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Bringing Formal and Informal Science Education in Elementary Teacher Preparation: An Evaluation of Health Center Collaboration

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Abstract: *The purpose of this study was to explore how a health-based informal science education course, as part of an elementary undergraduate teacher preparation program, influenced pre-service teachers' ideas about formal and informal science teaching and learning. Additionally, the study explored how the course impacted their understandings of the value of bridging informal science to supplement formal instruction. Qualitative study data were gathered through two (mid- and end-of-semester) focus group interviews with five pre-service teachers enrolled in a health-based informal science course. Analysis of data indicated that the inclusion of informal science education experiences during PST preparation has the potential to support novice teachers' developing ideas about science teaching and learning including ways to connect science to students' lives and make science engaging and meaningful. Findings are reported in four key themes that emerged from the data: (a) formal teacher preparation and informal education, (b) connections between formal and informal science education, (c) personal and professional collaborations, and (d) benefits of informal science education.*

Keywords: Elementary science education, informal science education, health science, teacher preparation

INTRODUCTION

Elementary school teachers are responsible for teaching all subjects, yet many feel they lack the disciplinary knowledge or confidence in teaching science. Many pre-service teachers (PST) report few or weak models of effective science teaching during elementary school and in field placement schools (Abell & Roth, 1992; Avraamidou, 2014; Davis, Petish, & Smithey, 2006). Calls for reform have emphasized the need for teachers to prepare today's children with the ability to think critically and be creative problem solvers (National Research Council [NRC], 2007; NRC, 2012). Helping children learn strategies for investigating their world with a critical lens includes building a solid foundation in elementary school science. However, preparing elementary school teachers to identify as science teachers is challenged by elementary pre-service teachers' (PST) memories when they were elementary students (Thomas & Pederson, 2003). One legacy of No Child Left Behind (NCLB, 2003) legislation is the marginalization of science through an emphasis on mathematics and language arts and their related test scores (Goldston, 2005). To address this deficit, researchers have identified the potential to supplement what children learn in school by bridging formal science education with informal experiences and outreach (Avraamidou, 2015; Rennie & Johnston, 2004; Russell, 2002). Relatedly, expanding elementary teacher preparation to include informal science opportunities offers potential to enrich and expand pre-service teachers' learning experiences (Avraamidou, 2015; Carrier, 2009).

INFORMAL SCIENCE EDUCATION

Formal science education, in the context of this paper, is defined as traditional classroom teaching and learning, whereas informal science education references learning that occurs outside of school, such as field trips to museums or nature centers (Eshach, 2007). Braund and Reiss (2006) report that two-thirds of students' waking lives are spent outside of formal school settings. Their review of international research studies identifies positive impacts of free choice learning inherent to informal settings on students' attitudes and motivation for science learning, and on connecting science to students' lives (Griffin, 2004). Here we add to studies that examine the affordances of bridging of informal science experiences in formal science

teacher preparation (Avraamidou, 2015; Carrier, 2009; Hofstein & Rosenfeld, 1996; Kelly, 2000; Kisiel, 2013).

Informal science education and teacher preparation. Bridging formal and informal science learning environments to address science education reform goals may enhance pre-service science teacher preparation (Avraamidou, 2014; McGinnis et al., 2012). For example, Jung and Tonso (2006) found that PSTs who taught elementary school students in museum and nature centers perceived their experiences as supportive of their own classroom-based science teaching and learning practices. PSTs reported that the experience felt non-threatening, thus building their confidence in teaching science. In another study, PSTs credited their improved science teaching self-efficacy to experiences teaching students at a forestry preserve (Carrier, 2009). PSTs described the how students' excitement and interest in the informal settings strengthened their confidence in their abilities to teach science. Research suggests this connection to informal science experiences can shape PSTs' views on the nature of science teaching and learning, build confidence, and support science learning that occurs in formal instruction (Anderson, Lawson, Mayer-Smith, 2006).

METHODS

Context

The present research examined the informal science education field experiences of five PSTs enrolled in an undergraduate STEM-focused elementary teacher preparation program. The teacher preparation program includes two science methods courses; requirements beyond those of many teacher preparation programs as identified in a recent national survey in the U.S. (Trygstad, 2013). Following the first science methods course, PSTs have the option to enroll in a supplemental informal science education course, concurrent with their second science methods course. The informal education course consists of working with informal health educators at a local health education center (Center) that serves elementary and middle school field trip groups. Each PST worked individually with an informal health educator from the Center who guided PSTs to develop programs on health topics to present to visiting school groups from across the state. The topics included: dental health, nutrition, family life, general health, and drug education. PSTs' experiences were captured to help inform teacher preparation programs about the potential impact of informal science education experiences during teacher preparation. Additionally, through their experience at the Center, the PSTs had the opportunity to work closely with their first science methods professor, the informal health educators at the Center, as well as collaborate with one another.

Participants

The five pre-service teachers represented the common demographic for beginning elementary teachers (white and female) as identified in the National Survey of Science and Mathematics Education (NSSME) (Banilower, Trygstad, & Smith, 2015). At the time of the study, the pre-service teachers were 21-22 years old and enrolled in the second semester of their junior year in a four-year elementary teacher preparation program.

Our research question asked:

How does participation in an informal science education experience during formal elementary teacher preparation impact elementary pre-service teachers' views of science education?

Data collection

The PSTs were invited to participate in two hour-long focus groups, one mid-semester and one later in the semester. Williams and Katz (2001) have identified focus groups as providing collective and individual ideas that empower participants in this research process. The PSTs were asked about their observations of children visiting the Center during school field trips, their experiences with the informal educators, and the impact of their former and current views of science education. During focus groups, the researcher audio recorded the conversations with PSTs using pseudonyms to protect PSTs' identity. The audio data were then transcribed and coded using NVivo qualitative analysis software. Three researchers individually coded transcripts, identifying themes that emerged from the data. Common themes were discussed and differences in interpretation were resolved. A second round of coding narrowed the identification of themes and researcher interpretation; this was followed by a third round and resolution of differences. Researchers' common codes were compared and interrater reliability of 95% was established during a second round of coding and discussion.

Data analysis

Focus group transcripts were open coded to identify common themes that emerged (Creswell, 2007).

The main themes were:

1. Formal teacher preparation and informal education
2. Connections between formal and informal science education
3. Culture of collaboration
4. The benefits of informal science education

RESULTS

Overall assessment of PSTs' experiences revealed their professional and personal growth related to their semester-long involvement at the Center. Focus group data (excerpts) are reported below and organized by main themes that emerged from the interview transcripts across both focus group meetings. These data illustrate ways that the experience broadened PSTs' conceptions of formal and informal science education during their teacher preparation.

Formal Teacher Preparation and Informal Education

The PSTs reported that they could link what they learned in their formal science methods classes with practices they observed at the Center. Ann described learning from her methods courses that science instruction "has to have some relevance to students' lives and science is all about our lives." She explained, "I think our methods courses are frequently aligned with the idea of informal science, of capturing the energy of informal science in the classroom." PSTs recognized how science content and practices presented in their science methods courses applied to informal settings, and their informal science education course working at the Center solidified their understanding of these collective practices. PSTs further made connections with engaging science instruction practices. Bonnie explained, "Seeing the kids really excited to be there and enjoying the programs…kids tend to learn better when they're moving around."

Connections Between Formal and Informal Science Education

PSTs' collaborations with informal educators at the Center showed them that the educators spend a large amount of time planning and trying to balance a fun, low-pressure environment with learning, which they strategically linked to the state's science standards. In the second focus group Cathy stated, "I know how much work goes into teaching, but planning these programs and thinking about what will be fun for the kids but still educational and get the point across, it's a lot of work." Sharon explained, "You need to have a game plan...kids can still get excited, but they still need to learn at the end of the day." Sally reported feeling surprised by how closely related classroom educators' and informal educators' tasks and goals are, and she recognized from her observations of school group visits that teachers can enhance student learning from informal settings by providing students with related activities prior to the field trip.

Culture of Collaboration within Informal Science Environments

Many PSTs described the benefits of having deep conversations about teaching and learning with their professor and the Center's informal educators, which they believed would strengthen their abilities to collaborate with experienced teachers in the future. The PSTs reported that their work with the health educators made them feel valued and they began to see themselves as professionals. They appreciated the relaxed connections with their professor in the informal science education setting. Ann stated, "Working with [Professor] is awesome and getting to know [Professor] on a personal basis, I think we all have the stigma of our professors being scary…"

PSTs also described that working and communicating with their peers about their projects contributed to a deeper understanding of what they could do for their projects. These interactions also built camaraderie and enriched their learning. Bonnie said, "The conversations that we've had as a group … has really helped me to develop a much better understanding of...informal science education."

The Benefits of Informal Science Education

The PSTs' observations of school groups at the Center helped them gain an appreciation for the varied opportunities and benefits afforded by the Center. They recognized that informal education could be engaging for children and provide students with opportunities they may not otherwise experience. Sharon described the engagement they witnessed, "It's a different experience so you're getting the informal science and you're getting them excited about learning." Bonnie stated, "I think kids

tend to learn better when they're moving around and experiencing it on a different level than they do in the classroom."

The PSTs recognized that when schools incorporate informal science learning they expand students' visions of science. Sally explained, "They might never get to go to a museum…Their parents might not have the resources." Ann described how informal science education enriches students' learning because (formal education) teachers "might not have the time in the classroom."

DISCUSSION

These focus groups suggest that the inclusion of informal science education for PSTs can enrich their formal teacher preparation program experiences (Avraamidou, 2014, 2015; Carrier, 2009). Such experiences have the potential to broaden PSTs' notions of science instruction by providing them with exposure to science teaching and learning that occurs outside of formal classrooms. Interviews with PSTs in this study revealed four dominant outcomes of their participation with the Center that expanded their visions of science learning beyond formal school settings to embrace the benefits of informal science education:

(a) PSTs were able to recognize how programs at the Center connected science to students' lives, a concept promoted in their science methods courses. As they developed programs for visiting school groups, PSTs witnessed students' interest and engagement (Griffin, 2004) while participating in activities learning about their bodies and healthy living;

(b) PSTs recognized the mutual goals for active and engaged learning that formal and informal science educators share (Hofstein & Rosenfeld, 1996); the PSTs described plans to incorporate learning activities from the informal education setting into their future classrooms;

(c) PSTs' collaborations with other PSTs, the Center's health educators, and the course instructor supported their developing identities of themselves as professionals and provided them confidence for future collaborations with fellow teachers and administrators (Anderson et al., 2006; Carrier, 2009);

(d) PSTs in this study recognized how formal educators may encourage student engagement in science by supplementing formal instruction with learning opportunities in informal settings (Hofstein & Rosenfeld, 1996).

PSTs' work in an informal science setting helped prepare them as teachers to better supplement formal education with informal experiences. They learned that when teachers provide students with activities before and after their informal education experiences, they increase the potential for student learning.

Limitations

PSTs self-selected for their participation in the course, which limits the generalizability of the findings to broader populations. Data collected in this study were focus group interviews, which have the potential to limit as well as expand discussion ideas. The small sample size further limits generalizability of the findings beyond this study.

CONCLUSION

The findings from this study indicate that informal science experiences have the potential to support pre-service teachers' developing notions of effective science teaching and learning. As identified in the present study and by other researchers (Anderson et al., 2006; Avraamidou, 2015; Carrier, 2009; Kisiel, 2013), informal science environments offer motivating free-choice learning experiences and connect science to students' lives. The inclusion of informal science experiences as part of teacher preparation has potential to expand novice teachers' visions of science teaching and learning. Further research can follow beginning teachers whose teacher preparation included informal education experiences into their novice teaching years to examine their inclusion of informal strategies and experiences with their future students.

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