Chapter 10
Section Editorial – Ponder This: Can Ecojustice Education Go Mainstream?

George E. Glasson

Several years ago I visited Lampang, a province in northern Thailand to observe a teacher professional development program that focused on place-based science education (Klechaya 2014). In the local community, the students' families were predominately from the hill tribe people, a minority group that is largely marginalized from the mainstream Thai culture, both economically and through the lack of educational opportunities. The students' parents made a living mostly through rice farming or selling vegetables in the local markets. One day during this project, I observed elementary children collecting water samples to learn about the health of a local river (see Fig. 10.1). Using water test kits, students measured dissolved oxygen, pH, nitrates and phosphates, coliform bacteria, and other indicators of water pollution. As I observed the children eagerly testing and comparing water samples, I couldn't help but notice livestock grazing close-by in the muddy banks along the river. Later, I learned that the children discovered that the water, even though it appeared to be clear, was unhealthy to drink and was a polluted habitat for critters to live in. The children shared and discussed their findings with the local farmers and later presented their results to the community at the school science symposium. As a result, the students and community members learned about the impact of animal wastes on the health of the river and how insecticides could harm fish populations.

Before this place-based project, the teachers were originally unprepared to teach science and the students were disengaged from the mainstream science curriculum. However, with support from Rojjana Klechaya, the place-based science educator coordinating the professional development program, the teachers learned how to engage children in authentic problem solving and inquiry learning that related to local environmental issues. I was intrigued by other place-based science

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Fig. 10.1 Students collecting water samples in a rural Thai community

projects in this rural community that situated learning in the local Thai culture, such as: raising frogs and selling in the local market, growing local vegetables and herbs in the school garden, and studying dengue fever and mosquito life cycles. In each case, parents, experts in the community, and even Buddhist monks served as mentors in the children's projects. These projects involved students as youth scientists as they were engaged in making ethical choices that might impact the local ecosystems and economy. Throughout the investigations, children were learning science in the context of place-based ecojustice education that was embedded in their own community.

STEM Education Conference

More recently in 2013, I again visited Thailand to attend a conference in Bangkok on STEM (Science-Technology-Engineering-Mathematics) Education. The conference was designed to address the need to develop the science and technological workforce in the Association of Southeast Asian Nations (ASEAN) countries through world-class, quality STEM education. STEM education is a predominant framework for globalized education that is increasingly embraced by the governments and the corporate world. The goal of STEM education is to prepare students for the workforce in the global marketplace. STEM education is standards-based and is driven by neoliberal economic policies associated with globalization. Assessment in STEM education focuses on school accountability and how individual students perform on standardized international science and mathematics tests, such as the Program for International Student Assessment (PISA). During the conference, I was struck by how the vision of STEM education proponents contrasted to the place-based science education project that I visited a few years earlier in rural Thailand. The neoliberal, corporate vision of STEM education was seemingly incompatible with ecojustice education, where education is community-based and the goal is for students to be active citizens critically engaged in learning about

eco-socio-scientific issues. In marginalized communities found in both rural and urban areas, students and families seldom benefit from the material wealth generated by corporations. Standardized STEM education models that are driven by high stakes tests are largely irrelevant to the needs of these students.

Later at the conference, I had the opportunity to observe presentations at a day-long roundtable meeting from educators from 11 countries (including both ASEAN and Asian countries from the north): Republic of Indonesia, Lao People's Democratic Republic, Republic of Singapore, Thailand, Malaysia, Sri Lanka, Republic of the Philippines, Republic of China [Taiwan], South Korea, China, and Japan. A STEM educator from each country was asked to report on the current status of STEM education in their respective countries. In most all of these countries, STEM subjects were taught separately rather than as an integrated curriculum that connects and transcends traditional subject boundaries. Rather than promoting inquiry and problem-based learning, teacher-centered pedagogies were most predominant in STEM education. Although preparing future scientists, engineers, and a scientifically literate workforce were considered important; several presenters reported that many students, particularly in rural areas, do not have access to the scientific and technological infrastructure and resources thought to be necessary for a world class STEM education. Other presenters reported that STEM education does not address the many ecological sustainability issues that are important to local communities, such as pollution of rivers and agricultural land, flooding, poverty, and smog in the cities. STEM education also neglects connections to local cultures and funds of knowledge in the local communities. Although there are exceptions in more industrialized ASEAN countries or in urban centers, teachers were not prepared in content or pedagogy to teach STEM subjects.

Ponder This: Can Ecojustice Education Go Mainstream?

As I ponder this apparent mismatch between STEM education and ecojustice education, I propose the following question: Can ecojustice education go mainstream? This question is especially relevant in considering students from marginalized populations like the rural Thai children investigating the health of the local river. This question is also relevant for students from any place throughout the globe who are involved in ecojustice education but may be subjected to high stakes testing in schools. Considering that STEM education is increasingly becoming mainstream, I would like to consider the Next Generation Science Standards (NGSS). As discussed by Teresa Shume in Chap. 2, the goal of these standards are linked to economic development and preparing students to compete in the global economy. These standards are considered mainstream as they were developed by a national consortium of scientists, engineers and educators from professional organizations including the National Research Council, National Association of Science Teachers, and the Association for the Advancement of Science (NGSS 2013). Many countries throughout the world in support of STEM Education

(including educators in the ASEAN countries) are paying close attention to the NGSS that are designed for students to learn about common processes between science and engineering, core science concepts, and cross-cutting concepts that transcend scientific disciplines.

In reviewing the NGSS, it is quite evident that the standards do not saliently address place-based ecojustice education. Nevertheless, a closer look reveals important pedagogical and core concepts related to "earth and human activity" that may be very useful in providing a rationale that supports ecojustice education (NGSS 2013, p. 125). First, the standards emphasize that science and engineering practices are based on students being engaged in argumentation based on evidence. Consider the following NGSS standard related to earth and human activity:

Constructing Explanations and Designing Solutions

- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ESS3-4) (NGSS 2013, p. 127)

This standard clearly addresses what we want our students to do in ecojustice education, especially if they are involved in youth activism and citizen science. The children in the Lampang province in Thailand were engaged in citizen science as they analyzed and shared the importance of the data they collected from the water samples with farmers in the local community. Second, the NGSS reveals important core concepts relating to the human impact on global climate change. Consider this core NGSS standard relating to global climate change:

Global Climate Change

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding human behavior and applying that knowledge wisely in decisions and activities. (MS-ES53-5) (NGSS 2013, p. 84)

Although global climate change remains politically controversial, the core concepts relating to human impact on global climate change are now considered mainstream and legitimized by the scientific community. Third, the NGSS standards make it clear that science and technology raises ethical issues and that the issues are not resolved by science, but within the context of societies and culture. For example, consider this NGSS crosscutting standard that addresses ethical issues, decision-making and human values:

Science Addresses Questions About the Natural and Material World

- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2)
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (HS-ESS3-2)
- Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. (HS-ESS3-2) (NGSS 2013, p. 127)

In effect, by studying the eco-socio-scientific and ethical issues that are associated with human activity and climate change, it can be easily inferred that ecojustice education is becoming mainstream in the NGSS standards.

Nevertheless, when considering the ethics of human impact on the environment, it is important to understand that these issues have origins within the local community and culture. For example, as discussed by Anne Kern and her colleagues in Chap. 7, global climate change is having a huge impact in local Native American communities growing wild rice in the shallow lakes and marshes of Minnesota. Recently in West Virginia, a chemical used in the processing of coal recently leaked out of unregulated storage tanks into the Elk River. Local residents smell a strong licorice odor and reported to the authorities. The result was that 300,000 residents were out of clean drinking water for weeks. The chemical that leaked was used in the coal industry, which as we know, has created catastrophic environmental catastrophes through mountaintop removal and pollution of rivers and streams. Pollution from the coal industry has also been in the headlines of the neighboring state of North Carolina as coal ash generated by the power company has leaked from holding ponds into multiple rivers and streams. The impact on the local environment from the burning fossil fuels is an ecojustice issue with global climate change implications.

Authentic Assessment of Student Learning

Even though high stakes standardized testing is a hallmark for STEM education, it is clear that assessment of students engaged in ecojustice education and citizen science will not be accomplished through raising the bar. Like in the stream investigation conducted by Thai children, authentic assessment is necessary to connect to the goals of preparing youth scientists to investigate environmental issues that impact the local community. Ecojustice educators must ask these questions related to assessment: How do students investigate the impact of human activity on their local environment? How do students engage in the local community? How do children's actions contribute to the sustainability of local ecosystems and culture? What are the representations of student learning about ecojustice issues? As the children in rural Thailand collected and analyzed data relating to water pollution and shared their results with the community, they were clearly involved in authentic assessment. Standardized assessments do not align with the goals of ecojustice education and are therefore inappropriate for assessing youth engaged as citizen scientists.

One final question emerged from my experiences in Thailand: Can STEM education be place-based while focusing on ecojustice issues? The answer is emphatically yes! It was very clear to me that the educators in the ASEAN countries were considering the need for STEM education to address eco-socio-scientific issues that were relevant in local communities. This can be accomplished by embracing the NGSS standards of learning that engage students as citizen scientists in problem solving, analyzing and discussing evidence, ethical decision-making, and connecting local

environmental problems with global issues. Rather than relying on decontextualized standardized tests, the assessments should be aligned with the vision for encouraging students to be active citizen scientists who contribute to the well being of their communities. Assessments can be aligned with the NGSS but they must also be authentically aligned with the issues and the values of the local community. As the survival and sustainability of humans and the earth systems of our planet are dependent on preparing our youth scientists, ecojustice education will become mainstream for the next generation of students.

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