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Abstract
The 4-H Youth Development Program can play an important role in targeting improved science literacy among urban youth in the U. S. However, 4-H volunteers must be trained effectively in order to be competent in their roles as science educators, and existing methods of volunteer training in urban areas are inadequate. Lesson study, a professional development model for educators that uses a constructivist approach to learning, is a viable option. Lesson study occurs within the context of the specific learning setting, takes place incrementally over extended periods of time, and has been shown to be effective.

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Science Literacy in the United States: Challenges and Opportunities

National and international assessments have revealed that the levels of science literacy among youth in the United States are well below other developed nations (Hiraoka, 1998; National Center for Education Statistics, 2000; NSTA, 2005; Zinsmeister, 1998). Furthermore, science literacy is lowest among youth in urban areas, with test results falling consistently below U. S. national averages (Cavanagh, 2006; Fraser-Abder, Atwater, & Lee, 2006). Carlson and Maxa (1997) have advocated for non-formal education programs as important resources in addressing the science literacy problem, and Kisiel (2006) indicates that these resources are particularly viable options in urban areas.

The 4-H Youth Development Program has the potential to play a role in helping to address the issue of youth science literacy in urban areas in the U. S. Currently, approximately 1.7 million 4-H youth members, 26% of the total national enrollment, reside in urban areas (USDA, 2005), and 54% of all 4-H Program offerings are science-related (USDA, 2003). However, to have an impact on the science literacy of urban youth, 4-H must provide adequate professional development opportunities for the adult volunteers who lead 4-H activities.

Professional Development Needs of Volunteers as Non-Formal Educators in 4-H

Volunteers are essential to 4-H, serving most commonly as non-formal educators who lead projects and programs with youth (Boyd, 2004; Fritz, Karmazin, Barbuto, & Burrow, 2003; Smith & Finley, 2004), and with the current national youth membership demographics there has been an increased reliance on volunteers from urban areas (Fritz et al., 2003; Smith, Dasher, & Klingborg, 2005). In order to be successful in their role as educators, volunteers must be trained effectively (Hoover & Connor, 2001); however, according to Fritz et al. (2003), existing methods of training 4-H volunteers in urban areas are inadequate and the development of new strategies is imperative.

Volunteer Professional Development Using Constructivist

Strategies

Constructivism**,** as a learning theory, holds that knowledge is developed through experience (Schulte, 1996; von Glaserfeld, 1989). Through interactions with their physical and social environments, learners construct meaning by developing schemata, mental models of objects or events that allow them to organize their thoughts and develop understanding (Nichols, 2002). Over time, learners' knowledge increases and matures through continued and more complex environmental interactions. Existing schemata are modified when new information challenges prior knowledge (assimilation) and an adjustment in understanding (accommodation) is necessary; new schemata are formed when novel experiences are encountered and none existed previously. The knowledge that is constructed through these processes is learner-dependent and reflects an individual's developmental stage and the cultural context within which the learning occurs (Starratt, 2001).

As an overarching theoretical approach to training 4-H volunteers in urban areas, constructivism could be important for three key reasons. First, constructivism provides learners with the opportunity to challenge their current thinking and formulate new explanations relative to their understanding of science and effective ways to teach the subject. Through assimilation and accommodation, volunteers, as learners, would have the opportunity to review and reform their ideas about teaching and learning.

A second reason is that constructivism is a learner-centered approach that allows for the consideration of individuals' prior experience, race/ethnicity, culture, language, social class, and gender, all crucial factors that influence knowledge and practice. This is critical because these are important and interrelated factors that affect learning and contribute to the low levels of science literacy among urban youth in the U.S. (Fraser-Abder, Atwater, & Lee, 2006).

Third, a learner-centered approach to professional development can serve as a means for educators to model the process of constructivist learning to their target audience (Daley, 2003). Youth science in the U.S. is typically taught through lectures and demonstrations that place an emphasis on the memorization of facts (Hinman, 1999; Jorgenson & Vanosdall, 2002), which tends to result in disaffected students (Weld, 1997). Conversely, constructivist methods exhibit the potential for improving youth science literacy (Beerer & Bodzin, 2004) by engaging learners in the process of generating their own understanding through direct experience (Marek & Cavallo, 1997).

Lesson Study: A Constructivist Approach to Volunteer Professional Development

One option to address the professional development needs of 4-H volunteers using constructivist methods is through lesson study, an educator training model that occurs within the context of the learning setting and takes place in increments over time (Rock & Wilson, 2005). In lesson study, educators work in groups and engage in active reflection around interests, ideas, and issues related to a particular lesson in a specific learning setting. Through these social interactions, they challenge their beliefs and construct new knowledge that helps them develop and improve their practice (Marble, 2006; Rock & Wilson, 2005). The process is thoughtful and deliberate, and educators assume a leadership role with respect to their professional development (Boss, 2002).

Lesson study has a long and successful history in Japan--over 100 years--and is increasingly recognized as a model that has great potential in the United States (Lewis, Perry, Hurd, & O'Connell, 2006). Research on lesson study has shown it to be effective, revealing positive impacts on teachers' knowledge, skills, and confidence (Rock & Wilson, 2005; Stigler & Hiebert, 1999; Wiburg & Brown, 2007), as well as their abilities to develop and implement science lessons (Marble, 2006). Furthermore, the lesson study approach is an excellent match with the 4-H method of "learning by doing" and could help volunteers in urban areas meet the needs of their diverse populations through its contextualized approach.

Lesson study is relatively new to the United States (Lewis, Perry, Hurd, & O'Connell, 2006; Lewis, Perry, & Hurd, 2004; Wiburg & Brown, 2007), and there is currently no literature describing its use in non-formal education settings. However, a variety of resources exist that are extremely useful in learning about the background, theory, and application of the model. For example, Wiburg and Brown's (2007) book entitled *Lesson Study Communities: Increasing Achievement with Diverse Students* is a comprehensive resource that leads educators through the process with the goal of establishing effective lesson study communities. Additionally, Lewis, Perry, and Hurd (2004) describe essential features of successful lesson study, Marble (2006) discusses the use of the model as a professional development tool to help improve educators' abilities to design and implement science lessons, and Rock and Wilson (2005) investigate the influence of lesson study on teachers in urban areas.

Conclusion

There is a need to improve science literacy in the United States, particularly in urban areas, and non-formal education programs like 4-H can play a vital role. However, in order to make contributions in this capacity, there is a need to provide adequate training to the volunteer educators who lead 4-H educational activities, and this problem is particularly acute in urban areas

(Smith, Dasher, & Klingborg, 2005). Lesson study, a constructivist approach to educator professional development, is a viable option. Lesson study has shown to be effective in improving educators' knowledge and abilities to develop and teach science lessons; furthermore, lesson study uses a learner-centered approach and has the qualities that Zeichner, Klehr, and Caro-Bruce (2000) deem necessary for effective professional development strategies in that it "respects and builds upon the knowledge and expertise" that educators already have.

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