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Place-based STEM Education

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Place-based STEM education prepares agriculture and science teachers to solve problems in the local community. It is consistent with aims and commitments stated in the Sustainable Development Goals. Place-based STEM education is linked to the natural and cultural environments. It provides students the opportunity to act locally to connect with global sustainability issues.

Problem Solving

Place-based STEM education is consistent with the recent development of the U.S. Next Generation Science Standards (NGSS) that focus on the applications of science and engineering practices as students learn to solve problems in real world contexts (National Research Council, 2013). The NGSS standards include cross-cutting concepts that unify the study of science and engineering through the core ideas in the physical sciences, life sciences, earth and space sciences, mathematics, technology. Proponents of the NGSS have identified interdisciplinary STEM education as essential to workforce and economic development. Place-based STEM education connects students to local community resources and fosters engagement opportunities for entrepreneurial and workforce ready skills development through experiential education.

Connecting to the Local Community

Place-based STEM education focuses on the sustainability and "provides a way for teachers and communities to prepare children to become participants in local problem-solving" (Smith & Sobel, 2010). Based on the concept that, "… education should prepare people to live and work to sustain the cultural and ecological integrity of the places they inhabit" (Woodhouse & Knapp, 2000), place-based STEM education includes the sources of intellectual and cultural capital in the local community known as funds of knowledge (e.g., Gonzalez, Moll and Amanti, 2005). Funds of knowledge may include knowledge and practices of sustainable agriculture or the use of local technologies that connect to core concepts in science and agricultural education.

Inquiry-by-Design

Embracing an inquiry and critical thinking approach, place-based STEM education assumes the teacher and students are all learners in the classroom. The science teacher orchestrates collaborative learning that is problem-based, experiential, and reciprocal. Inquiry-by-design pedagogies engage learners in problem solving and design though an integrated approach in STEM subjects. The inquiry-by-design process involves learners in identifying problems related to local issues then brainstorming solutions; applying science and mathematics concepts; analyzing resources issues; choosing the best technologies and methods of data analysis; and evaluating solutions. The 5-E Learning Cycle (Engage, Explore, Explain, Elaborate, Evaluate) is a useful teaching model for place-based STEM education. It provides a framework for teachers to engage learners in problem-solving and active learning. Using the place-based approach, each student brings the gift of his or her own perspective and life experiences to the activity and discussion. The classroom is enriched by collaborative discussions and investigations that directly affect the sustainability of their communities.

Connecting to Indigenous Knowledge and Practices

This place-based approach to STEM education was a central focus of collaborative efforts among teacher educators and elders in Malawi. Lesson plans were developed using locally available resources to address ecological sustainability issues that were relevant to the community and culture (Glasson, Frykholm, Mhango, & Phiri, 2006). These issues included deforestation, water quality, charcoal making, and sustainable agriculture. The teachers consulted community elders and identified local funds of indigenous knowledge and practices as resources in developing and teaching lesson plans. Inquiry and learner-centered strategies were employed that encouraged student dialogue and reflection, hands-on activities, role-playing, storytelling, and engagement in local communities.

Place-based STEM education is now being implemented at sites throughout the world to improve student participation and achievement in STEM subjects. In Thailand, science teachers' content knowledge, attitudes, and capabilities improved after participating in a place-based education (Klechaya, 2012). In rural Spain, Dopico and Garcia-Vazquez (2011), documented the learning of students who were investigating agricultural practices that are passed down for generations. In the southwest United States, place-based STEM education was embedded in both literate and non-literate oral traditions of Native Americans and is "fundamental to both individual and sociocultural identity" (Semken and Brandt 2010, p. 294). Nadelson, Seifer, and McKinney (2014) found that place-based STEM has the potential to improve STEM knowledge and engagement of students by contextualizing learning in the local environment, workplace, businesses, and industries.

Place-based STEM approach in practice

Teachers and students connected with traditional farmers at Tikondwe Freedom Gardens in rural Malawi by using mobile phone technology to learn about sustainable agricultural practices (Glasson, 2010). Sustainable farming practices, including gravity-fed irrigation, composting, organic pest management, and sunken plots are employed to improve crop yield, enhance food security, and provide employment to local villagers. Freedom Gardens also provides a site for collaborating with academics, NGOs, and local villagers to learn about sustainable farming practices. In learning about sustainability issues, connecting scientific knowledge and processes to indigenous knowledge and practices is considered important for encouraging ownership and action by the teachers and students (Glasson, Mhango, Phiri & Lanier, 2010).

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