Chapter 11
The Commonplaces of Schooling and Citizen Science

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I remember waking up with my Dad in our camper van parked within a conservation area. It is a beautiful sunny day in mid-June around 6:00 AM, and the year is 1982. I walk outside and the forest echoes with a variety of bird songs. In this natural area, a lake, wetlands, forests and meadows play an important ecological role in protecting the headwaters of the Credit and Nottawasaga Rivers. Within its boundaries, varied landscapes provide recreational and educational experiences for many people. The lake is rich in life with fish and underwater plants. On shore, mammals such as deer, red fox, porcupines and even flying squirrels can be found here. Ospreys, great blue herons, mallard ducks and many other breeding bird species are also seen, as are painted turtles and leopard frogs. In spring and fall, migratory birds take advantage of the diverse habitats along their journey north and south. We are here for one particular goal this morning: to assist the Federation of Ontario Naturalists and Long Point Bird Observatory in collecting breeding bird data in order to compile a breeding atlas for the birds of Ontario (Bird Studies Canada). We are conducting a survey of breeding birds in the rolling hills and lakes near Orangeville, Ontario, Canada. For the first time ever, in cooperation with hundreds of volunteers and coordinated by ornithologists, a 5-year survey of breeding bird distribution for all of Ontario is being conducted using valid scientific protocols. We are doing citizen science that beautiful Saturday morning.

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It is June 2007 on a warm, slightly overcast day over Woodfield Public School located on the Niagara Escarpment, a UNESCO Biosphere Reserve conserving Ontario's natural and social capital by protecting prime agricultural lands, forests, water, wetlands, heritage and recreational spaces. More specifically, the school resides in a semi-rural area, with a few residences, a small woodlot, and farmers' fields adjacent to the school property. Other than American robins, house sparrows, and the occasional swallows and squirrels, not much animal life abounds the boundaries of Woodfield P.S. At around 2:00 pm, a mixture of 25 grade 4–8 students and two teachers exit the back of the school and head toward the soccer field carrying hula-hoops, shovels, laminated worm ID charts, trays, water bottles, thermometers, observation sheets and clipboards. This is part of a regular routine for this group. Each Friday a group of approximately 25 students and teachers take ownership for one monitoring site on the school premises while student groups rotate each week from one site to the next collecting, identifying and recording the abundance and variety of worm species in various habitats on and adjacent to the school site. Worm abundance and diversity data collected from the school are compiled and later entered onto the Ministry of Environment's environmental monitoring database. As one of the participating teachers tells us at the end of the monitoring process: Students would pester her every week asking, "When are we going out again to watch worms?" Who would have believed that observing worms and contributing to science is so much fun!

We introduce this section through the above vignettes. They illustrate citizen science experiences that we as authors have observed and participated in both school and out-of-school settings. These vignettes signal our intentions for this editorial based on an adage coined by Gregory Bateson, namely, *it is a difference which makes a difference*.

For this section introduction, we provide a brief overview of citizen science and our personal experiences implementing citizen science with elementary and secondary schools. Next, we problematize citizen science and schools using visual representations in order to highlight and juxtapose the 'commonplaces' of schooling as articulated by Joseph J. Schwab, a prominent curriculum theorist. We use visuals and text to introduce the reader to a variety of settings and how these representations illustrate both similarities and differences, and highlight the conceptual tension or dialectic between schools and citizen science. Finally, we offer some prompts for interpreting reports and essays about citizen science.

Overview of Citizen Science

Citizen science is a term that has been around for decades. It is used to describe the participation of the general public in authentic scientific studies. In its simplest terms, it involves everyday citizens cooperating with scientists to conduct

scientific-based research. Scientists in universities and government agencies around the world are engaged in a variety of citizen science programs (Cornell Lab 2014). Although citizens have been involved in a plethora of science projects in recent years (e.g., *Discover Life, 2014; Environment for the Americas, 2012; Monarch Watch, 2012; Project BudBurst, 2014; Project FeederWatch, 2014*), members of the public have been independently recording observations of natural phenomena for centuries (Miller-Rushing et al. 2012). Citizen science has gained greater attention in the field of ecology primarily due to the history of amateur scientists (i.e., naturalists) collecting long term and diverse ecological data.

Over the last decade, the term "citizen science" has come to mean different things to academics and laypersons alike. Other phrases such as "public participation in science" and "volunteer-based monitoring" are used interchangeably, causing some confusion for educators and scientists new to citizen science. Bonney et al. (2009) attempt to reduce this confusion in a report for the Center for Advancement of Informal Science. In this report, they categorize models for public participation in scientific research including: contributory, collaborative, and co-created descriptive models. While these models provide a general heuristic for analyzing past and current citizen science projects, of interest to readers, these categorizations may assist in future theorizing and formalizing of citizen science within schools. Ultimately, the broad aim of any citizen science program is to promote learners' scientific and ecological literacy in formal and extended school settings.

Past Experience with Citizen Science and Schools

To support the teaching of environmental and science curriculum learning goals, from 2006 to 2009 we coordinated a collaborative research partnership with elementary and secondary schools in southern Ontario, Canada involving a government ecological monitoring agency called the Environmental Monitoring and Assessment Network (EMAN). This program is a partnership between Environment Canada and Nature Canada, coordinating a variety of ecological monitoring programs (Environment Canada 2008). EMAN is made up of organizations and individuals across Canada involved in ecological monitoring to better detect and report upon ecosystem change.

In order to facilitate the participation of interested individuals with limited scientific expertise (i.e., citizen scientists) a specific program called *NatureWatch* was created. *NatureWatch* is a suite of accessible ecological monitoring and assessment programs called: FrogWatch, PlantWatch, WormWatch, and IceWatch. Participants follow the program's specific ecological science protocol for collecting certain environmental monitoring data, whether identifying frog species by their species-specific call, collecting and identifying earthworms and their abundance, observing ice-on/ice-off dates on bodies of water, or identifying the flowering dates of various plants (NatureWatch 2012). Collected data sets are recorded and organized by the

citizen scientists and then entered onto Environment Canada's EMAN database for environmental researchers to interpret and for government policymakers to utilize (Karrow and Fazio 2010). Participants are provided feedback on their data, which is uploaded onto a centralized database—accessible by both environmental scientists and the public. Prior to this, research partnerships involving education practitioners and ecologists was mostly nonexistent in Canada, partly because *NatureWatch* had never been implemented within schools, and education research into the relationship between this form of citizen science and schools had never been considered. Our research into school-based ecological monitoring served as a catalyst to initiate and secure this research partnership (Fazio and Karrow 2009). The viability of these programs became the basis of this research with elementary and secondary schools, specifically, how citizen science educates and nurtures ecological literacy within students and teachers.

Given the context of elementary and secondary schools, our findings from these studies reveal confusions and deficiencies in the rhetoric and practice surrounding ecological literacy in schools, and in particular, confusion with respect to ecological curriculum, teaching and learning. Further, designing quadripartite collaborations amongst external providers, schools, environmental scientists, and educational researchers is challenging when existing resources are limited or unavailable to support such unique collaborations. While we envisaged school participants' enhanced capacity to contribute to community-based ecological monitoring, and students and teachers alike becoming more ecologically knowledgeable, regrettably, our research has discovered more challenges to school-based practices and aims of citizen science.

Environmental education shares many elements with citizen science in schools—especially linking schools, communities and the environments that they occupy (Barratt-Hacking et al. 2007). Environmental education and citizen science in schools necessarily involves teachers and students engaging with nature in local community contexts. As we discover, however, citizen science is a demanding endeavor often in conflict with the dominant purposes, structures, and practices of schooling. Indeed, it has been known for a long while that the constraining regularities of schooling conflict with many goals of environmental education in schools (Stevenson 2007)—this is also true of citizen science. Therefore, to address school's normative constraints, citizen science practices must be coherent with many of the practitioner and student activities occurring in these schools in the shorter term.

We have argued elsewhere that laudable citizen science programs applicable for schools (e.g., *NatureWatch*) are challenging to implement given the general aims of school (Fazio and Karrow 2013; Karrow and Fazio 2010). While citizen science programs can be adapted to the operating contexts of schools, doing this limits the potential of citizen science to address the concerns of school environments and communities (Mueller et al. 2012). It is the challenge of how to reorient practices in schools for our youth that will be required for the future. Reconceptualising outcomes and finding synchrony between schools and citizen science is the next important task for researchers and practitioners in science and environmental education.

Visual Representations

Citizen Science and Schools

Schwab's (1973, 1983) commonplaces—*learner, teacher, content, and milieu*—provide a conceptual framework for thinking about curriculum in schools and its relationship to citizen science. Commonplaces are interrelated components that help frame curriculum. In essence, they are the fundamental processes and products of schooling. They are useful as a schema to juxtapose schools and citizen science. As influenced by their social and familiar environments, the *learner* represents knowledge of students in terms of their abilities, aspirations, and qualities. The *teacher* represents educators' knowledge and pragmatic pedagogical and subject matter experiences—including their beliefs and attitudes towards schooling. The c*ontent* represents the underlying systems of thinking and products stemming from the subject disciplines, and associated curricular materials. Finally, *milieu* or context brackets the educational context (classroom, school, local environment) where learner, teacher, and community are physically and culturally interrelated.

In this section, we capitalize on the idea that integration of multiple modes of communication can enhance or transform the meaning of ideas (Mitchell 1994; National Council for Teachers of English (NCTE) 2005). Specifically, by integrating visual and textual modes, organized by the commonplaces, we hope to illustrate and prompt critical thinking about the similarities and differences representing schools and citizen science. By working in tandem, the texts presented in the chapters of this section of the book on citizen science combined with these visual representations further prompt possibilities for much needed dialogue to conceptualize and reconceptualize citizen science and schools.

Learner

According to Schwab's (1973, 1983) commonplaces, the *learner* is broadly conceived as representing the knowledge of a "student." A learner is an individual who is attending an elementary, secondary, or post-secondary institution, or may be beyond the school context, such as a member of the community at large—a mature citizen for instance. The knowledge is viewed in terms of what students know, what they aspire to know, and the unique qualities the learner possesses to mediate the learning itself. These facets of knowledge are co-constructed through social interactions. In the school, for example, social interactions may be facilitated through other students, teachers, and perhaps ancillary school staff and scientists. Beyond school contexts, social facilitations of knowledge occur through adult citizens, naturalists, and scientists (Figs. 11.1 and 11.2).

Consider the following questions:

Do students and adults learn citizen science in the same manner? Are all learners given equitable opportunities to learn? What curricular resources do learners have available to support their learning? How will learners collaborate with scientists?

Fig. 11.1 Secondary students conducting a Wormwatch survey

Fig. 11.2 Adult citizen science participants (From: https://blogs.dal.ca/sustainabilitynews/files/2012/09/citizenscience.jpg)

Teacher

The *teacher* is the locus of the educator's knowledge, embodying certain teaching and subject matter experiences, each shaped by their personal beliefs and attitudes toward schooling. Within schools, teachers must assume responsibility for the

Fig. 11.3 Teachers learning about citizen science (NatureWatch)

explicit acts of teaching and their intended and unintended consequences upon/of the learner (or students). Within educational sites in the larger community, citizen science "guides" interact in distinctly difference ways with citizen science participants (Figs. 11.3 and 11.4).

Consider the following questions:

Are science teachers capable of leading citizen science programs? What professional learning is required for science teachers to support learners doing citizen science? Should science teachers be participants in citizen science alongside students?

Content

Wordle is an online tool for generating "word clouds" from text provided (Wordle 2012). The clouds give greater prominence to words that appear more frequently in the source text. Thus, the program presents a visual content analysis of texts. Figure 11.5 represents abstracts from this section's chapters (pp. xx-xx), where clear links between citizen science and schools are being presented. In Fig. 11.6, abstracts are presented from plenary speakers at a recent public participation in scientific research (PPSR) conference held August 2012 (Citizen Science Community Forum 2012).

Consider the following questions:

What is similar/different between the vocabularies in these images? What are the emphases for doing citizen science in school? How do the content emphases affect the experience of citizen science? Why should students in school learn citizen science?

Fig. 11.4 Citizen science participants being guided

Context

The last of Schwab's four commonplaces, *context* or *milieu*, situates and coalesces the previous three commonplaces into a functioning whole. Of course, within school settings these usually involve the classroom or activities situated on or within the school property, that is namely the playground, sports field, naturalized area, or a small patch of grass. Compared with contexts for conducting citizen science beyond schools, these more "natural" settings shape experience in profoundly different ways. Of course the way citizen scientists participate, interact, mobilize, and enact, are enabled differently within these contexts (Figs. 11.7 and 11.8).

Consider the following questions:

Does learning about citizen science in schools differ from learning it in a more complex natural environment? Should the environmental context of schools determine the citizen science programs made available to students?

Fig. 11.5 Wordle image from abstracts for this section of the book

Where Do We Go from Here?

In this introductory chapter for the citizen science section, we provide an overview of citizen science and schools based on our experiences. Using vignettes, descriptive texts and images with queries organized around Schwab's curriculum commonplaces, we present citizen science in schools juxtaposed with more natural settings. Our intention using this multimodal representation method is to evoke a deeper analysis of the similarities and differences between schools and citizen science. Consider some themes based on our analyses of these texts and images:

- Incentives for schools to participate in citizen science.
- Scientific and ecological identity of learners.
- Learning outcomes of students participating in science.
- Professional learning required to mediate citizen science programs.

Fig. 11.6 Wordle image from abstracts of plenary speakers from the 2012 PPSR conference

- Practitioner understandings of the outcomes from citizen science.
- Science education, citizen science, and interdisciplinary curricular emphases.
- Social and ecological outcomes and school-community collaboration.
- Natural versus human-designed environments and citizen science.
- Curriculum re-conceptualized beyond Schwab's four commonplaces.

As you read the chapters focused on citizen science and schools, keep in mind the commonplaces of schooling. Accordingly, consider some of the above themes when problematizing and generating ideas for future collaborative work between citizen science and schools.

Fig. 11.7 School yard as a site for doing citizen science

Fig. 11.8 A natural space for doing citizen science

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