Education for Sustainability in Science Teacher Education

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What Is Education for Sustainability?

Sustainability education, education for sustainability, or education for sustainable development reflects a decades-long and growing response to the impact of humanity on the environment and the inequities of that impact across different peoples and geographies. Dewey (1916) described education as a result of "the very process of living together" (p. 7), and climate change compels learning through living together in ways that are environmentally, economically, and socially responsible. Simple, technocratic solutions cannot resolve climate change (Feinstein & Kirschgasler, 2015). Sustainability implies humanity's continued development and comfort in ways that maintain environmental integrity (Kuhlman & Farrington, 2010; Albert, 2019) and what Daly (2008) described as intergenerational justice. The concept of sustainability is rooted in the field of forestry (Schmithüsen, 2013; von Carlowitz, 1713/2009). As an area of curriculum, sustainability education is described by Evans et al. (2017) as "rooted in the theoretical and pedagogical approaches of the older field of EE [(environmental education)] and includes a diverse range of conceptual approaches" (p. 408).

Sustainability education integrates knowledge domains such as the natural and social sciences (Feinstein & Kirschgasler, 2015), humanities (Henke, 2022; Otto & Wohlpart, 2022), philosophies (Clarke & Mcphie, 2016; O'Brien & Howard, 2016) with STEM skills such as systems thinking (Kutty et al., 2020). For the last 2 decades, United Nations Educational, Scientific and Cultural Organization (UNESCO) has focused international efforts on education for sustainable development (for a critique of sustainable development, see Kaul et al., 2022) and developed the initiatives such as the United Nations Decade of Education for Sustainable Development (2005–2014), which was followed by the Global Action Programme on Education for Sustainable Development (2015–2019). Its most recent framework, Education for Sustainable Development for 2030, has five priorities, including "empowering and mobilizing youth" and "building capacities of educators" (UNESCO, 2020). Education for Sustainable Development has a shared, international focus and is likely to grow in its prioritization within standards and curricula globally. The focus on Education for Sustainability (EfS) reflects a growing acceptance of the realities of human intervention and disruption of our planet, but science teacher educators have seen other priorities arise and recede. How can our work as science teacher educators shape the conversation around sustainability education?

What Is the Importance of Education for Sustainability in Science Teacher Education?

A position statement from the Association for Science Teacher Education (ASTE Leadership Team, 2016) framed “science teacher education as a profession that celebrates our global tethers, while working diligently to make the world a better place for all.” Science teacher education, therefore, has a responsibility to promote dispositions, understandings, and skills of sustainability. Fischer et al. (2022) frame “Teacher Education for Sustainable Development” as an “area of policy, practice, and research focused on the integration of ESD-related concepts [(concepts related to education for sustainable development)] and objectives into teacher education” (p. 510). Their literature review “of 158 peer-reviewed publications” described a field that has been primarily focused on “designing learning environments, understanding learner attributes, measuring learning outcomes, promoting systems change, and advancing visions for the field” (p. 509). Innovations in science teacher education for sustainability are needed in order to integrate this body of work into our teacher education spaces in ways that can be taken up by practitioners.

How Has Education for Sustainability Arisen in Science Teacher Education Policy?

According to UNESCO, in 2021, just over half of a group of 100 nations (53%) included climate change in national curriculum frameworks, but most of those only mentioned climate change and did not include any depth of focus on it (p. 4). Among teachers in those nations, however, fewer than half (~40%) were confident in their ability to support learning around specific dimensions of climate change, and only around 20% felt they would be able to support learning about how to take action (p. 2). Support from teacher education for sustainability is critical, but science teacher education, specifically, is necessary. Scotland and Wales were found to include sustainability in teacher professional standards by Evans et al. in 2021, but many nations, including Botswana, Malawi, South Africa, Sweden, and Canada, have incorporated education for sustainability through their professional organizations and teacher education programs.

Strategies and Challenges for Teacher Education for Sustainability

Evans et al. (2017) found evidence of four approaches to embedding sustainability education in initial teacher education: embedding sustainability (1) across curriculum areas, specific classes, and institution-wide, (2) through core subject areas that preservice teachers are required to complete, or more specifically, (3) through one component of a core subject area, and lastly, (4) through an elective subject dedicated to sustainability education (p. 409). There are challenges inherent in each approach and in educating teachers about climate change specifically. Beach (2023) observed challenges that are reflective of both the nature of teacher education systems as well as of the bodies of skills, knowledge, and dispositions associated with climate change. These challenges include those imposed externally, such as navigating the variation in U.S. state learning standards regarding climate change. There are also challenges inherent in working with teachers in integrated domains that have been politicized, such as climate change. Teacher education in this domain needs to support accurate knowledge about climate change, incorporate systems thinking in teacher

education for sustainability, promote the inclusion of environmental justice, and incorporate transdisciplinary curriculum within teacher education programs. Although using local climate change phenomena may pose challenges (Beach, 2023), it may help teachers overcome poor attitudes or negative feelings of self-efficacy about teaching about climate change.

What Science Teacher Education Innovations Are Called for?

Scholars note that EfS in teacher education "is generally under-theorised and descriptive" (Evans et al., 2017, p. 413), and there are calls for the systemic inclusion of EfS in teacher education programs and licensure. Therefore, momentum around engaged and active communities of science teacher educators and scholars developing theory, professional development, curriculum, strategies, and assessment is critical. Our history as a field offers some insights into some ways forward. What can we learn from the late-20th-century focus on subject integration or the present emphasis on STEM and engineering? How can our foundation in nature study and scholarship on the nature of science and scientific inquiry inform the ways in which we approach science concepts, skills, and dispositions that are socioculturally embedded? Adapting what we have learned and making our values regarding environmental and social justice explicit will play an important role in orienting our science teacher education context to not only add sustainability education to our repertoire but also contribute to the change that is needed.

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