Design Elements and Learning Outcomes of Two Place-Based Teacher Professional Development Programs Situated in the Southwest United States: Concordance with Universal Design for Learning

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Abstract

Place-based education is situated and trans-disciplinary, informed by the diverse cognitive meanings and affective attachments that tie people to places (i.e., sense of place). This rich contextualization, coupled with the varied experiential and inquiry learning processes characteristic of authentically place-based teaching, render this pedagogical approach concordant with the principles and guidelines of Universal Design for Learning. These guidelines call for the use of (1) multiple means of representing information, (2) multiple means of student expression and action, and (3) multiple means of engaging, motivating, and retaining students. Place-based teaching and learning meets these guidelines by engaging the multiple meanings of places in curriculum and pedagogy, enabling students to find meanings in and form attachments to the places under study; and if it also minimizes or avoids physical, linguistic, and disciplinary barriers that constrain full student participation. This concordance, and the positive cognitive and affective learning outcomes of place-based science education, are demonstrated in two case studies of place-based teacher professional development programs in science and pedagogy conducted in the naturally and culturally diverse Southwest United States.

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Introduction

Place-based curricula and teaching methods are situated in environments and communities, experiential, and trans-disciplinary: reflecting the diverse meanings affixed to places and ways that people experience and know them. As recounted in the work of different practitioners and researchers, the goals of the place-based approach include environmental and cultural sustainability (Orr, 1992; Gruenewald & Smith, 2008), integration of disciplines (Gruenewald, 2003; Ault, 2008), community service and informed citizenship (Woodhouse & Knapp, 2000; Sobel, 2004; Gruenewald & Smith, 2008), engagement of diverse student groups (Emekauwa, 2004; Semken, 2005; Chinn, 2006), and personal well-being (Ault, 2008). An authentically place-based curriculum or professional-development program in science education must be informed not only by scientific inquiry in places and regions, but also by the humanistic meanings and affective attachments that imbue them through time. The connection between individuals or groups and place is encapsulated in the sense of place: the set of all meanings found in and attachments formed to a given place (Williams & Stewart, 1998). Fostering and enhancing sense of place is an authentic and measurable learning outcome of place-based teaching (Semken & Butler Freeman, 2008; Ault, 2008).

The cognitive and affective richness of place as a context for learning and the numerous experiential and inquiry-based means of teaching available in an authentically place-based approach are directly relevant to the guidelines for Universal Design for Learning (CAST, 2008).

These guidelines call for the use of (1) multiple means of representing information, (2) multiple means of student expression and action, and (3) multiple means of engaging, motivating, and retaining students. They can be met through place-based teaching and learning if curriculum and pedagogy engage and leverage the multiple meanings of places, if every student or participant is enabled to find meanings in and form attachments to the places or regions used as context and example (Semken & Butler Freeman, 2008), and if physical, linguistic, and disciplinary barriers that constrain full student participation are minimized or removed.

The arid, mountainous, scenic, and multicultural Southwest United States (hereafter referred to as the Southwest) is an attractive regional setting for place-based education on account of its geologically, physiographically, climatically, and ecologically diverse landscapes; its millennia of inhabitation and cohabitation by numerous and varied indigenous and immigrant populations and their rich archaeological and historical record; and its familiar iconographic depiction in all manner of artworks and popular media.

Many of the overarching goals of place-based science education, notably environmental and cultural sustainability, and greater cultural and ethnic diversity in the scientific community, resonate particularly well in this region. A resource-extractive economy and several decades of explosive population growth and urbanization, coupled with climate change, have strained and damaged many environmental systems. Further, the region is the aboriginal home of many American Indian nations and the historical home of a large (and still growing) Mexican American community. Both groups have deeply place-based cultures (Cajete, 2000; Bonfil Batalla, 1996) and have long been underrepresented in scientific studies and careers (National Science Foundation, 2009). Many minority-majority communities in the Southwest are economically disadvantaged, and their school systems suffer from chronic teacher turnover.

Two place-based programs for in-service teacher enhancement, both offered in minority-majority areas of the rural Southwest but differing in process and duration, are profiled here with brief summaries of ongoing assessment activities, and commentary on their adherence to the principles of Universal Design for Learning (CAST, 2008).

Situating Earth Science in Superior

The region around Superior, a rural mining town in central Arizona 80 kilometers east of Phoenix, is a diversely meaningful place: a route from the low Sonoran Desert to rugged mountain terrain that has been used for millennia, historic territory of two American Indian nations, a mining district that has yielded millions of dollars in silver and copper while attracting an ethnically diverse population to work the mines, and a rural community whose identity is now challenged by encroachment of the nation's fifth-largest metropolitan area. The physical landscape directly influenced, and continues to influence, the evolution of the cultural landscape.

During 2007 and 2008, Semken and Williams offered an experimental Southwest-based Earth system science course (*Situating Earth Science in Superior*) for professional development of in-service educators in the Superior and nearby San Carlos Apache school districts (Semken & Williams, 2008; Williams & Semken, in revision). Forty educators, about half of whom reported Mexican American or American Indian identity, participated in the project. The project was designed to be inclusive from a disciplinary perspective and welcomed humanities and English teachers as well as science teachers.

The curriculum, an abridged but more experiential version of an introductory course previously developed for use in a university setting (Semken & Butler Freeman, 2008), introduced (or re-introduced) these local teachers to the physiography, geology, hydrology, climate, ecology, and resources of their surroundings, in the context of their cultural and

historical meanings. Course activities were periodically conducted outdoors at places of geological and cultural interest. Content was organized to represent interactions of rock, water, air, and life systems: a concept that bridges mainstream Earth system science and indigenous Southwestern ethnoscience (Cajete, 2000; Semken, 2005; Semken and Butler Freeman, 2008). Sense of place was leveraged by regular evocation (using graphic and textual resources) of the Southwest region's aesthetic beauty, importance to diverse cultures, and allure to scientists, artists, and visitors. The participating teachers, representing diverse disciplines, in turn enriched the course by sharing their own senses of place as knowledge that became integrated into the curriculum.

Williams and Semken (accepted, in revision) assessed qualitative outcomes of the course by means of two ethnographic methods: direct behavioral observation and semi-structured interviews. Direct observations were collected through fieldnotes and videorecordings; these were transcribed and coded in an ethogram to characterize engagement with the place-based curriculum and pedagogy. Ethologic analysis of these findings revealed increased engagement with Southwest-based course elements over more globally situated components. For the semi-structured interviews, a questionnaire was developed and used to elicit cognitive and affective responses regarding the course, its curriculum and pedagogy, and the student's sense of the specific places that were studied. Verbal, textual, and content analyses were applied to interview data to determine concepts, patterns, and relationships that were linked into thematic categories. The majority of respondents in two cohorts of in-service teachers studied in 2007 and 2008 (Williams & Semken, accepted, in revision) reported three forms of positive responses to the place-based approach: (1) enhanced place attachment and meaning linked to Arizona and the Southwest, (2) enhanced Earth science comprehension, and (3) implementation of place-based

curriculum and pedagogy in the respondent's own classroom. These results complement quantitative findings that suggest significant pre-post increase in sense of place as a consequence of place-based teaching.

The experimental Arizona- and Southwest-based Earth science course, now a formal catalog course at Arizona State University, met the principles of Universal Design for Learning (CAST, 2008) by accommodating teachers from multiple disciplines, integrating relevant place-based content from multiple disciplines, and affording participants the freedom to demonstrate learning through self-designed capstone projects.

Bioregional Outdoor Education Project

The long-term goal of the Bioregional Outdoor Education Project (BOEP), operated by the Four Corners School of Outdoor Education, is to educate a generation of teachers and students about the features and natural processes of the Colorado Plateau (CP) physiographic province and bioregion, an extensive high-desert region that encompasses major portions of the Southwestern states of Arizona, Colorado, New Mexico, and Utah. BOEP effects this by creating permanent place-based, trans-disciplinary (science, math, language, and culture) outdoor education programs in K-8 schools across the CP. Teachers in BOEP are a mix of Natives and non-Natives, the student population is primarily Navajo, and many of the participating schools are located on or near the Navajo Nation. BOEP offers year-long opportunities for teachers (over a two-year period per school) to engage in place-based learning to extend their understanding of science, art, language, and culture content, and inquiry skills. Over the 2007-2009 school years, BOEP researchers have been creating, testing, implementing, and evaluating a learning progression across three grade bands (K-2, 3-5, 6-8) based on the concept of Interdependence of Life, which is common to indigenous (Kawagley & Barnhardt, 1999) and mainstream scientific worldviews.

The professional development for teachers in the BOEP program begins with a five-day total immersion in learning, the Summer Institute. Each teacher spends this time gaining understanding of CP-based and locally relevant science, art, language, and cultural knowledge; and also hones inquiry skills. Bimonthly during the succeeding year, a Regional Coordinator (RC; one is based in each of the four states) visits each school to assist and observe the participating teachers. Each visit provides teachers with practical and affective support, and ongoing learning opportunities. At the end of the first year teachers reconvene for a summer field experience: a rafting trip down the San Juan River, a spectacular high-desert stream that transects the CP. This trip provides teachers with additional geologic, hydrologic, climatic, ecological, and cultural knowledge about the CP and reinforces the year-long school-centered learning process. BOEP has developed over 100 CP-based interdisciplinary lessons and activities for use during the field excursions (see http://www.boep.org). Teachers learn and modify these lessons and activities for use in their own classrooms. Several examples are presented here.

Concept Map of the Colorado Plateau

Early in their professional development, teachers are asked to draw, with guidance, an annotated map of the CP. Typically identified are the four states, the boundaries of the CP; the rivers, the mountain ranges including the Sacred Mountains of the Navajo (Kelley & Francis, 1994); reservation lands of the Navajo, Hopi, Ute, Apache, and Pueblo nations; National Parks; and some cities and towns. The teachers also locate their own home towns.

A modification of this activity is for teachers to draw a map from home to school. Points of interest which brought joy and alarm are marked, and the participants then share their stories. This can be modified to an indoor or outdoor area of any size.

The use of topographic maps is taught during a field trip taken into the mountains near the base camp for the river trip. These map activities help orient teachers and their students to the geography of the CP, their place.

Nature's Camera

This activity is intended to hone observational skills. Teachers are paired, and one looks around to choose and compose a "picture" for the partner to experience. The second teacher holds his or her hands around the eyes to form an aperture, and the first teacher gently directs the partner's view to the intended "picture." The second and first teacher take turns sharing what each observed in the limited area of vision. This activity helps teachers to concentrate on a small area and focus their observational abilities.

Matching Colors

In this simple but limitless observational activity, teachers are provided with paint chips of different colors and asked to find things in the environment that match each color exactly. This may seem easy, but it is often difficult to match colors exactly. It is exciting for the teachers to discover objects that match the paint chips: rocks, bark, leaves, grass, etc.

Square Foot Field Trip with Journaling

In this activity, a 4-foot length of string is given to each teacher or student with four corner pieces to hold the string. An area of one square foot is selected, bounded with the string, and then the teacher or student makes measurements of air and soil temperature therein, detailed written observations of the nature of the surface, movement seen, noises heard, and so on. All data are recorded, and interesting features or phenomena sketched, in the teacher or student's journal. Observations of the surrounding area may also be included. The square-foot study plot is then visited at a later date, a day, week, month, next season, depending on the schedule of the

class. The revisiting allows the observation of changes which occur, and helps teachers develop the ability to make time-integrated observations and records. The data can be placed in tables or graphed for interpretation (e.g., changes in temperature, differences between temperature in sunny and shady areas). Unexpected events sometimes occur, such as the unfortunate destruction of a sunflower plant in one girl's study plot by a carelessly piloted all-terrain vehicle. (This girl immediately became a vocal opponent of off-road driving!) This activity ties together science, art, language, and math skills, and enables each participant to build a tangible connection to his or her home or teaching place.

Learning through Song

BOEP teachers use songs to help learn concepts better. One example is the *Water Cycle Boogie*, a kinesthetically rich song that incorporates motions representing the major steps in the water cycle. Teachers pair this with the *Water Cycle Dice* game (NOAA, 2008), which leads participants through their own water cycles among soil, plants, river, clouds, ocean, lake, animal, groundwater, and glacier. Students then tell about their journey and come up with reasons they went from one to another and why they might have stayed at some stations for a longer than others.

Animal Olympics

This is a favored activity that uses playing cards with animals from the CP on one side, and information about the animal on the other. The participants look at the pictures first, and try to envision the specific adaptations that allow these animals to flourish in this harsh environment. After sharing their ideas with the group, they turn over the card, and read an explanation of one of the adaptations. One example is "Hummingbirds can hover, and even fly backwards! They can do this because they can flap their wings up to 79 times a second! (That is

790 times in 10 seconds, or 4740 times in one minute!) How many times can you flap your arms in 10 seconds?" The participant or class does the activity or calculation specified on the back of the card; results are recorded and sometimes graphed. These activities have the participants predicting, calculating, imagining, and doing. A possible extension of this activity would be the investigation of a particular animal using an internet or library search, followed by a presentation of the new information in a format chosen by the presenter.

Scavenger Hunts

These allow each participant to independently explore and make discoveries. One hunt is specifically for CP plants and for specific details of their structur, and a second is held around the base-camp area. During the Summer Institute, BOEP staff help the teachers plan scavenger hunts more specific to their places and their classrooms (e.g., finding specific items in the classroom at the start of the year, rocks around the school grounds or homes, or local plants).

Bioregional Outdoor Education Conference

Each winter, BOEP hosts a CP-wide conference in which participating teachers (current and former) and invited speakers present and share ideas on all of the diverse scientific, artistic, and cultural meanings of the CP, and how to teach and learn them. The objective is for all to learn how to better incorporate CP-situated, focused, place-based, hands-on, outdoor education into their classrooms. During a typical conference there are more than 20 diverse workshops that give teachers a wide variety of ideas, activities, and lessons they can use in their classrooms. Presenting at the conference adds to each teacher's self-confidence and sense of self-worth by ensuring that their personal experiences and ideas have been shared and well-received by their colleagues.

San Juan River Trip

The river trip in the summer following the year's professional development, the final component of the BOEP training program, is a fantastic experience. Teachers raft the swiftly flowing but mostly placid San Juan River in southeastern Utah for three days, through red-rock desert landscapes and deep canyons, and past numerous sites of historic and archaeological significance. During the entire trip, teachers are completely out of contact with the outside world but completely in touch with nature. It is frequently the first opportunity for a teacher to personally experience an extended outdoor excursion. Expert guides point out geologic and hydrologic features, plants and animals, and sites formerly occupied by prehistoric peoples. Frequent stops and short hikes allow teachers to observe Ancestral Puebloan pictographs, petroglyphs, and ruins, landforms, and outcrops of fossil-bearing rocks. The first-hand experience with wilder parts of the CP is not forgotten by teachers, and enhances their place-based teaching.

Universal Design for Learning (CAST, 2008) guidelines calling for the use of (1) multiple means of representing information, (2) multiple means of student expression and action, and (3) multiple means of engaging, motivating, and retaining students, are all met by BOEP. Information is presented to engage multiple modes of learning. Expression and action is written, oral, as well as through art and culture. Each lesson has a variety of ways to engage, motivate and keep the interest of the participant. The bimonthly RC visits with the teachers also keep them aligned with the program and its pedagogy.

Discussion

The BOEP professional development model and learning progression development are based on research (Bransford, Brown, & Cocking, 2000) that states that effective learning environments are *knowledge-centered* (wherein emphasis is on understanding versus remembering); *learner-centered*

(wherein individual learner's personal and cultural backgrounds and learning styles are valued); community-centered (wherein learning activities are collaborative and foster a community of practice that involves legitimate peripheral participation; cf. Lave & Wenger, 1991); and authentically *assessment-centered* (wherein formative assessment is used to make learners' thinking visible to them, and evaluations are performance oriented. Learner, knowledge, community, and assessment-centered education, if based on a learner's home locality or place, will be given meaning by a teacher or student's experiences in their home region. The multiple meanings and representations of these places render this approach concordant with the three guidelines for Universal Design for Learning (CAST, 2008).

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