

PLANTING THE SCIENCE SEED: ENGAGING STUDENTS IN PLACE-BASED CIVIC ACTIONS

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Abstract

As teacher educators, we are interested in examining the extent to which science education programs based on principles of place-based and experiential education engage students in the study of science and the application of science to issues of civic concern. A great deal of research confirms that science education programs have generally been ineffective in producing students who understand and successfully apply science concepts and knowledge to social issues. This research examines the extent to which public school programs incorporating place-based and experiential learning through extended field experiences and integrated coursework have led to engaging students in science and related civic actions.

Keywords: Experiential Education, Place-based Learning, Student Engagement, Science Field Studies, Civic Actions

Introduction

We write as two science educators with considerable experience teaching science in both K-12 public school contexts and also in preparing teachers in post-secondary science education. We share significant frustration and concerns about the fundamental conceptual framework that appears to be implicit in North American science education programs (Duschl et al., 2007; Michaels et al., 2007). We do not believe that there is, at present, a general consensus on a productive or successful model of science pedagogy that builds on student engagement and interests that ultimately leads to a personal and professional passion for the science field (Bayne, 2009; McGinnis & Roberts-Harris, 2009).

Some questions we propose to consider: *When do students become engaged in scientific thought and process? What pedagogical conditions promote transformative science learning?* and; *What public conditions support these thoughts and processes taking root and growing within young people?*

By the time a student reaches post-secondary education and enrolls in science courses, they demonstrate an interest and engagement that has been fostered at some earlier time (Klahr & Nigam, 2007; Moss, 2003; Wolffe & McMullen, 1995-1996). Universities may secure, focus and facilitate such knowledge and practical experience but students do not usually participate without earlier engagement. Our research investigates how place-based (Smith, 2007) experiential (Dewey, 1938) activities and critical pedagogy (Kincheloe, 2005) may foster such interest and engagement within public schools.

For more than twenty years, school approaches departing from traditional organizational and instructional patterns have been conducted and monitored in a number of Canadian school contexts. One major component of the research focus seeks to ascertain if such approaches lead to significant changes in career and citizenship choices later in

life. This paper describes the results of two studies examining the question of student engagement. It then outlines a number of conditions that appear to be an important contributing factor to the involvement of young people. The studies focusing on these programs include an academic dissertation (O'Connor, 2009), longitudinal analysis by educational administrations that have resulted in educational policy (Sharp, 2013; Yukon Territory Government [YTG], 2007) and teacher-driven curriculum and pedagogical analysis. This paper will summarize these analyses, outline the results and identify common reoccurring practices, principles and long term outcomes.

Context of the Study

These studies are broadly rooted in a long tradition of experiential and place-based education, first articulated by Dewey (1938). In experiential learning, learners are first immersed in the experience of the targeted learning and then are asked to reflect on and analyze their experience in order to make sense of it. Experiential science education provides a purpose to the knowledge and reasoning taught in schools, provides a contextual framework for much of the curriculum (i.e., it gives meaning to school studies), and engages learners in the conditions of their own reality. Thus:

- Experiential education places major importance on the knowledge of learners derived from a good deal of experiential learning, a sort of practice-to-theory approach (Dewey, 1938).
- Experiential education is defined as the process of actively engaging learners in an experience that will have real consequences (Tyler, 1949).
- By immersing themselves in direct experience, learners make discoveries and experiment with knowledge themselves instead of exclusively hearing or reading about the experiences of others (Kolb & Lewis, 1986).
- Activities often use one subject as a means of understanding another subject. Wells (1986) states: “Knowledge cannot be transmitted. It has to be constructed afresh by each individual knower on the basis of what is already known, and by means of strategies developed over the whole of that individual's life, both outside and inside the classroom” (p. 218).
- Learners also reflect on their experiences, with the goal of developing new skills, new attitudes, and new theories or ways of thinking. They test and refine that knowledge in socio-constructivist interaction with each other and with mentors who accompany them in their learning (Kraft & Sakofs, 1988).
- This process of experiential learning is a continuous process alternating between action in experience and opportunities to reflect upon that experience to make sense of it, and then returning to action to further test out and modify emerging hypotheses, followed by further reflection upon the new experience, and so on (Dillon & O'Connor, 2010). In short, we see learning as a dialectic process between experiences on the one hand and concepts, observations, and action on the other.

Kolb (1984) offers a working definition of experiential learning: “Learning is the process by which knowledge is created through the transformation of experience” (p. 38). In this perspective, learning is viewed as a continuous process grounded in experience as opposed to content or outcomes, knowledge is seen as a continuous transformation process of creation and re-creation rather than an independent and objective entity to be acquired or transmitted, and ultimately learning is seen as a process that transforms experience.

Place-based education is an approach to teaching that is grounded in the context of community, both natural and social (Raffan, 1993; Theobald & Curtiss, 2000). It connects place with self and community (Woodhouse & Knapp, 2000). The design of the referenced science programming might be best characterized as the pedagogy of place (Gruenewald,

2003) as school science field experiences and the reinforcement of the essential links between students, their peers, and place (practice) are linked through targeted course work (theory). Through this integrated process, students make connections to their science curriculum through field-based courses that are focused on realistic, immediate, and important statutes (Kawagley & Barnhardt, 1999). The goal is to have the students see the relevance and importance of their science coursework since those studies have immediate causal effect on their present educational context as learners and, ultimately, the well-being of themselves and their community (Kincheloe, 2005).

Description of the Program

The Yukon Experiential Science 11 program, initiated in 1994, is an integrated approach to chemistry, biology, forestry, and geography delivered through an applied studies course in field methods, a fine arts program and a career planning course. The program involves grade 11 students for a semester with about half the time spent in field studies and about a quarter of the time spent in lab settings.

The Yukon Experiential Science 11 program was developed around three basic principles:

- *Diverse Ways of Learning:* People learn in many different ways. For many, hands-on experiences are far more effective means of learning than lectures, readings, and visual presentations while for others engaging in problems as a social enterprise involving a give and take between peers resonate with the way they learn most effectively. This approach to science addresses curricular outcomes in many different ways, frequently incorporating experiential processes, collaborative processes and media technologies. This means of addressing different individual ways of learning allows many more to learn effectively.
- *Integration:* People learn more effectively when they are able to see things in relation to other things. This principle of integration of subjects is central to instructional processes used in this program. Such integration lends itself to the examination of real life scientific issues and the transmission of various forms of knowledge and epistemologies. Activities often use one subject as a means to understanding another subject.
- *Motivation:* People learn far more effectively when the importance of their studies is “authentic” and internalized. Participation in meaningful events, studies, or enterprises involving students in a wider scientific community is both exciting and motivating to students. Involving students in adventurous science-related enterprises captures their emotional commitment, as does the sense that their participation will make a difference to community decisions.

The Experiential Science 11 (ES11) program was designed to help students develop as critical learners and engaged members of their community by reflecting upon individual and group response(s) in a variety of settings. The program encourages each student to become a responsible citizen, with the self-confidence and skills needed to meet the many challenges facing a person in a changing society.

Activities are organized using a range of field studies and lab activities that focus on specific program objectives. The field studies and their corresponding technologies support all aspects of the program. Field studies are complemented by detailed observations and graphic illustration, increasing students’ appreciation of the topic in a natural setting. The use of various forms of information technologies is often based on coordination with government and community organizations. These partnerships add interest to the science field studies and encourage students to develop skills they would often miss in the conventional programs. During the field activities, students meet and take part in studies with community members, professionals, Aboriginal Elders and other students. These encounters provide students with

in-depth discussions about many issues that relate to their specific science program but also with respect to local community interests, social justice and world affairs.

All the studies described below appear to embrace a combination of three fundamentals.

- They embrace diverse and personable instructional practices that led to diverse learning experiences. These involve students in experiential, social, relevant and reflective practices.
- They center about problems, puzzles, inquiries that are apparently relevant and important.
- They integrate a wide variety of subjects, demanding collaboration and imagination.

Twenty five to thirty days of these field experiences are given over to either one trip or many shorter trips depending on the year of the program. These trips have taken the students through Alberta, central British Columbia and along the British Columbia coast of Canada, U.S state of Alaska and into remote areas of the Yukon Territory of northern Canada. Some activities include forest and marine surveys, sailing, private company and government facility tours, SCUBA diving, marine and intertidal inventories, sea kayaking, water quality assessments, backcountry skiing, wildlife assessments, caving, assessments of human impacts, canoeing, culture camps, university and college visits. These outings often provide a contextual reference for the balance of the science taught throughout the program.

In the experiential programs students are responsible for undertaking a major science project and developing a comprehensive study for their fellow students. The major projects have touched upon topics such as: water quality analysis on a community lake, analysis of the effects of effluent released in a small stream, GPS/GIS mapping of community trails, long term thermal observations to determine appropriate northern gardening locations, traditional ecological knowledge practices in environmental assessments, fitness assessment of the entire class, development of a salt water aquarium with tidal movement, development of an alternative working model of a full suspension bike, raising populations of arctic char in a pothole lake, stream restoration and salmon population rehabilitation. This list goes on with literally more than one hundred examples. Students are encouraged to take responsibility for their learning and to work cooperatively. Information and Communication Technologies ICT become a basis for much of the students work as they are in contact with participants across the territory, country and world. Virtual communities evolve as the students are asked to work with others as a team and be flexible and adaptable. Students are also encouraged to create online journals and generate “blogs” that promote the educational objective of a “critically engaged learner” that the program strives to achieve.

The survey of the students who took part in the program between five and nineteen years ago (2008-1994) explored many aspects of their life following secondary school (grade 12). Information was collected through email responses, phone or in-person interviews and focus groups. The analysis of this program is ongoing. To date, the study has involved more than fifteen percent of the 640 ES11 students who took part in the program between 1994 and 2009. Participating students who were in the city of Whitehorse, Yukon Territory were asked if they would complete the survey (taking more than an hour to complete). All students approached said they would appreciate the opportunity and 75% of the emailed surveys have been completed. Four different teachers had taught the program over this time span and their input has been included in the study. The students surveyed described their subsequent education, employment, travel, shared reflections on the value of the educational activities and addressed the impact it had on their participation in a range of citizenship activities.

A number of preliminary outcomes addressing the larger research questions about engagement and civic responsibility have emerged. The following points are drawn from their responses.

- 90% of the students graduated from university and more than 60% of these in science fields.
- 70% have worked in a variety of employment fields linked with science.
- All students have traveled to two or more different countries.
- All students identify the Experiential Science 11 program as influential in their selection of science courses and professional careers.
- 90% of the students identify their high school science lab experiences facilitated their understanding of university or college labs.
- All students cite specific field studies as influencing their professional career and academic decisions.
- All students indicated they voted in elections.
- 90% of the students said they felt they could influence civic affairs.
- 80% of the students coached or volunteered their time in community affairs.

Each of these responses indicate an approach that engaged students. Taken collectively they provide compelling evidence that place-based and experiential learning through extended field experiences and integrated coursework realized the broader goals espoused by the experiential science education programs.

Factors Fostering Outcomes

Our action research studies—utilizing anecdotal evidence, semi-structured interviews of a sub-set of students, teachers and administrators, and end-of-semester focus groups and anonymous surveys and questionnaires has revealed several key factors related to the concept of place that contributed to the positive outcomes of these alternatives:

- The longer time on field studies and in labs, which allowed students to approximate the work within a science field to a larger extent than is normally possible in regular classroom setting.
- Not just the occasion to step back from their learning, but primarily the self-reflective and socio-constructivist pedagogy employed in the inquiry-based science pedagogy that helped students make sense of their experience together and construct their emerging understandings.
- The supportive and trusting relationship between students and the teachers in the program, as well as the collaborative and supportive relationships that developed within the school groups, field groups and larger communities.
- The fact that the program was often held in the field rather than back on campus (as is for students in the regular school program), thus creating an entirely school/community-based semester.
- Finally, it is a multidisciplinary approach, which utilizes an integration of strategic science course curriculum that promotes a relational aspect to knowledge (i.e. Holistic Education).

Conclusion

In summarizing the contribution that experiential and place-based processes have made to science education, four possible conclusions are suggested: First, the practical application of theoretical knowledge is a valuable contribution to the learning process. Second, an active participation developed by the immersion experience may provide student motivation for recognition of environmental and social variation and the need for new civic strategies for social change. Third, the students develop an understanding of the interrelationship between the field of science, the ecology of their community, and its social framework within a global context. Finally, experiential science learning provides the student

with the task of being conscious about and take responsibility for the reality of his or her own political and social awareness. It is in this very act that the central value is realized: the ability of all persons to know their potential for development and self-awareness (Denise & Harris, 1989).

A continuing and deep legacy running through this study has been that of John Dewey. It may be instructive at this point to recall that he wrote *Experience and Education* in 1938 in order to explain and clarify how progressive education was different from traditional schooling, as well as to clarify what it hoped to achieve that traditional schooling had generally not achieved. Our paper, in calling for a shift in the traditional figure/ground of science pedagogy by placing experiential and place-based learning at the center of science education programs, has essentially been a call for a “progressive” science education, a schooling of science that would ideally achieve much of what traditional science education has generally not succeeded in achieving.

Unfortunately, applications of such experiential, community-driven, and place-based initiatives are commonly labeled unscholarly and frivolous by some purportedly academic programs. These are typically those that are didactic in nature and follow the more characteristic organizational models that place students in rows of desks and ask them to be passive recipients of knowledge (Freire, 1970). The notion that students should be supported in their own science-based inquiries as student-researchers who explore their own civic responsibilities within a community and connect academic information with their own lived experience is foreign to many educational programs (Harris 2002; Kincheloe & Steinberg 1998). Our analysis indicates the time for change in science education is long overdue.

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