to learn more science or technology, and what did these occasions suggest about the conditions for successful work with the girls? To address this question, we used a form of vignette analysis. Vignette analysis is a contextualizing, rather than a coding, strategy (Maxwell 1996, 79). Contextualizing strategies complement coding strategies such as domain analysis. Contextualizing strategies are means of looking for relationships that connect data in a context into a coherent whole. In vignette analysis, salient events that bear on the research question are excerpted from the data texts, simplified, related to each other, and retold in the form of short stories called "vignettes" (Van Maanen 1988). In the section below, we present the results of the domain analysis followed by two vignettes, one about the red-eared slider turtle and one about dogs.

Findings

From the domain analysis, we found that we and the girls were creating some spaces that were mutually acceptable, i.e., spaces in which the girls achieved goals that were meaningful to them and we achieved goals that were meaningful to us. The key to this success was finding activities that allowed the girls to use the technology we wanted them to learn to enact gender and ethnic identities that they valued. In particular, we found that technological activities linked to the girls' gender and ethnic identities were sustained longer than those that were not.

Technology Appropriated by Gender and Ethnicity: The Semantic Domain Analysis

On many occasions, especially at the beginning of the school year, the girls told us that they didn't like computers, they didn't like the Internet, and they didn't like the activities (or kind of work) associated with these technologies. One said this about her feelings: "I couldn't spend so much time on just one thing and tryin' to figure out what it does and what it's for. I just don't like that." Another said: "I don't have the patience to wait years to figure out a certain code or something."

However, we observed the girls actually engaged in numerous activities in which interest in technology was sustained across more than one class meeting. As indicated in Figure 1, most of these sustained activities occurred when technology use intersected with gender and ethnic markers.

Of the 63 class meetings we examined, 23 (36 percent) included some new technology content, activity, or discussion. (Most other classes were devoted to science or to continuation of the technology work; a few were field trips to museums, parks, etc.) Of the 23 new technology activities, 14 (61 percent) were sustained over more than one class meeting due to the girls' interest in continuing. Of the 14 technology activities that were sustained, 12 (all except #2 and #12 in

Figure 1) were linked to domains of gender or ethnic identity by the girls. Of the nine that were not sustained, only one was linked to the domains of gender or ethnic identity. These results suggest that when the girls worked with technology in ways that link to aspects of their gender and ethnic identities, they were motivated to do more with them.

Figure 1. Activities of Sustained Technology Use

1. Using a Polaroid camera to take and admire pictures of each other smiling and posing like fashion models or cheerleaders.
2. Using a video camera to record each other's antics and play them back.
3. Using the Internet to obtain the phone numbers of boys they want to contact.
4. Using word processing to make Valentine's Day cards for boys.
5. Using CD players to listen to hip-hop music and memorize lyrics.
6. Playing Barbie games on the computer.
7. Scanning pictures, sizing them, and transferring them to t-shirts for selves or to give as gifts to others.
8. Talking about famous Black women based on information gathered from the Internet, a CD, or a video.
9. Talking about sexual reproduction, babies, parts of the body, and body size based on information from the Internet, a CD, or video.
10. Using clip art images as a springboard for talking about what the girls call "tight" fashions, styles, and looks (where "tight" or "tite" means "good-looking," "stylish," or "cool").
11. Describing one's self as an "inventor; ... someone who always thinks up tight inventions," e.g., designing a container to keep food cold outside while preparing to barbeque, or designing a skirt that is easily converted to pants.
12. Using the computer, the Internet, or experiments to learn about something of personal interest, e.g., dogs, common diseases, sexual reproduction.
13. Using logos from templates to design their own "business cards," e.g., by making a Betty Boop logo Black, surrounding the Black Betty Boop with hearts, or adapting a dragon from favorite (male) hip-hop artist Sisqo's website.
14. Naming their own computer files after Black female hip-hop, sports or television stars.

We introduced most of the technological tools and activities listed in Figure 1, but the girls were the ones who applied the tools in ways and contexts that were meaningful to them. For the most part, the girls did not passively accept what we introduced, nor did they actively resist it. Most often, we introduced the tools in a rather conventional, school-like way, and then they used them in contexts that suited their gender and ethnic preferences. This was an indication that the flexibility to situate developing academic proficiencies in contexts of interest to low-achieving students was a condition for stimulating achievement. It was also an indication that the girls were quite capable of applying and using the tools in their own ways.

Technology Turned to Other Agendas: Two Vignettes

From the vignette analysis, we found that there were some situations in which the girls more actively turned the skills and knowledge we presented to their own purposes. Two vignettes illustrate this pattern. The first one ("Red-Eared Slider") tells the story of a girl using the class material as a way to achieve a goal of her own. This is a kind of learning—transferring and expanding skills in a new context—that most teachers hope for. The second vignette ("Dogs on the Loose") illustrates another kind of learning—more sophisticated on the part of the students but perhaps less desirable in the eyes of teachers. In this vignette, the girls use class activities to trick the teacher and engage in an activity of which the teacher does not approve.

Red-Eared Slider

One day the girls were learning how to use a multimedia authoring software program (ToolBook) when Careece[2] decided that she wanted to use the software to convince her grandmother to let her have a pet turtle. In the weeks just prior, the girls had been studying turtles after Careece expressed an interest in them. The class had visited two pet stores and the apartment of a college student to see her pet turtle. After these visits and using information from the Internet, Careece developed a multimedia presentation[3] to persuade her grandmother (with whom she lived) that she knew enough about turtles to care for one. This presentation included an audio track and nine computer screens of information about the red-eared slider turtle, including its natural history, habitat, nutritional requirements, and disease susceptibility (Figure 2). Careece transferred her presentation to a laptop and showed it to her grandmother, but was told that she still could not have a turtle because its tank would smell.

Disappointed but undaunted, Careece proceeded to use the next several days in our class to figure out how to overcome her grandmother's objection. She decided to use the animation features of the software to create two simulations– one showing a turtle in a tank with a filter, and one with a turtle in a tank without a filter. Including additional scientific knowledge about bacteria and decomposition, Careece designed 12 more screens to show that she knew what causes a turtle tank to smell and that she knew how to take care of that problem (Figure 3).

After Screen 10 (the title screen), Screens 11-13 show a turtle eating hot dogs and pooping (defecating) afterwards. Screen 14 shows a turtle tank with a filter sucking up most of the poop so very little is left for bacteria to decompose and produce a bad odor. Screen 15 shows that the filter produces a sweet-smelling tank (hence the flowers floating to the nose in the upper right corner). Screens 16-20 show the same process for a tank without a filter. In this case, the poop is left for the bacteria to act on, and a bad smell (hydrogen sulfide, a byproduct of bacterial decomposition) results.

Figure 2. Screen Captures of Turtle Slides 1-9 (left to right, top to bottom). A Flash version of the presentation can be accessed online at http://www.colorado.edu/journals/cye/14_2/presentation.htm

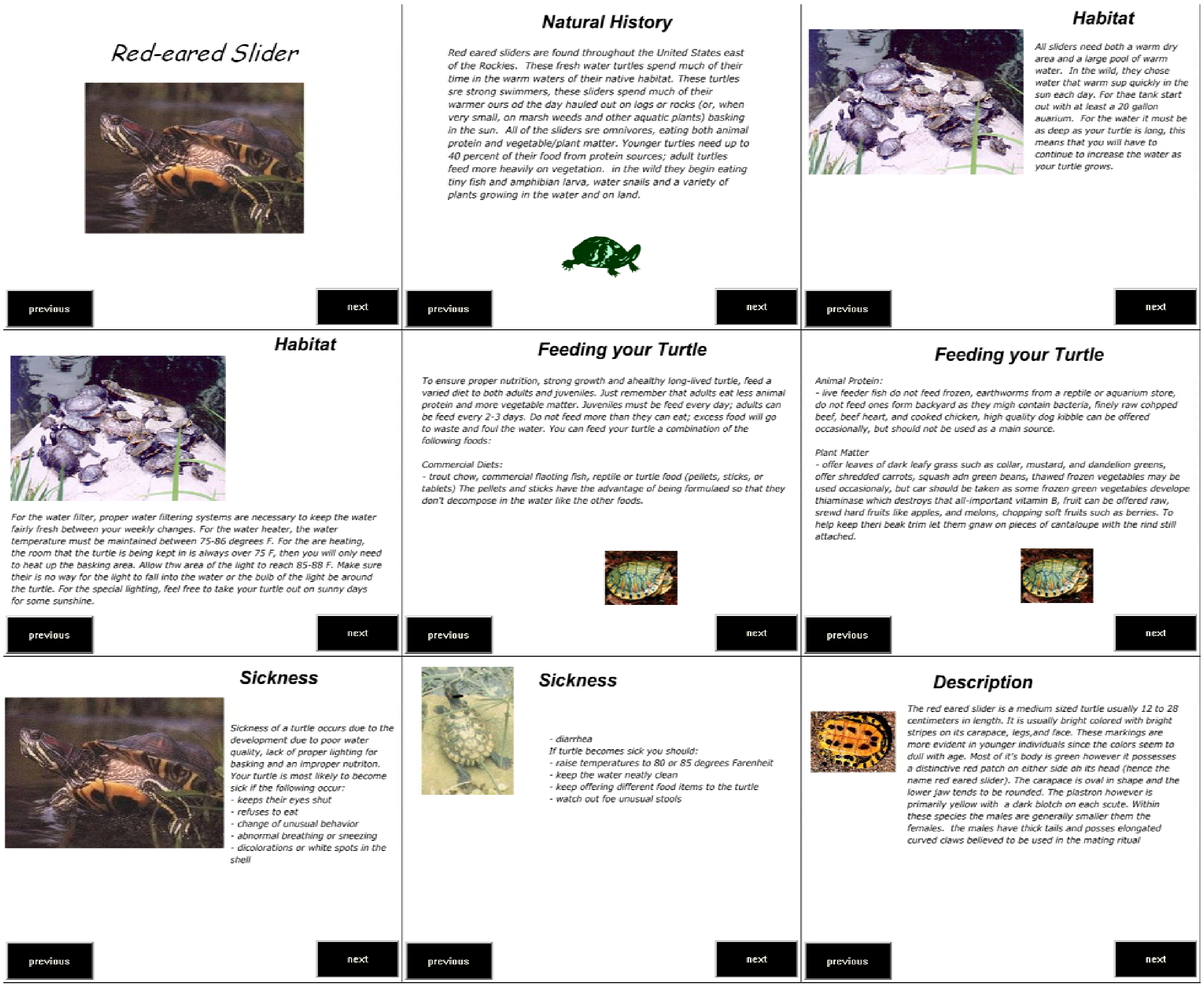
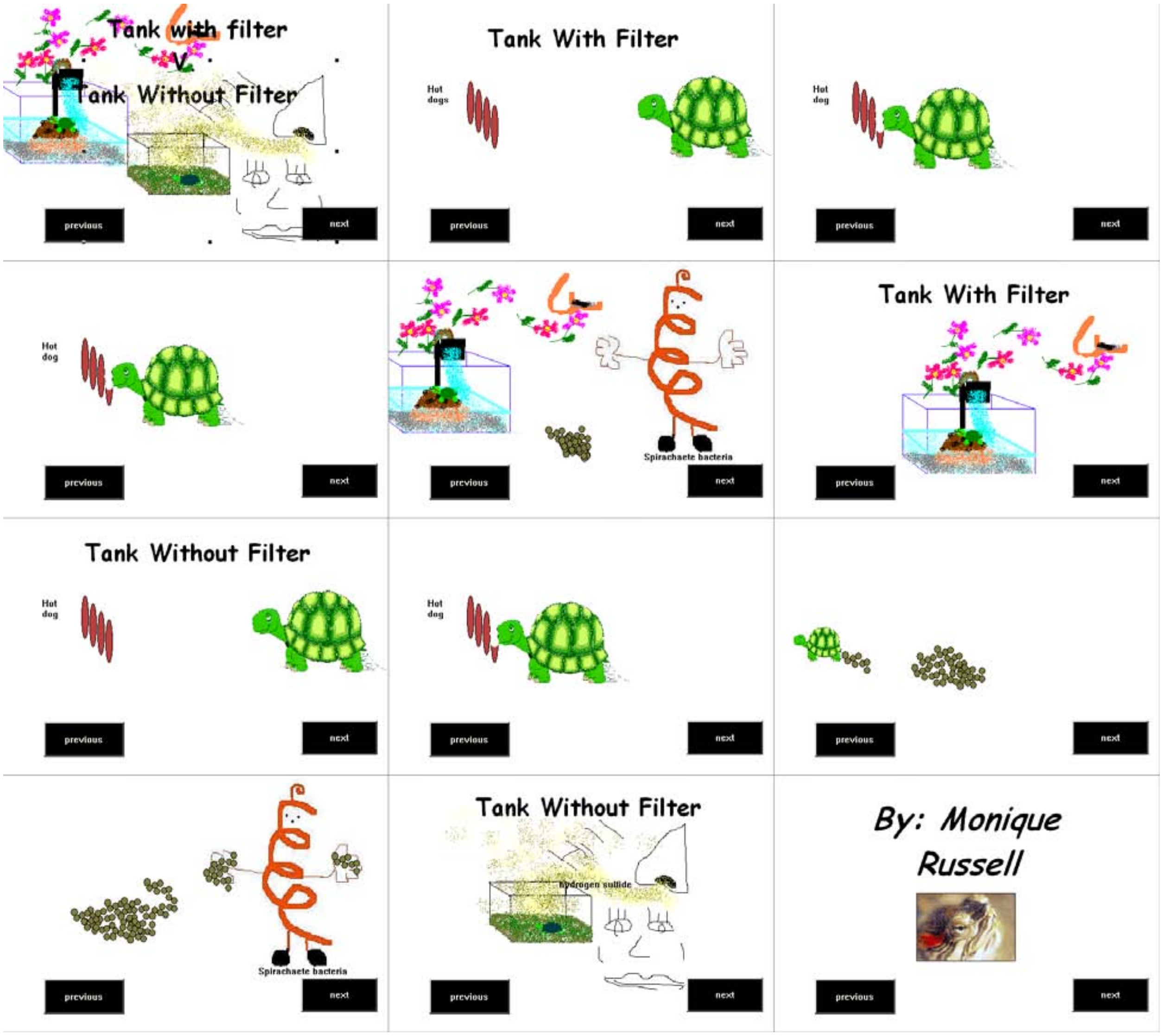


Figure 3. Screen Captures of Turtle Slides 10-21 (left to right, top to bottom)



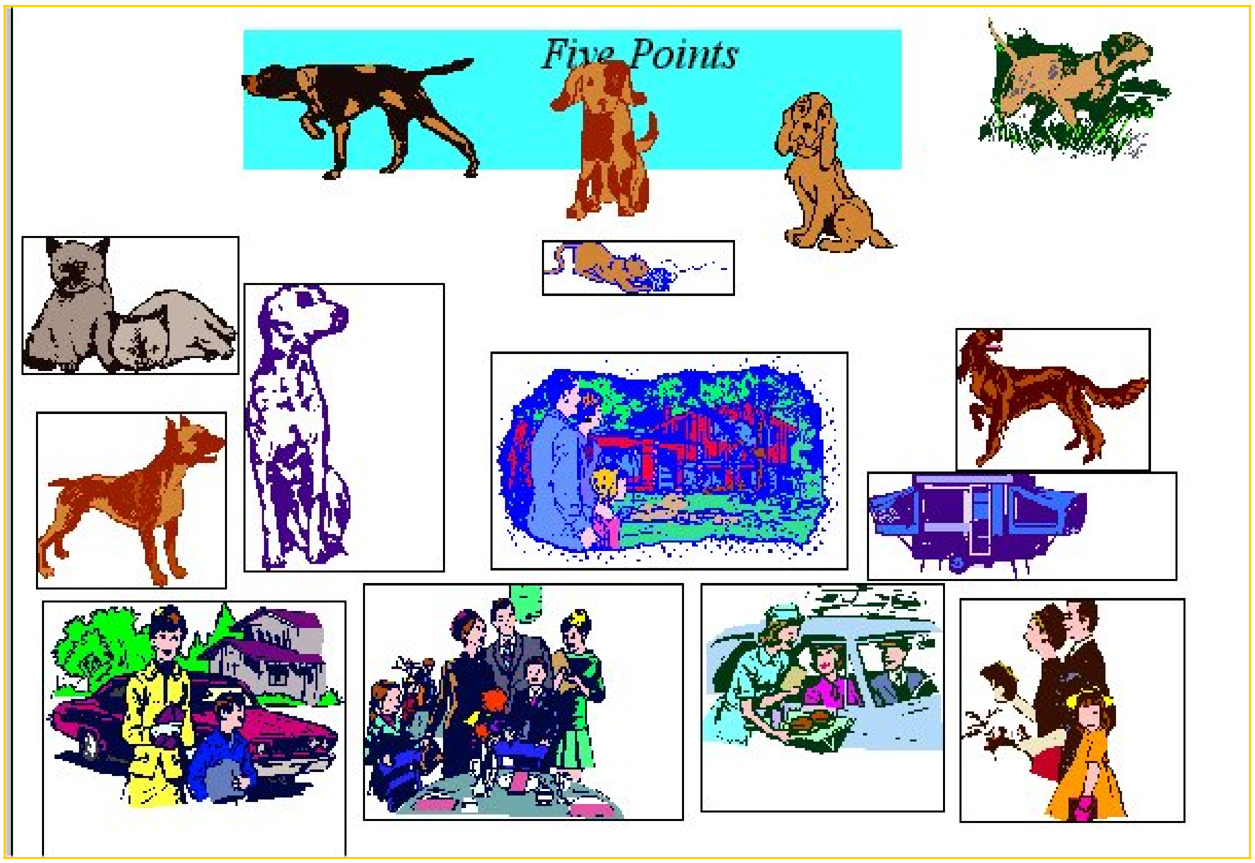
Despite Careece's efforts, she eventually decided not to show the animation to her grandmother and not to pursue the idea of getting a turtle. Nonetheless, her concerted and sophisticated appropriation of the multimedia software led her to develop a number of technical proficiencies, including: (1) how to write short object-oriented and event-driven programming code (e.g., to make a button work); (2) how to record, embed, and playback audio files; and (3) how to add animation (e.g., to integrate the number and size of movement steps with length of time to make a smooth animation). She also learned some new scientific information about turtles.

In this example, Careece had a goal of her own and used the after-school program as a space to achieve it. In pursuit of her goal, she was motivated to learn more than she already knew about computer technology and turtle science. Enabled by her interest and motivation, we worked to increase her knowledge of turtles, bacteria, filters, and odors, as well as her technology skills, in ways consistent with school learning. In the process, she acquired multimedia skills, scientific knowledge, and the confidence to use them that she did not previously have.

Dogs on the Loose

One day we asked the girls to use what they had learned about Paint Shop Pro (an image editing software program) to depict their neighborhood. To our surprise, each girl (independently) chose to represent the neighborhood with images that included a large number of dogs. Figure 4 is a typical representation.

Figure 4. Dogs on the Loose



We were surprised because the dog pictures were selected from CD ROMs with thousands of clipart images and because we did not think of this neighborhood as a place with a lot of dogs. Later, in interviews, the girls told us they chose dogs to represent the community because “there are lots of dogs in [this neighborhood].”

On the basis of such statements and with the girls' help, we designed a neighborhood survey of dogs. Our plan was to have the girls canvass their neighborhood to find out how many dogs there were, and to identify issues that might arise in an urban area with lots of dogs. From these data, we anticipated developing a unit on the ecology of dogs in the neighborhood.

What we found as we conducted the survey was quite surprising, at least to us. First, in canvassing residences, we found very few dogs. Of the residences with dogs, most were owned by whites (less than 20 percent of all residents). When we asked the girls about this, they said we had chosen the wrong neighborhood blocks to canvass. They suggested we go to another, nearby set of blocks and canvass there instead. We asked why and the girls said that they knew there were lots of dogs there, because they had seen them when riding the bus. So off we went. Again, we found the same pattern– African-American and Mexican-American households did not have dogs, while the few white households did. Very perplexed and a bit irritated now, we asked them: "Why were we doing this?" "Why are you telling us that there are lots of dogs in neighborhoods with so few?" The girls finally said, "We wanted to drive around and look for cute boys!"[4]

What was going on here? After further questioning and explanations the following picture emerged. At first the girls wanted to represent their neighborhood in a favorable light to us. Thus, the pictures of dogs, campers, large homes, and family gatherings—things the girls associate with higher-income, more mainstream neighborhoods. It also seemed that the girls liked dogs and knew quite a bit about them. For example, they all knew the names of the breeds shown in the clipart. Then, when faced with the unexpected opportunity to canvass their neighborhood for dogs, the girls pursued the topic probably knowing what the results would be but hoping to enjoy the chance to drive around in a car. Then once we were out driving around, they realized they could use the opportunity to look for boys– which they sometimes refer to as "dawgs." "Dawg" is a black slang word used by girls and women in this community to refer to boys and men; the word may have a positive or negative connotation depending on the context.

Apparently, while we pursued the topic of dogs literally, the girls switched to a metaphorical, black colloquial usage that offered an opportunity they didn't often get and concealed from us what they were really up to—paying attention to boys, an activity they knew we disapproved of in the context of our program. Another way to put this is to say that the girls incorporated our curriculum goals into their language game to pursue a topic of interest to them.

In this case, we did eventually get the girls to create spreadsheets of the data collected about dogs, but we never succeeded in piquing their interest in dog ecology. We did go back to their talk about dog breeds and in doing so, discovered an interest in how a dog's eyes work. This became the topic of a later successful science unit on dog optics—a topic we would never have selected on our own for these girls!

In this example, the girls appropriated our assignment to depict their community in terms of middle class ideals. When we pursued their imagery and found it lacking (few dogs in their community), they improvised an activity that tricked us into believing they were doing something we wanted when they were not. Part of the trick involved signifying—substituting the black slang word, dawgs, for (our) dogs. In consequence, the girls were able to pursue an exciting and elusive activity (time and opportunity to look for boys) that we never would have approved had we recognized it. At the same time, we were able to pursue one of our goals (surveying) and discovered a topic (dog optics) that otherwise would have eluded us. This vignette suggests the potential for learning opportunities in which it is possible for students to have some fun, to reverse the normal power relationship between teacher and student, and to allow unexpected interests to emerge.

Conclusion

In using the concept of "third space" to understand classroom interactions, Gutiérrez, Rymes and Larson (1995) described it as a metaphorical "space-between" the official space of the classroom (represented by the teacher and the curriculum) and the informal space of student social life (represented by student peer groups). Gutiérrez et al. say that a third space develops "when the teacher and student depart from their rigidly scripted and exclusive social spaces" (467) and something different– something that is heteroglossic (representing both or more than one) and new to both– emerges. In such a context, it "becomes possible for both teacher and student to redefine what counts as knowledge" and for instruction to be "re-keyed so that participation is more symmetrical..." (467-468).

The identification and construction of heteroglossic or hybrid spaces in which various funds of knowledge from inside and outside of school come into contact, inform each other, and "re-key participation" in formal learning has been a mainstay of anthropologically-oriented efforts to design curricula that are responsive to culture. The literature reviewed earlier in this article illustrates this core, and the research conducted here follows in that tradition.

What is different about our results is the focus on what young people choose to do with school resources or funds of knowledge in third spaces when encouraged to "run" with them outside of school. Previous research has demonstrated that third spaces purposefully constructed to bring non-mainstream students' cultural resources into contact with formal school resources facilitate school learning for these students. Our research demonstrates that third spaces can also enable non-mainstream students to make formal knowledge an active part of their own lives. Although the way non-mainstream students use third spaces to accomplish their own goals may surprise or shock those of us in the mainstream, this is a form of learning that needs to be explored and encouraged, not ignored.

In the case of the African-American girls we have been working with, our efforts to bring our interests and values into contact with those of the girls highlight the potential of third spaces outside of school. While we explicitly teach formal skills and knowledge, we also allow the curriculum to be flexible enough to accommodate applications of skills and knowledge in ways that the girls choose. In doing this, we found that the girls sustained work in science and technology when it was connected to their own lives and values and did not sustain it when this connection was absent.

We also found that the girls could and would take the skills and knowledge we provided and turn them to their own ends, some congruent with teacher goals (turtle tank) and some not (dogs/dawgs). In Careece's development of the turtle natural history and tank animation, she used our resources to achieve a goal of her own and at the same time acquired new skills that we wanted her to have. In the case of dogs/dawgs, the girls collectively manipulated our resources to achieve an end that had high interest for them and was discouraged by us. Nonetheless, contact between our interests and the girls' motivated a willingness on their part to pursue (at least to a point) some otherwise uninteresting skills (surveying and ecology) and led us to explore with them a topic (dog optics) that was completely unexpected to us.

Elizabeth Moje and her colleagues (Moje et al. 2004) have recently summarized three current theoretical perspectives on third or "hybrid"spaces. The first is Soja's (1996) geographic perspective in which he argues that although physical and social space may appear to be separate binary categories, they in fact co-determine each other, and in doing so, they create third spaces in which new knowledges are generated.

The second perspective is Bhabha's (1994) postcolonial model in which discourses are examined for the multiplicity of meanings, symbols, and signs embedded in them. Struggles over meanings can be both productive and constraining. About Bhabha's view, Moje et al. write:

> *The struggle over and through different Discourse communities...can be made productive, but only if people are not constantly defined in relation to a dominant Discourse [e.g., the academic canon or white hegemony]. Third space, then, becomes a productive hybrid cultural space, rather than a fragmented and angst-ridden psychological space, only if teachers and students incorporate divergent texts in the hope of generating new knowledges and Discourses* (2004, 43).

The third perspective is called "educational;" it includes the views of Gutiérrez et al. (just above) and extends the insights of Moll et al., Warren et al., and Lee (cited above under Previous Research). Drawing on these theoretical developments around the concept of third space, Moje et al. call for more research that can suggest how:

> *policies and perspectives have to change to recognize the potential value of integrating what youth and their families know with the conventional knowledges and Discourses of upper level [middle and high school level] content and...learning as a means of producing new knowledges. This goal is, perhaps, the most difficult to achieve, because we cannot know what*

> *these new understandings look like until we construct them, we cannot study their effectiveness until we enact them, and it is difficult to construct and enact them without a change in policies and perspectives that shape classroom practices (2004, 68).*

Our findings from an after-school program that does not face the organizational constraints of formal schooling illustrate the potential and the difficulties in what Moje et al. call for. Our findings demonstrate that low-income, urban, minority, low-achieving teenage girls actively engage in using, adapting, and extending skills and knowledge in science and technology in situations that can be called third spaces. The girls are interested. They are motivated to learn more. They succeed in learning new skills and knowledge, and they manipulate skills and knowledge to their own ends. This is not the picture that usually emerges from investigations of girls in science and technology, and these are not the kind of girls expected to defy the norm.

Yet, it is difficult to imagine how the orientation toward learning in third spaces that we can pursue in an after-school program could be transferred into school programs as we know them. Perhaps these kinds of third spaces will have to remain the province of after-school and other similar, more flexible learning sites.

Currently, we are continuing to work with and follow these girls and others who have joined them in our program since 2000. We are impressed with what they are becoming. Although we cannot attribute their successes to our program alone, we do take pride in what they have accomplished since we met them. These accomplishments include improved school attendance, improved grades, increased involvement in enrichment activities, increased interest in attending college, and improved “attitudes” according to parents and guardians. The girls themselves have described the influence of the program on them. One said: “It gave me a more positive attitude about [what] you can do with what you learn in school.” A second said, “I learned how to do stuff without always depending on someone else.” Another said, “I learned to talk [in front of others] by learning to explain [things in the program].” And a fourth said, “It has changed me into a person who knows about computers and science.”

The increased knowledge, increased technical competence, and increased academic confidence that these girls demonstrated are a hopeful sign for all who care about improving girls’ educational outcomes in science and technology. Our results point to the need for teachers and curricula sensitive to the interests and values of culturally diverse students. They also point to the need for spaces of learning that are flexible, so as to accommodate the interests and values of learners as well as those of teachers and schools.

Endnotes

1. Given the background differences between us and members of the community, we were not the ideal persons to take on this task. However, like the majority white teachers and other social servants who work in low-income communities in the U.S., we hoped to make some positive contribution, despite our obvious differences. We

worked on this project as volunteers. We were not paid for developing the curriculum or conducting the research. All the money we raised for this project went to direct services (teacher, space, and supplies) for young people in the community.
2. Pseudonyms are used for the names of the girls. Informed consent for participation in this research was obtained from all the girls and their parents or guardians during personal visits by the teacher and one researcher to each home.
3. The original ToolBook and Multimedia ToolBook programs are object-oriented, event-driven software that were inexpensive (around $100 and $500 educational price, respectively) and easy to learn yet rich in features, allowing users to combine text, graphics, interactivity, animation, audio and video. This makes them perfect "developmental" tools to interest and engage middle school students for the long periods of time required to learn technology skills needed to be successful in high school and obtain good, high-paying jobs. For example, we use Multimedia ToolBook as the foundational step in a tightly scaffolded series of lessons on animation where students move from Multimedia ToolBook to challenging software like PhotoShop, Sound Forge, and Macromedia Director along with JAVA and 3D programs—a process that is crucial in teaching students how to "learn to learn software."
4. African-American readers of this example may have anticipated this result from the beginning. We, the authors who are white, did not. One way of interpreting this difference is to say that the white teacher and researchers were naïve about African-American culture. And, had they not been so naïve, they would not have allowed the girls to get away with this prank. Another way of interpreting the difference is to say that these kinds of cultural misunderstandings among people in interaction with each other are inevitable. Yet, in the right circumstances, they can be productive moments (or spaces) for members of both cultural groups.

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