11-2017

Using Culturally Relevant Experiential Education to Enhance Urban Children's Knowledge and Engagement in Science

Cara Michele Djonko-Moore
University of Tennessee, Knoxville, cmoore85@utk.edu

Jacqueline Leonard
jleona12@uwyo.edu

Quintaniay Holifield
US Department of Agriculture, qholifield@fs.fed.us

Elsa Bailey
ebbailey@earthlink.net

Sultan Almughyirah
salkulib@kfu.edu.sa

Recommended Citation

Cara M. Djonko-Moore, Jacqueline Leonard, Quintaniay Holifield, Elsa B. Bailey, Sultan M. Almughyirah. "Using Culturally Relevant Experiential Education to Enhance Urban Children's Knowledge and Engagement in Science." Journal of Experiential Education. November 2017 https://doi.org/10.1177/1053825917742164

Journal of
Experiential Education

Using Culturally Relevant Experiential Education to Enhance Urban Children’s Knowledge and Engagement in Science

Journal:	*Journal of Experiential Education*
Manuscript ID	JEE-16-0006.R4
Manuscript Type:	Original Article
Keywords:	urban children, field trips, experiential science education, Cultural diversity < Topics, STEM education < Topics
Abstract:	Background: Children living in urban areas often have limited opportunities to experience informal science environments. As a result, some children who live in urban settings do not have a deep understanding of the environment, natural resources, ecosystems, and the ways human activities affect nature. Purpose: The purpose of this paper is to examine how experiential science education supported urban children’s science knowledge and engagement through cultural relevance and eco-justice during a one-week summer camp. Methodology: The researchers implemented this study with third- through sixth-grade children from African-American and Latinx urban communities in Colorado. The children participated in a weeklong program that utilized experiential learning opportunities, including environmental and climate change lessons, activities at a local community-based site and three field trips to nature- and science-themed sites. Pre- and posttests, focus group interviews, journals, and student work samples were analyzed. Findings: Results reveal that children’s science content knowledge as well as their engagement in science lessons and field trips were positively influenced during the study. Moreover, this study provides a template for establishing a culturally relevant experiential learning experience to engage underrepresented children in science.

Using Culturally Relevant Experiential Education to Enhance Urban Children's Knowledge and Engagement in Science

Abstract

Background: Children living in urban areas often have limited opportunities to experience informal science environments. As a result, some do not have a deep understanding of the environment, natural resources, ecosystems, and the ways human activities affect nature.

Purpose: This article examines how experiential science education supported urban children's science knowledge and engagement through cultural relevance and eco-justice during a one-week summer camp. **Methodology/Approach:** Third- through sixth-grade children from African-American and Latinx urban communities in Colorado participated in a weeklong program using experiential learning opportunities including environmental and climate change lessons, activities at a local community-based site, and field trips to nature- and science-themed sites. Pre- and posttests, focus group interviews, journals, and student work samples were analyzed. **Findings/Conclusion:** Children's science content knowledge as well as their engagement in science lessons and field trips were positively influenced during the study.

Implications: This study provides a template for establishing a culturally relevant experiential learning experience to engage underrepresented children in science.

Using Culturally Relevant Experiential Education to Enhance Urban Children's Knowledge and Engagement in Science

Science education in urban public schools has diminished over the past ten years in favor of additional instruction in reading and mathematics to address accountability measures (Lee & Buxton, 2008; Leonard, Barnes-Johnson, Dantley, & Kimber, 2011). As a result, some children who live in urban settings do not have a deep understanding of the environment, natural resources, ecosystems, or the ways human activities affect nature. Yet, children in the 21st century spend less time outdoors and have few opportunities to connect science to real-world experiences (Ferreira et al., 2012; Holmes, 2011).

Experiential education has been described as a methodology that is used purposefully to engage learners in direct experience and personal reflection to improve knowledge, develop skills, clarify values, and increase one's capacity to contribute to the local community (Association of Experiential Education, 2014; Mohan, 2016). Experiential science education can take place in a variety of settings such as parks, museums, libraries, zoos, and other places where children can engage in authentic learning while still having fun (Holmes, 2011; Yoon, Elinich, Wang, Van Schooneveld & Anderson, 2013). Furthermore, intentional experiences that allow children to self-select their activities provide opportunities for them to have a voice and make choices that are relevant and meaningful to their lives (Falk, 2001), thus incorporating cultural relevance.

To increase opportunities for urban children and youth to experience culturally relevant, authentic science education through the natural environment, the researchers implemented this study with third- through sixth-grade children from African-American and Latinx urban communities in Colorado. Through culturally relevant experiential education in the form of science lessons in community-based centers and outdoor education settings, the children used science processes (i.e., observation, prediction, inference, problem solving, drawing conclusions, etc.) as they explored and collected data to learn about the environment, climate change, and sustainability.

The researchers selected experiential education as the foundation of this study because of the research on learning that indicates inquiry-based, hands-on approaches are important for diverse learners (Lee & Buxton, 2008). Moreover, experiential learning compliments STEM learning in several ways. First, collecting data from real objects helps children to see connections between science and real life. Second, STEM content runs the risk of becoming obtuse and meaningless without authentic experiences (Bishop, 1988). Third, embedding cultural relevance allows children to make connections between content areas like mathematics, science, and writing and their personal lives, homes, and communities. The purpose of this paper is to examine how experiential science education supported urban children's science knowledge and engagement through cultural relevance and eco-justice during a one-week summer camp.

Theoretical Framework

This study is underpinned by culturally relevant and eco-justice pedagogy. Cultural and social dynamics are missing from traditional conceptions of experiential learning. Cultural differences influence the ways in which individuals interpret their lives and educational experiences. White (as cited in Bishop, 1988), described four components of culture: a) ideological (i.e., beliefs, symbols, and philosophies); b) sociological (i.e., customs, institutions, and patterns of behavior; c) sentimental (i.e., attitudes and feelings); and d) technological (i.e., manufacture and use of tools). These cultural components are crucial for developing a theory on culturally relevant pedagogy (CRP). Ladson-Billings' (1995) grounded theory of CRP incorporated these components in the following propositions: "1) concrete experiences as a criterion of meaning (i.e., sociological and technological), 2) use of dialogue in assessing knowledge claims (i.e., ideological), 3) the ethic of caring (i.e., sentimental), and 4) the ethic of personal accountability (i.e., ideological and sentimental)" (Collins, as cited in Ladson-Billings, 1995, p. 471). Three tenets emerged from these propositions to further describe the essential elements of CRP: a) academic success; b) cultural competence; and c) critical consciousness (Ladson-Billings, 1995). Thus, CRP combined with experiential education provides a more complete theoretical foundation.

Science educators and scholars have come to realize that science instruction is often disconnected from the lives of students (Buxton, 2010; Elmesky & Seiler, 2007). Eco-justice pedagogy connects experiential education and CRP to the domain of science and the natural environment. Eco-justice can be defined as a school of thought that combines environmental and social justice along with oppression of peoples and nature and the decline of the ecosystems (Bowers, 2002; Mueller, 2009). Science should be presented in a manner that considers diversity and inclusion of underrepresented persons, community-based issues, and other cultural aspects, such as poor air and water quality in Black and Brown communities and pipelines through Native American lands. According to Brickhouse and Kittleson (2006), "we must teach sciences and local knowledge in ways that link them to values and purposes consistent with ecological sustainability and that encourage participation in science-related communities both in and outside of schools" (p. 204).

Review of the Literature

The bodies of literature that support the current study are as follows: a) experiential science learning in informal settings and b) culturally relevant science education and eco-justice. The literature in each of these areas expands the theoretical framework and is presented below.

Experiential Science Learning in Informal Settings

Informal settings, such as museums, provide unique opportunities for children and youth to engage in experiential science activities that can stimulate curiosity and interest in science (Holmes, 2011). Yoon et al. (2013) conducted a study to learn how experiential learning sites like museums can reinforce middle school students' learning in science. They concluded it is important to balance structured learning and informal activities to enhance conceptual knowledge and scientific inquiry (Yoon et al., 2013).

Field trips have also been noted for providing children with deep learning experiences and a sense of community (Aikenhead, 2001; Ferreira et al., 2012). Morag and Tal (2012) conducted a study on the impact of experiential learning in the form of twenty-two field trips taken by children in Israel. The researchers determined that planning and preparation before the field trip, pedagogy used during the field, and connecting the field trip to children' everyday experiences were important components in fostering children' learning. The aforementioned studies inform the current study in terms of planning and executing experiential learning activities with children in informal settings

Culturally Relevant Science Education and Eco-Justice

Connecting science learning to issues that impact and concern communities of color has the potential to increase student engagement and content knowledge for the purpose of empowering them to participate in social action (Agyeman, 2014; Akom, 2011). Culturally relevant pedagogy includes critical consciousness as a major tenet and can be interwoven with eco-justice pedagogy. Bowers (2002) suggested that eco-justice pedagogy has a significant role in assisting children in understanding and engaging in non-commoditized activities and societal tasks as well as realizing important implications for making connections among societies and the natural environment.

Eco-justice focuses on exploring the connections between cultural norms and the natural environment, particularly ecosystems, and combines environmental justice and social justice issues (Mueller, 2009). Akom (2011) sought to reconceptualize eco-justice by focusing on the "social determinants of health, critical race theory, and social epidemiology" (p. 832). In particular, he addressed issues of air and soil quality in California and how the health of children in overcrowded urban schools was impacted.

Presently, eco-apartheid persists in African American communities in large urban cities like Flint, Michigan, which continues to suffer from contaminated water (Oosting, 2016). While lead-based paint was banned in 1978, contractors in Denver, Colorado, violated the renovation, repair, and painting (RRP) rule, exposing residents to toxic lead in 2015 (Mylott, 2016) and asbestos dust in 2014 (Mitchell, 2017). Thus, children in urban communities continue to be impacted by toxins that lead to asthma, developmental impairment, learning disabilities, hearing impairment, attention deficit disorder, hyperactivity, and behavior disorders (Mylott, 2016).

Two studies— Bang and Martin (2015) and Brayboy and Maughan (2009)—emphasize the importance of making connections between the natural world and cultural forms of life in science education. Brayboy and Maughan (2009) studied an Indigenous preservice teacher's use of beans during a science lesson to illustrate Indigenous systems of knowing, being, valuing, doing, teaching, and learning. Children in a fourth-grade classroom conducted an experiment where they tried to grow bean plants in different types of soil (i.e., dirt and sand). This study had direct implications to our focus on plants and growing lima beans, which are easily accessible and a staple in the African-American community. Using materials that children from specific cultural groups are familiar with is culturally relevant (Aikenhead, 1997; Brayboy & Maughan, 2009; Lee & Buxton, 2008; Leonard, Napp, & Adeleke, 2009; Leonard, Brooks, Barnes-Johnson, & Berry, 2010;).

Research Questions

Based on the theoretical framework and the review of literature, the research questions were:

1) How did culturally relevant experiential learning influence student participants' science content knowledge?
2) How did the learning environments student participants' experience influence their engagement and interest in science?

Methodology

Narrative inquiry, simultaneously methodology and phenomena, is a method for studying experience (Clandinin, 2013). In this study, we extend narrative inquiry to urban children and youth in informal settings. Specifically, we used narrative inquiry as an analytical approach to unpack the qualitative data collected in this study. Researchers examined student participants' journal reflections, work samples, and content understandings through the lens of storytelling. These narratives add to the extant literature on experiential education and CRP.

Participants

The participants in the study include thirty-four children (18 African American; 12 Latinx; and 4 Biracial) who registered for a tuition-free summer camp. The 12 Latinx children were also all English Language Learners. After IRB approval, the children were recruited through a partnership with three churches located in working-class urban communities. These children went to K-6 public schools in African American and Latinx communities that provided free or reduced lunch for 87% to 91% of the children, respectively. Incentives for participation included a trip to a waterpark, backpacks with school supplies, and a drawing for prizes at the conclusion of the study (e.g., tablet, printer, and graphic calculator).

Context of the Study

Teacher-researchers (one African-American female, one Asian female, and one European-American male) at two universities in the Rocky Mountain West collaborated on the study presented in this paper. Two scientists collaborated with the universities to develop and implement the curriculum. The teacher-researchers were university professors with expertise in science or mathematics education. One of the teacher-researchers was also a minister at a local church that some of the student participants attended.

The weeklong camp for the children was located at a community center near downtown Denver. The community, known as Five Points, has become gentrified as property values skyrocketed and public housing shrank between 2000 and 2015 (Schrader, 2017). Thus, the community-based center was situated in a neighborhood that was shifting racially and economically. Sessions were held at the center from 9 am to 4 pm each day. There was a one-hour break included for lunch and recreation.

Overview of the Science Lessons

The soil scientist three teacher-researchers, two project staff, and 12 near-peer-mentors NPMs (ages 16-22) led the children through a rotation of four science lessons in the center that focused on the biotic processes of microorganisms, plants, and soil. The lessons and field trips included: a) observing microorganisms through the proper use of a microscope; b) modeling the life cycle of seeds; c) investigating the biological and chemical decomposition of organic material through composting; and d) analyzing soil samples and soil texture techniques. Each field trip included an aspect of nature and wildlife carefully selected to enhance student learning about the natural environment. A summary of the weeklong activities is presented below in Table 1.

[Insert Table 1 here]

Data Analysis and Data Sources

The researchers in this study used mixed methods as described by Creswell (2013) to collect quantitative and qualitative data. Data sources included three science content tests, focus group interviews, student journals, field notes, and student work samples. The three content tests were administered to participants on a pre-post basis. The content tests, developed by Qoncepts in Environment Education© and obtained from the United States Department of Agriculture, covered three topics: emergency preparedness, composting, and soil science. Scores were analyzed using paired-samples *t*-tests. Additional data sources included a questionnaire developed by an external evaluator who facilitated two focus group sessions with six children each on the final day of the camp. The focus group interviews were audiotaped and transcribed for analysis. Children's journals, field notes, and student work samples were also analyzed using the narrative inquiry approach (Clandinin, 2013) for themes and patterns and the constant comparative method (Strauss & Corbin, 1990) to determine the level of children' engagement and interest in science. The journals and transcripts of focus group interviews provided evidence to tell a narrative about culturally relevant experiential education in science.

Results

The purpose of this study was to investigate how culturally responsive experiential learning environments supported and enhanced student participants' science content knowledge as well as their engagement and interest in science.

Student Content Knowledge

Science content tests were administered to assess student knowledge relative to what they learned during the weeklong activities. Table 2 summarizes the results of the *t*-tests.

[Insert Table 2 here]

The results of the paired sample *t*-tests revealed a significant difference between pre- and posttest scores on the emergency preparedness test, $t(24) = -3.08$, $p = .005$, with posttest scores ($M = 71.88$, SD = 12.15) significantly higher than pretest scores ($M = 59.16$, SD = 18.97). There was also a significant difference between pre- and post-test scores on the composting test, $t(24) = -2.43$, $p = .023$, with posttest scores ($M = 64.84$, SD = 19.30) significantly higher than pretest scores ($M = 51.44$, SD = 21.23). Effect size results suggest a moderate effect for emergency preparedness and a small-to-moderate effect on composting. There was no significant difference between pre- and posttest scores on the soil test. Given the importance of soil for eco-justice, these results informed the researchers where there were gaps in children's learning.

Learning and Engagement during Science Lessons and Field Trips

Microscope lesson. The microscope lesson allowed children to observe micro-organisms of ready-made slides and to prepare slides to examine onion cells and check cells. Three children commented on the microscope activities.

> *What was cool for me, it was when we looked at the cells….* (Student group interview)
>
> *A new thing for me was also the cell. Mainly at school we were looking at different stuff.* (Student group interview)
>
> *[The] cell is [a] basic form of life. All systems make us function.* (Student journal entry)

The first two excerpts indicate that the microscope lesson was valuable for some participants due to the inclusion of live, organic material (cells) and the novelty of the experience. The third comment hints at the importance of a cell in the biosphere and the information it provides to help the body function. Finally, the comment about formal schools is insightful. Use of curriculum materials like those children experienced during the summer camp are sparse in urban schools with a high concentration of children of color and ELLs (Lee & Buxton, 2008).

Lima bean lesson. The lima bean lesson had the fewest comments in student journals but student work samples provided numerous observations and reflections about how the lima bean changed each day. Field notes show children observations each day except for Day 4 (field trip). One child claimed the lima bean activity was her favorite:

> *My favorite moment was spending time with new people. My next favorite moment was playing with [NPM]. My most favorite was doing the lima beans.* (Student journal entry).

This excerpt also reveals relationships were important to this child. She established a strong sense of community by engaging with other children as well as her NPM.

Children's work samples were analyzed for science vocabulary during the lima bean lesson. Lee and Buxton (2008) extolled the use of hands-on materials and inquiry to foster language acquisition and authentic science communication among ELLs. The observations of three randomly selected ELLs who identified as Latinx are presented below.

Day 1: *The seed looks big and its hard.* (ELL student 1)

It is closing. (ELL student 2)

It starting to close and it got more layers. It started to get smoother on the…side …on the edges besides being bumpy. (ELL student 3)

Day 2: *The three seeds opened, and the one in the middle opened more then the other seed and…didn't open that much.* (ELL student 1)

> *They smell bad and the paper is pelling.* (ELL student 2)
>
> *They got wrinkle in the outside. It started to close. It started to get smelly. The skin of the lima bean started to peel off.* (ELL student 3)

Day 3: *It looks a little puffy and looks a little bigger and turned white.* (ELL student 1)

Day 5*: In the last day the seed is sprouting and there black spots and there dirty*. (ELL student 1)

> *It smell bad and change color and some close and has little hand.* (ELL student 2)
>
> *The lima bean's skin is peeled off in the bottom. It started to smell bad. Also, one of the beans started to pop out and started to sprout.* (ELL student 3)

These ELL children used science vocabulary and scientific processes to describe the changes they observed as the lima bean germinated during the week. Children also used their sense of sight to describe the size (e.g. big(ger), color (e.g., white, black), texture (e.g., hard, smoother, bumpy, puffy, wrinkle, dirty), and behavior (e.g., close/closing, open(ed), peel(ed/ing), pop out, sprout(ing)) of the seeds. Two ELL children also used the term sprout or sprouting, indicating they understood the seed was alive and growing (Brayboy & Maughan, 2009).

Composting. Children learned how organic material decomposed to make soil, which can be used to grow fruit and vegetables like tomatoes, cucumbers, and beans. During this lesson, children engaged in measuring and explaining (Bishop, 1988). Six children made comments about composting:

> *The coolest thing was starting a compost … I watch TV shows; composts aren't that big. But now that we are doing compost, it takes a lot of work.* (Student group interview)
>
> *[I learned] that it takes 90 days for compost to break down.* (Student group interview)
>
> *[I learned about] the different stuff you can put in compost bins….* (Student group interview)
>
> *The good things to put in compost [are] banana, egg shell, and water. Bad things [are] meat, cheese, foil, egg, [and] poop.* (Student journal entry)

> *My favorite activity this week is the compost pail. The compost pail was my favorite because after a while it is going to make soil. That is going to be cool so then we can [grow] plants.* (Student journal entry)

> *…the composting isn't really fun for me, because to me it's just a big pile of trash.* (Student group interview)

These data indicate that two participants found the composting activity interesting, and one made connections to prior exposure via television. Three participants learned the time, effort, and materials needed for composting. However, another student simply saw composting as a "pile of trash."

Soil texture lesson. Two student participants made comments about soil analysis.

> *And we never talked about dinosaurs. So, I was confused. I was like, we were talking about dinosaurs and climate change, but we never talked about any of that. We only talked about soil. I was trying to put this together, but it didn't work.* (Student group interview)

> *I get to [work] with chemicals, and I get into some chemical reactions, and I get to test the soil and stuff like that.* (Student group interview)

The comments reveal one participant seemed to be disengaged from the soil lessons due to interests in other topics like dinosaurs and climate change. Although climate change was touched upon in every lesson, the first excerpt suggests the student needed these connections to be made explicit. In the second excerpt, the student expressed enjoyment in working with chemicals and seeing chemical reactions which suggests a high level of engagement.

Denver Museum of Nature and Science. Children visited exhibits at the museum, including a health exhibit. Furthermore, they saw an IMAX movie on the Galapagos Islands to learn about ecosystems and animal migration. Other exhibits included dinosaurs and other species both living and extinct.

> *My favorite [sic] day was at the nature and science museum because when me and Master Chief (NPM) stuck our hand in a hole, and we were both scared, and we looked inside it, and it was deer hide.* (Student journal entry)

> *I really liked the natural science museum, mostly because we did different exhibits and didn't really stand in one spot. We kind of spread out around it. My favorite part of the museum was the [health] exhibit, and walking around and actually getting to do stuff in it, instead of just standing there and looking at stuff …The bike … It tells you how fast your heart rate was, and how many beats per minute you had. And when you stopped, it showed how healthy your body and your heart is.* (Student group interview)

> *My favorite part was when we went to the museum…. The IMAX theater… It was fun. [It made you] think it was real…. It's 3D.* (Student group interview)

> *I enjoyed the museum and going to the health expedition thing…It was fun going across the screen thing that they had…. Doing cartwheels.* (Student group interview)

These data suggest the children had high interest in the museum exhibits. The first excerpt mentioned exploring an interactive exhibit with a NPM. This excerpt reveals this NPM developed rapport with one of his children as they engaged in inquiry and learned alongside one another. Several NPMs engaged in an ethic of caring (Ladson-Billings, 1995) and co-constructed knowledge with the children in this study (Leonard, Chamberlin, Johnson, & Verma, 2016; Morgan et al., 2009). These experiences support Yoon et al.'s (2013) findings that museums offer opportunities for children to engage in science inquiry to develop science concepts.

Denver Botanic Garden. The trip to the botanic garden included a nature walk and an activity at the tropical conservatory similar to the *Survivor* television show. Children engaged in counting (i.e., tallying), locating, and explaining (Bishop, 1988).

> *[I liked] all the field trips I took. I learned something new that I didn't know. Like nature, and botanic garden . . . the Japanese garden.* (Student group interview)

> *My cool part was when we went to the botanic gardens, because we got to go to the survivor one. And it was really fun going on the survivor one… But it was really, really hot.* (Student group interview)

> *My favorite part of the [field] trips so far is the Botanic Garden. First, the Jappenese Garden was beautiful. There were many lily pads with wonderful flowers. Second, was the Survivor. We saw many plant-like bannanna] trees. Third,*

> *there were pretty flowers. All of the flowers I saw were glamourous like Queen Anne's lace. All in all, my favorite part of the trip so far is the Botanic Garden, and going there makes me feel like a calm bee.* (Student journal entry).

> *I enjoyed going to the botanic garden although it was very hot.* (Student journal entry).

> *I didn't really like the botanic gardens, because it was kind of boring, and there was a lot of walking. And nature, to me, is basically plants. It's just plants, so they really don't interest me.* (Student group interview)

> *I kind of didn't like the botanic gardens either, because sometimes I don't like nature, a lot of times. I don't like to get out. I'm not an outdoor person a lot of times.* (Student group interview)

Due to the activities offered or because of a personal interest, four excerpts demonstrate some of the participants were engaged at the botanical garden. Two children specifically enjoyed the Japanese garden. One of these children identified lilies, banana trees, and Queen Anne's Lace. She also stated the garden made her feel calm.

Not all the children enjoyed the botanic garden. Two children stated they did not like the hot conditions in the conservatory, and two stated they did not like this field trip. One student stated, "*I'm not an outdoor person….*" Another child, thought the trip was boring and was simply uninterested in plants. Perhaps building children's prior knowledge about plants and their importance for sustaining life and providing food sources for growth and reproduction could have helped these children to make deeper connections (Morgan, Hamilton, Bentley, & Myrie, 2009; NGSS, Lead States, 2013).

Rocky Mountain National Park. Children engaged in several experiential activities such as learning how the mountains were formed by glaciers. Children also learned about FBI (fungi, bacteria, and invertebrate), predators via CSI (Carnivore scene investigation), and explored animal pelts. Finally, children enjoyed nature walks and learned how some trees were infested with pine beetles.

> *I learned that the CSI and FBI and all of those things that you see on TV mean different things in the wilderness. Like, FBI means fungus, bacteria, and invertebrates. And CSI means carnivore scene investigation.* (Student group interview)

> *I learned that wolverines were actually real. Because the "Wolverine"… movie, I thought it was like a myth, that wolverines were a myth … And I learned that wolverines were real. Because we had to go on a little hunt and figure out what the different animal skins were … wolverines. It's a movie called "Wolverine" from Marvel.* (Student group interview)

> *My faveorit activaty was the neighborhood watch. On that walk we learned about FBI witch was fungus, bacteria, and invertibrat. You can find FBI on rocks, under rocks, and on trees. I also liked the other activety wich were geodetectives and CSI.* (Student journal entry)

> *My favorite thing was when we went to Rocky Mountain National Park because we got to go on a hike. Also, when we got to run down a hill. Then when we got feel the animal fur. That is why I liked Rocky Mountain National Park.* (Student journal entry)

Student learning and interest are evident in the excerpts above. Children connected the carnivore science investigation (CSI) theme used in the park activities to *Crime Science Investigation* on television. For example, one student explained knowing what it would feel like to be in a detective. Moreover, children used scientific vocabulary (i.e., carnivore, fungi, bacteria, and invertebrate) and learned that CSI and FBI can have other meanings in outdoor settings. Another child explained where to look for FBI in the park, enjoyed examining animal pelts, and just having fun. Thus, children engaged in locating, playing, and explaining (Bishop, 1988).

Finally, additional excerpts reveal some of the student participants' interest in hiking:

> *I liked all the field trips. The neighborhood watch was really cool, because I got a toe bone from an elk.* (Student group interview)

> *We went to Estes Park. That was fun … I like hiking, and I like the mountains more than I like the city. So that was fun. And I learned a couple of things about certain animals that I didn't know … I learned about animals … [I learned about a] Wolverine … I [didn't] … know wolverine …* (Student group interview)

> *[I liked] when we got to see dead animals and see what had [inaudible]…. I liked all the field trips.* (Student group interview & written note)

> *When we went to the mountains, I didn't like the scat, because it was everywhere…. Scat is poop…. It was everywhere I stepped on … it was scat.* (Student group interview)

> *It was scary to me a little bit by the mountain, because we saw a coyote… It wasn't that cool, because it was limping.* (Student group interview)

These data show a variety of interest in activities at the national park. Three of the participants identified animals, such as elk, wolverines, and coyotes as well as other animals and animal remains. Two participants discussed concerns they had about the experience related to the animals. One participant noticed the abundance of animal feces in the park while another noted seeing an injured animal. These comments reveal some participants may have been unprepared for their encounters. For many urban children, it was their first time visiting a national park, and they were unfamiliar with its sights and sounds (Van Velsor & Nilon, 2007). Thus, urban children should be prepared in advance for the wildlife, smells, and sounds they may experience at national parks (Gillan & Hebert, 2014; Morag & Tal, 2012).

Discussion

The purpose of this study was to provide culturally relevant experiential education by exposing underrepresented children to science in natural environments. The main characteristics of this study were offering science content during out-of-school time (OST), providing concrete hands-on science activities for children, and facilitating field trips. Climate change was addressed through the lessons as each one dealt with some aspect of the ecosystem. For example, discussions on catastrophic weather events and emergency preparedness occurred during the weeklong summer camp. Children's content knowledge on emergency preparedness increased significantly from pre- to posttest, and the effect size was moderate. Th children made connections to eco-justice and food justice by allowing children to engage in composting, soil sampling, and soil texture lessons. Children's scores on the composting test also increased significantly. Student had the largest gain score on this test, which had a small-to-moderate effect size. However, children did not make significant pre-post gains on the soil test. Children's prior knowledge was lowest on this topic compared to composting and emergency preparedness. Knowing this fact, the researchers realize the need to spend more time on this topic to help children develop deeper content knowledge about soil in future studies.

The results of this study suggest that it had a positive impact on children's learning, engagement, and interest in science. Various modes of disseminating content knowledge to children are crucial to maintain their interest (Basu & Barton, 2007). The children's narratives suggest that they preferred the field trips and hands-on activities, which helped African-American and ELL children to build content knowledge, use scientific vocabulary, and create unique understandings about science and climate change (Lee & Buxton 2008). The variety of activities and field trips allowed the children to experience several aspects of the natural environment (Holmes, 2011; Yoon et al., 2013). The topics and field trips provided children with authentic science activities that they most likely did not experience at school (Ferreira et al., 2012). Science was accessible and made visible (Linn & Hsi, 2000, and children were able to learn from one another and engage in autonomous learning through reflection (Bowers, 2002).

Limitations

The results of this study are limited to the participants and the setting where it took place and should not be generalized to other children and settings. In addition, a weeklong summer camp may not have been enough time for children to learn all the science concepts. While we attempted to develop activities that were culturally relevant and hands-on, the connections were not always explicit enough for every child to understand the importance of the concepts. We also could have better prepared for the field trips to ensure that lessons were more closely aligned to eco-justice. If this study were to be replicated, we suggest focusing on fewer topics for children to develop greater depth and breadth of knowledge. Future research should also incorporate pre-post measures of children's science engagement and STEM attitudes to provide additional evidence about student learning and preferences. A longitudinal design might also help to determine whether summer programs help children's science achievement during the school year or influence taking STEM courses in middle and high school.

Acknowledgements

We acknowledge Shorter "Community" African Methodist Episcopal Church, Campbell Chapel African Methodist Episcopal Church, and Gracia y Vida Church for recruiting the participants in this study. The material presented is based upon work supported by the National Science Foundation Award Number GEO-1260957. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the National Science Foundation.

References

Agyeman, J. (2014). Global environmental justice or Le droit au monde? *Geoforum, 54,* 236-238. doi: 10.1016/j.geoforum.2012.12.021

Aikenhead, G. S. (1996). Science education: Border crossing into the subculture of science. *Studies in Science Education, 27*, 1-52. doi: 10.1080/03057269608560077

Aikenhead, G. S. (1997). Toward a First Nations cross-cultural science and technology curriculum. *Science Education, 81*, 217-238. doi: 10.1002/(sici)1098-237x(199704)81:2<217::aid-sce6>3.3.co;2-3

Aikenhead, G. S. (2001). Students' ease in crossing cultural borders into school science. *Science Education, 85*(2), 180-188. doi: 10.1002/1098-237X(200103)85:2<180::AID-SCE50>3.0.CO;2-1

Akom, A. (2011). Eco-apartheid: Linking environmental health to educational outcomes. *Teachers College Record, 113*, 831-859. doi: 10.1080/10999940802523968

Association of Experiential Education. (2014). Retrieved from https://aee.memberclicks.net/what-is-ee

Bang, M., & Marin, A. (2015). Nature–culture constructs in science learning: Human/non-human agency and intentionality. *Journal of Research in Science Teaching, 52*(4), 530-544. doi: 10.1002/tea.21204

Basu, S. J., & Barton, A. C. (2007). Developing a sustained interest in science among urban minority youth. *Journal of Research in Science Teaching, 44*(3), 466-489. doi: 10.1002/tea.20143

Bishop, A. J. (1988). Mathematics education in its cultural context. *Educational Studies in Mathematics, 19*(2), 179-191. doi: 10.1007/978-94-017-2209-4_4

Bowers, C. A. (2002). Toward an eco-justice pedagogy. *Environmental Education Research, 8*(1), 21-34. doi: 10.1080/13504620120109628

Brayboy, B. M., & Maughan, E. (2009). Indigenous knowledges and the story of the bean. *Harvard Educational Review, 79*(1), 1-21. doi: 10.17763/haer.79.1.l0u6435086352229

Brickhouse, N. W., & Kittleson, J. M. (2006). Visions of curriculum, community, and science. *Educational Theory, 56*(2), 191-204. doi: 10.1111/j.1741-5446.2006.00011.x

Buxton, C. (2010). Social problem solving through science: An approach to critical, place-based, science teaching and learning. *Excellence & Equity in Education, 43*(1), 120-135. doi: 10.1080/10665680903408932

Clandinin, D. J. (2013). *Engaging in narrative inquiry.* Walnut Creek, CA: Left Coast Press.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage Publications.

Elmesky, R., & Seiler, G. (2007). Movement expressiveness, solidarity and the (re)shaping of African American students' scientific identities. *Cultural Studies of Science Education, 2*(1), 73-103. doi: 10.1007/s11422-007-9050-4

Falk, J. H. (2001). *Free-choice science education: How we learn science outside of school.* New York, NY: Teachers College Press

Ferreira, M. M., Grueber, D., & Yarema, S. (2012). A community partnership to facilitate urban elementary students' access to the outdoors. *School Community Journal, 22*(1), 49-64. doi: 10.1037/e741382011-025

Gillan, A. L., & Hebert, T. (2014). It's a zoo out there. *Science and Children, 51*(9), 59-65. Retrieved from: http://www.scholarworks.iu.edu

Holmes, J. A. (2011). Informal learning: Student achievement and motivation in science through museum-based learning. *Learning Environments Research, 14*(3), 263-277. doi: 10.1007/s10984-011-9094-y

Ladson-Billings, G. (1995). Toward a Theory of Culturally Relevant Pedagogy. *American Educational Research Journal, 32*(3), 465. doi: 10.2307/1163320

Lee, O., & Buxton, C. (2008). Science curriculum and student diversity: A framework for equitable learning opportunities. *The Elementary School Journal, 109*(2), 123-137. doi: 10.1086/590522

Leonard, J., Barnes-Johnson, J., Dantley, S. J., & Kimber, C. T. (2011). Teaching science inquiry in urban contexts: The role of elementary preservice teachers' beliefs. The Urban Review, 43(1), 124-150. doi: 10.1007/s11256-010-0173-7

Leonard, J., Brooks, W., Barnes-Johnson, J., & Berry, R. Q. (2010). The nuances and complexities of teaching mathematics for cultural relevance and social justice. *Journal of Teacher Education, 61*(3), 261-270. doi 10.1177/0022487109359927

Leonard. J., Chamberlin, S., Johnson, J. B., & Verma, G. (2016). Social justice, place, and equitable science education: Broadening urban students' opportunities to learn. *The Urban Review, 48*(3), 355-379. doi: 10.1007/s11256-016-0358-9

Leonard, J., Napp, C., & Adeleke, S. (2009). The complexities of culturally relevant pedagogy: A case study of two secondary mathematics teachers and their ESOL students. *The* High School Journal, 93(1), 3-22. doi: 10.1353/hsj.0.0038

Linn, M. C. & Hsi, S. (2000). *Computers, teachers, peers: Science learning partners*. Mahwah, NJ: LEA.

Mitchell, K. (2017, May 17). Apartment executive sentenced to federal prison for exposing Overlook at Mile High tenants to asbestos dust. *Denver Post.* Retrieved from http://www.denverpost.com/2017/05/17/overlook-mile-high-asbestos-landlord-imprisoned/

Mohan, S. (2016). Traditional vs. experiential: A comparative study of instructional methodologies on student achievement in New York City Public Schools. Retrieved from ProQuest. (Order no. 10009853).

Morag, O. & Tal, T. (2012). Assessing learning in the outdoors with the Field Trip in Natural Environments (FiNE) framework. *International Journal of Science Education*, *34*(5), 745-777. doi: 10.1080/09500693.2011.599046

Morgan, S. C., Hamilton, S. L., Bentley M. L., & Myrie, S. (2009). Environmental education in botanic gardens: Exploring Brooklyn Botanic Garden's Project Green Reach. *The Journal of Environmental Education, 40*(4), 35-52. doi: 10.3200/joee.40.4.35-52

Mueller, M. P. (2009). Educational reflections on the "ecological crisis": Ecojustice, environmentalism, and sustainability. *Science & Education*, *18*(8), 1031-1056. doi: 10.1007/s11191-008-9179-x

Mylott, R. (2016, June 28). Denver contractors cited for not following lead-safe requirements on home renovation projects. Retrieved from https://www.epa.gov/newsreleases/denver-contractors-cited-not-following-lead-safe-requirements-home-renovation-projects

Oosting, J. (2016, November 16). Flint mayor extends city's state of emergency. *The Detroit News.* Retrieved from http://www.detroitnews.com/story/news/michigan/flint-water-crisis/2016/11/15/flint-emergency-declaration/93925580/

Schrader, M. (2017, June 23). As Denver's neighborhoods gentrify, the poor are pushed to new pockets of poverty. *Denver Post.* Retrieved from http://www.denverpost.com/2017/06/23/as-denvers-neighborhoods-gentrify-the-poor-are-pushed-to-new-pockets-of-poverty/

Strauss, A.L., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques.* London: SAGE.

Van Velsor, S. W., & Nilon, C. H. (2007). A qualitative investigation of the urban African-American and Latino adolescent experience with wildlife. *Human Dimensions of Wildlife: An International Journal, 11*, 359-370. doi: 10.1080/10871200600894944

Yoon, S. A., Elinich, K., Wang, J., Van Schooneveld, J. B., & Anderson, E. (2013). Scaffolding informal learning in science museums: How much is too much? *Science Education, 97*(6), 848-877. doi: 10.1002/sce.21079

Table 1

Overview of Science Lessons

Day 1	Day 2	Day 3	Day 4	Day 5
Making the compost (nixed and observe compost made or organic materials for one week)	Microscope Activities cont.	Soil Labs (compared microorganisms in sand and soil using magnifying glasses)	Rocky Mountain National Park Field Trip (participated in four activities, including nature walk, FBI (fungi, bacteria, & invertebrate), CSI (carnivore scene investigation), and how the valley formed through glacial activity).	Planting a Community Garden (planted fresh flowers in mulch on the grounds of a local church)
Microscope Activities (used 400X microscope to examine onion and cheek cells)	Field trip to Nature and Science Museum (participated in health exhibit and saw IMAX movie on Galapagos Islands)	Field trip to botanic garden (participated in survival lesson and observed plants in several gardens)		Soil Sampling and Layers of the Earth (observed and analyzed content of a soil suspension and made models of the Earth's layers with Playdoh)
Lima Bean Activity (observed the germination of three lima beans in a zip-locked plastic bag)		Emergency preparedness lesson (learned what supplies were needed for survival)		Composting & Lima Bean Labs (finalized observations in journals)

Table 2

Summary of Descriptive Statistics and *t*-Test Results

Topic	*n*	*t*-statistic	Mean Pre-test (Std. dev.)	Mean Post-test (Std. Dev.)	Gain Score	Cohen's *d*
Emergency Preparedness	25	-3.08**	59.16 (18.97)	71.88 (12.15)	12.72	0.637
Composting	25	-2.43*	51.44 (21.23)	64.84 (19.30)	13.40	0.486
Soil	22	-1.68	45.36 (16.92)	52.50 (14.64)	7.04	-

Note * = $p < .05$; ** = $p < .01$