6 Integrating Core Sustainability Meta-Competencies and SDGs Across the Silos in Curriculum and Professional Development

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6.1 Introduction

Curriculum has been identified as the weakest area of systemic improvement on campuses by the Association for the Advancement of Sustainability in Higher Education (AASHE) and the organization Second Nature. Operational concerns (e.g., energy efficiency and recycling) have made the greatest gains in AASHE's Sustainability Tracking and Assessment Reporting System (STARS) reports and Second Nature's University President's commitments to Climate Action Plans.

Sustainability is often introduced ad hoc into courses lacking comprehensive design at the course and program levels. Learning objectives are seldom reviewed or assessed. Students generally graduate with adequate sustainability conceptual knowledge, but less often with the disposition or capability to make change in the variety of institutions and communities they find themselves working and living in.

What does effective sustainability curriculum look like? An effective sustainability curriculum is deliberately constructed with the aim to graduate students with the capacities to be effective systemic change agents. We find that the key framework and world view to be built upon the ethic of care for self, others, environment/nature, and knowledge. We find the key elements of effective curriculum design to be "Sustainability Meta-Competencies" (SCs), United Nations Sustainable Development Goals (SDGs), and case studies integrated with socio-scientific inquiry (SSI) pedagogies.

How do we effectively support faculty in bridging these practices into their classrooms across different disciplines? Applying the key elements and ethic of care framework above we have constructed simple templates for teaching sustainability and environmental justice across the curriculum in faculty development workshops and eco-literacy workshops for non-faculty staff.

This chapter draws upon our personal experience and practice of teaching sustainability and environmental justice in dedicated courses in sustainability and environmental justice and across the curriculum in physical science, life sciences, social science, and art, at four public and private universities. We are inspired by the shared experience and wisdom of the Sustainability

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Curriculum Consortium conceived as a community of practice as an affiliate of AASHE to collectively address the problems and needs outlined above. The more extensive research on science and environmental education is drawn upon for pedagogy, including our own ongoing research on civic engagement with ecosystem science and socio-scientific inquiry pedagogy discussed more fully elsewhere and to come (Ruppert et al. 2018, 2019).

6.2 Theoretical Framework

Our design and understanding of effective sustainability curriculum is founded on a theoretical framework of the ethic of care, domain-based moral development, and the sustainability meta-competencies, and socio-scientific inquiry pedagogies informed by the AIR-V epistemic cognitive framework (Barzilai and Zohar 2014; Chinn et al. 2014; Ruppert et al. 2018, 2019). We follow this section with the articulation of the design of professional development workshops based on this theoretical approach.

6.2.1 Ethic of Care

We approach teaching sustainability and environmental justice through the framework of the relational theory of the ethic of care for self, others, environment/nature, and knowledge.

Carol Gilligan developed a grounded theory of moral development from a qualitative research study of young women making moral decisions about abortion and weighing ethical issues of care and harm to self and others (Gilligan 1977, 1993). At the time, women were pressured by society to prioritize care for others over care for self. Gilligan discovered one had to balance care for self to be best capable of care for others. Nell Noddings (1984) applied the ethic of care to education, and Russell and Bell (1996) extended the theory to ethic of care for environment/nature including non-human beings and made the ethic of care a cornerstone of ecofeminism, animal rights, and ecojustice. We find it useful from our research on civic engagement with ecoscience to extend the ethic of care to care for knowledge (Ruppert et al. 2019). We also posit that the ethical care for knowledge be inclusive of place-based local knowledge and indigenous knowledge and ontologies.

It is more conventional to contrast anthropocentric vs ecocentric worldviews, but we find it more fruitful to contrast care with harm and balance care for self, others, environment, and knowledge. Ounvichit (2017) circumvents the conventional dualism by evaluating children with degrees of three poles of care: ego (self and family), others (community), and nature, where one can score high on all three without one as a tradeoff for the other.

Pope Francis's renowned encyclical of integral ecology Laudato Si' is written through the framework of ethic of care for "our common home" and was published in coordination with the promulgation of the United Nations Sustainable Development Goals (SDGs), which we also see as mutually reinforcing.

6.2.2 Domain-Based Theory of Moral Development

A complementary theory of moral development to the ethic of care is Larry Nucci's relational domain-based theory of moral development. Nucci's research finds that morality is not in practice absolute, but is contextual, each individual engages in moral-based reasoning and action relative to a context that can shift with time and place (Domain Based Moral Education [DBME] 2017; Nucci 2008; Nucci and Turiel 2009). Consequently, Nucci's research has found that apart from a very small percentage of psychopaths and sociopaths, most people engage in moral reasoning, but with different contextual domains. This is an important complement to the ethic of care, because for us to work together collectively for sustainability, we need to be able to not mistakenly judge others to be immoral, but instead seek to understand the contextual domain of their values and morality, and communicate with that understanding.

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6.2.3 Sustainability Learning Core Meta-Competencies

Debra Rowe, president of the U.S. Partnership for Education for Sustainable Development has challenged us to go beyond a focus on conceptual knowledge in education and shift our attention to develop student capacities to become agents for systemic change. This means integrating values, attitudes, behavior, and ethics with other education reform pedagogical strategies in the classroom (National Research Council [NRC] 2012, 2007; Sadler and Donnelly 2006; Sadler et al. 2011; Zeidler et al. 2005; Zeidler 2016; Ruppert et al. 2019). Ideally, this also involves activities that provide students with experience of self-efficacy and collective efficacy of systemic change (Svanström et al. 2008).

Wiek et al. (2011a, b, 2015) and Rieckmann (2012) from a research group at Arizona State University (ASU) and Northern Arizona University have identified from the sustainability practitioner and research literature reviews and their own experience various competencies that they have consolidated into five key competency categories of systems thinking, futures thinking, values thinking, and strategic thinking competencies which converge in practice and pedagogy as collaborative (teamwork) problem-solving competence necessary to become effective change agents. Theres Konrad at Leuphana University of Lüneburg, Germany is collaborating on a joint graduate program with ASU that explicitly develops these competencies with graduate student self-assessment (Konrad et al. 2018). This produces a self-awareness of students on how their competencies are developing, and how they can take an active role. The work-in-progress is demonstrating success of this approach.

Penn State University (PSU) Sustainability Institute engaged in a qualitative and quantitative research study of their own practices in classes and programs to identify core sustainability learning core meta-competencies (Engle et al. 2016, 2017; Buckland and Engle 2018). The authors use the term meta-competencies to highlight that the subjects were aware of and self-directing the learning process with the competencies. The pedagogical implications are to be explicit and direct in the curriculum when implementing the curriculum. PSU identified these five core meta-competencies to include system thinking, temporal thinking, interpersonal literacy, ethical literacy, and creativity/imagination. Later, in a webinar (Buckland and Engle 2018), add the strategic thinking competency of Wiek et al. (2011a, b, 2015) as equally important. PSU's elevation of creativity/imagination to a core meta-competency is an important contribution to this literature and practice, which we also make the case for in our discussion below.

The Sustainability Curriculum Consortium [SCC] (2016) has prioritized sustainability competencies and is working collaboratively with the National Council for Science and the Environment (NCSE) to develop sustainability program learning outcome guides based on "sustainability core competencies."

Rieckman (Rieckmann 2017) has extended and integrated sustainability competencies into learning objectives for a UNESCO resource: Education for sustainable development goals: Learning objectives.

6.3 Professional Development: Faculty and Staff

In this section, we articulate our design of professional development workshops based on the theoretical approach of the ethic of care and sustainability competencies. Following this section, we go into more detail on the importance of the core sustainability competencies and how they can be implemented in the classroom.

6.3.1 Sustainability Across the Curriculum

The sustainability across the curriculum faculty development workshop we designed is based on the MacGregor et al. (2014) AASHE bioregional workshop template. Faculty form small groups within the same or similar disciplines. Faculty identify the big ideas in their courses, close to the

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"trunk of the course," and not in the small outlying "branches." When finished, participants are provided with an extensive set of faculty sustainability concepts cards, some with detailed explanations on the back. Workshop facilitators guide participants to match cards to their big ideas. It is helpful to have facilitator assistants work with each team, as some sustainability concepts may need to be explained in the context of their discipline. From these associations, faculty develop class activities, helping each other in their team, or selecting one course example per team, depending on available time.

We add to the MacGregor et al. (2014) template two additional stages: participants matching activities with sustainability core competencies cards, and one or more of the 17 Sustainable Development Goals (SDGs). We have found these two stages easier for participants than matching sustainability concepts, effecting more confidence and satisfaction in the exercise. The competencies often prompt the faculty to enrich their proposed student activity, the creative/imaginative competency in particular. The sustainability goals help faculty connect their discipline and locality with practical projects and policies and help students connect the local to the global. Participants are introduced to the course mapping exercise developed by Buckland and Engle (2018), whereby they see how they cover some of the sustainability core competencies in their courses with activities that were already in their curriculum, and can enrich their courses by covering all of the competencies in more depth. Time permitting, faculty are introduced to the "Campus as a Living Laboratory" and AASHE STARS, deepening the local to global connections. For the final stage of the workshop, time permitting, faculty are introduced to the Environmental Justice Atlas (2019) and Seeds of Good Anthropocenes 2019 case studies to explore bringing into their courses. Information about local sustainability and environmental justice organizations is shared with the participants for potential field trips, student projects, and service learning.

6.3.2 Eco-literacy Staff Development

While "sustainability across the curriculum" workshops are expanding across the globe, eco-literacy workshops for non-faculty and non-programmatic staff are less common. Whereas the "big ideas" of courses is a path to incorporate sustainability into the curriculum, we use the ethic of care and domain-based moral development approach with staff who choose a non-academic career path and have a wide range of values and perspectives. Our starting point is to ask the staff participant what they care most about in life and do not want harm to come to. Participants write what and who they care about on cards, just like we did with faculty with big ideas in their courses. We then distribute cards of sustainability and environmental justice concepts and issues as we do in faculty workshops, and work with the participants to see what concepts and issues could affect who and what they care about. This may require indirect and direct guidance of the participants to make and understand the connections of sustainability and what they care about.

We open the discussion of the whole group and ask what they would like to know more about. We invite our librarians to show them how to get quality sources and volunteer their services. We inform them about the SDGs, which they also match to what they care about.

Follow-up workshops are proposed to be held by faculty with specialized knowledge about what they care about and to also develop staff Engle and Wiek's "sustainability meta-competencies" (system and temporal thinking, ethical literacy, interpersonal/intrapersonal literacy, creativity/imagination, strategic thinking) to enable staff to become effective change agents for their community and on the job. We can then recruit staff workshop participants to be on a campus bottom-up green team to complement our Sustainability Council and help bridge the divide between staff and faculty.

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6.4 Sustainability Learning Competencies

As mentioned above we follow in our implementation and discussion here the sustainability core learning meta-competencies identified Engle et al. (2016, 2017) and Buckland and Engle (2018) their research of existing classes and programs at Penn State five core meta-competencies: system thinking, temporal thinking, interpersonal literacy, ethical literacy, and creativity/imagination. We pay particular attention to creativity/imaginations, since it is not emphasized in other work, and we believe generally deficient in higher education.

6.4.1 System and Temporal Thinking

System thinking and temporal thinking can be taught directly or indirectly. We aim to provide students with many instances of complexity and how to be comfortable with uncertainty. A Delphi study by Ruppert and Duncan (2017) found that an important big idea of ecosystem science is understanding that it is impossible to know all the connections, relationships, and importance of elements and boundaries of an ecosystem. By teaching ecological case studies (e.g., Walker and Salt 2012; Healy et al. 2013; Environmental Justice Atlas 2019; Seeds of Good Anthropocenes 2019; Temper 2015), students discover the difficulties of human interventions and predicting impacts on ecosystems. Case studies and place-based student activities can teach students the contingency of knowledge and the importance of local and indigenous knowledge (e.g., Healy et al. 2013; Temper 2015). The concept of socio-ecological systems becomes more understandable with concrete examples (e.g., Tsurusaki and Tzou 2014; Walker and Salt 2012; Healy et al. 2013; Temper 2015). Students discover that human society is not separate from nature and the environment but is an intimate part of it with complex feedback. We can find various degrees of realization in classroom discussions and reflection essays, and some students can experience profound epiphany and identity shift (e.g., Nazir and Pedretti 2016; Carlone et al. 2014).

The fields of ecological economics and political ecology were developed to better understand and teach complex systems and interactions of humans and nature (e.g., social metabolism); they aim to be transdisciplinary, reconceptualizing economics as part of the biosphere and natural system and grounded in ethics (Timmerman 2012), an important correction to conventional academic economic discipline and pedagogies that characterizes impacts on habitat and the environment as externalities (Healy et al. 2013; Temper 2015).

Environmental justice case studies reveal to students that behind most harmful impacts on the environment and ecosystems is an economic distributive justice issue: some people benefit, and others are harmed (Environmental Justice Atlas 2019). System and temporal thinking help reveal these interconnections. Climate justice is also an issue of intergenerational distributive justice, as the present older generation benefits, the young and future generations will suffer, as we can see argued in the youth climate justice lawsuit (Juliana v. U.S. 2019).

The American Meteorological Society (AMS) course materials (2014) include "eInvestigations" internet computer labs. Students are guided to find and evaluate real historic and current climate data from government and scientific sources, just as scientists do, and thereby gaining a better understanding of what is known, what is unknown, and levels of uncertainty. Making sense of climate data from air, land, and oceans provides students with an exposure to interrelationships of physical systems, long temporal scales. AMS offers a Climate Diversity Workshop (2018) that teaches non-climate scientists from all disciplines how to teach climate science, since the need cannot be fulfilled by the limited amount of teaching climate scientists.

The Sustainable Human and Environmental Systems (SHES) group (Focht et al. 2018: xxi) sees system thinking as the most fundamental and elevates system science and system thinking to the status of a "supradiscipline" pedagogy:

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"In sum, the SHES approach maintains a holistic perspective throughout all of its stages. It does so by using a supradisciplinary pedagogy that conceptualizes both sustainability situations and sustainable alternatives in systems-thinking terms. By progressively revealing more of the systemic and interactional complexity of the sustainability situations, the SHES approach helps students to gain a more thorough and nuanced but always holistic understanding of the systems and system interactions that are essential to realizing the SHES vision. The use of the SHES approach to diagnose the sustainability challenges posed by these situations makes it possible to prescribe targeted interventions to transform the situations into alternatives designed to achieve sustainable outcomes. The implementation of these prescriptions through social learning leads to increased capacity on the part of the stakeholders to contribute more effectively to the emergence of sustainable societies."

6.4.2 Inter- and Intrapersonal Literacy

Engle et al. (2016, 2017) found in their research that interpersonal literacy to be the biggest barrier to producing change agents, the same reason we stress communication and the use of peer to peer education including team work.

We convey to students in their own class experience and through case studies the importance of recognizing the distributed and contingent nature of knowledge, with no one person having comprehensive and diverse expertise, and the importance of local and indigenous knowledge (Roth and Lee 2012; Feinstein 2011; Aoki Inoue and Moreira 2017). The ability to communicate with one another and function as a community of practice is essential to achieving sustainability and resilience.

Howard Gardner (1983) developed the theory of multiple intelligences based on empirical research. While some individuals may have natural different levels of abilities, these intelligences can be learned and taught. He identified both inter- and intrapersonal intelligences among seven discernable intelligences. Daniel Goleman popularized the finding in his book "Emotional Intelligence: Why it can matter more than IQ" (Goleman 1995). Although the theory originated in education, it became more popular in business literature, as a competency often missing from college graduates where learning has overstressed analytical cognitive intelligence. Emotional intelligence includes being aware of one's own emotions and others', the ability to manage emotions intrapersonally and interpersonally, and thereby be better able to communicate and function in a community of learning and practice.

The Psychology of Climate Change Communication guide (CRED 2009) is extraordinarily useful for teaching and sharing with students how to effectively communicate sustainability science and engage in productive collaboration in and out of school. Team wikis (e.g., Blackboard and ePortfolio), podcasts (audio, video, and animation), and art projects (e.g., eco-fashion show) are effective activities to develop inter- and intrapersonal literacy and creativity/imagination. Facilitated discussions (online or in-class), blogs, and reflection essays on exams provide further opportunities for student development of the "meta:" awareness of how they are learning and communicating and developing their own competencies.

Student individual work (including midterm reflection essays) and team work are presented to the entire class to expand peer-to-peer learning, and to flip the audience of their work from instructor to students and the public. ePortfolio and voice-thread are exceptionally good platforms for students sharing and expanding their modes of expression from written to aural and visual. We employ class wiki ePortfolios and individual student ePortfolios.

There is resistance with many students to teamwork, but that is often an indication on much the intrapersonal and interpersonal competencies need to be developed. Individual grading of student levels of participation can overcome the fear of teammates bringing their own grade down. Guided inquiry of team work by the instructor at each stage can help get through resistance and foster deeper learning and retention.

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6.4.3 Ethical Literacy

We define the ethical literacy competency to be the ability to recognize and understand one's own values, values of others, and the multitude of societal values including the values of indigenous cultures (Engle et al. 2016, 2017). The relational domain-based theory of moral development discussed above holds that morality is not absolute, but contextual, each individual engages in moral-based reasoning and action relative to a context, a context that can shift with time and place (Nucci 2008; Nucci and Turiel 2009).

The Canadian Truth and Reconciliation activities are generating a surge of sustainability curriculum in environmental education, drawing upon indigenous knowledge, ontologies, and world views. The University of Hawaii Center of Excellence incorporates indigenous knowledge and experience in the curriculum.

Our pedagogy is based on eliciting from students what they care about as the starting point and guiding them to see how they are connected to issues of sustainability and environmental justice. The sustainable development goals help make sustainability problems more concrete and actionable.

Our pedagogical approach is also informed by the research and practice of teaching "Socio-Scientific Inquiry (SSI)" and "Socio-Scientific Reasoning (SSR)" in K-12 (Sadler and Donnelly 2006; Sadler et al. 2011; Zeidler et al. 2005; Zeidler 2016; Ruppert et al. 2018, 2019). Instructors guide students to address complex sustainability "wicked" problems that do not lend themselves to simple solutions, and due to the impact of many other peoples and ecosystems, require a moral reasoning process.

As is for other competencies case studies, place-based projects and field trips can be effective to develop ethical literacy. Nazir and Pedretti (2016) took urban students into the wetlands and handled reptiles. Students initially had adverse reactions to the "icky" mud and "ugly" creatures. With some prompting, a student took the lead with fellow students, identifying with her fears and discomfort. Over time, students became comfortable with the reptiles and the environs, expanding their egocentric identity toward eco-centric identity to include wetland ecosystems and the non-charismatic creatures that inhabit them. Tsurusaki and Tzou (2014) designed a curriculum that investigated water use and pollution in Puget Sound. Students started out being overwhelmed by the scale of pollution and water use but could not see their personal and small communities contribution to be significant. The instructor guided the students collective research efforts where they became acquainted with each part and interaction of the human system with the ecosystem. Students came to an understanding of their own complicity and what could be accomplished on the individual level and community level.

One of the authors creates an action assignment in every course to connect the student directly outside of the classroom to a sustainability or environmental justice issue as an observer or as a participant. Ideally this is done at an event or with an environmental justice organization but can also be done on social media.

The new literature on post humanism and interspecies being builds upon animal ethics (e.g., Lloro-Bidart and Banschbach 2019). Art education methods are particularly successful in generating affect and expanding ethics beyond the human and are discussed in the following section.

6.4.4 Creativity/Imagination Competency

While Wiek et al. (2011a, b, 2015) with the Arizona State University (ASU) Sustainability Institute and Rieckman (Rieckmann 2012, 2017) with ASU and UNESCO identify creativity as important as a sub-competency for sustainability, the Penn State University's quantitative and qualitative studies of higher education experience found that it is important to elevate creativity/imagination to the level as an essential core meta-competency (Engle et al. 2016, 2017; Buckland and Engle 2018). The authors find that podcasts, team projects, and the use of ePortfolio multimedia software facilitate student expression and

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creativity/imagination competency. The following section is contributed by Milena Popov who teaches sustainability in the Art Department and an Environmental Justice Program.

In our time of global ecological crisis with unpredictable outcomes and scenarios, developing creativity/imagination competence is becoming increasingly important. As Engle et al. (2017) noted, creativity/imagination competence creates an "ability to envision, develop and apply innovative and strategic solutions, frameworks, etc. in order to adapt to changing and challenging situations… identified by research participant as necessary for addressing unforeseen outcomes and scenarios; not addresses in other categories" (Engle et al. 2017:12). Student reflections in their self-assessment essays in our classes show that students are also aware of the importance of this competence. While students recognize the importance of all sustainability competences, a big majority of students stated that they have developed in our courses creativity/imagination and that this is the competence they would like to develop further. Some of the reasons students stated for the necessity of developing creativity are lack of abilities of individuals to create and innovate, to create solutions on their own, to envision different things and to see them from different angles, and thus to make sustainable changes in the world. They noted how class' creative assignments (such as creating a green makeover of an unsustainable building or a waterfront), presentation of creative science and art projects (such as underwater city in Japan and Rising Currents exhibit in Museum of Modern Art in New York), as well as field trips (to High Line park for example) inspired them and changed their behavior toward the environment. Few students described creativity as the key for the future. Therefore, many students that stated they developed creativity in these courses, also stated they would like to develop it even more in the future. From some of the students' reflections, we have also seen that creativity/imagination competence is seen as something not only related to art/design, but also logical thinking and science. For example, one student noted that creativity/imagination competence helps a person to grow and develop logical thinking, while others stressed that with creativity one could envision the space exploration and colonization. This thinking might have stemmed from our interdisciplinary approach to teaching sustainability and the way creativity was presented in this particular class. Linking art and science into one large field (or seeing them as two faces of the same coin) is not something new. Historically, art, science, and religion were one large field, before they got completely separated in the time of Humanism (with the birth of modern science and aesthetics, and not coincidentally in the time of Industrial Revolution). The starting point of this segregation (and the origin of Cartesian dualism) can already be seen in Ancient Greece (the source of admiration for eighteenth-century humanists), where this division, not accidentally, went parallel with the separation of man from nature. Oppose to the dualisms man-nature and art-science, in historic and contemporary tribal societies, for example; one can see the unity between art and science (as well as religion) and at the same time between man and nature. A shaman in tribal societies stands in for both artist and scientist (as well as a religious leader) that is equipped with talents and knowledge to cure societal illnesses (as a whole from its roots, rather than just treat its symptoms). If we look at our environmental crisis, it is a problem that is at the same time a physical and a moral one in its nature. Thus, scientific innovations (as a single view approach) cannot solve this multifaceted problem alone. For example, as Hardin (1968) noted there are no technical solutions to overpopulation since the technology cannot cure the root of the problem—create a mind shift. What is needed here is an interdisciplinary approach to problem-solving—an art-science unity, as a single endeavor that Edwards (2018) calls "aesthetic creating" is needed to cure the ecological crisis. Moreover, as Edwards pointed out, humanity cannot just value innovations that have a more immediate and tangible effect (based on science and often profit driven), but also needs to value innovations that have long-term humanitarian goals—cultural innovations, even if their effects are not immediately seen or obvious (Edwards

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2018). Arts that are not just arts' for arts' sake have always had the ambitious tendency to bring awareness of the moral problems of society and bring about the cure. In our time of ecological crisis, diverse eco-arts as well as eco-design have shamanistic goals—to cure this crisis. For example, cli-fi novels, films, theatre plays, and artworks help humans visualize diverse negative scenarios that can happen if the future is not ecologically sustained, while bio-remedial artworks and reclaimed green architecture directly remediate environmental problem sites. "Eco artists are … visionaries inventing new means of art-making that are capable of addressing the Earth's mounting vulnerabilities and crises" (Weintraub 2012:1). They employ various strategies to achieve their goals such as visualization, dramatization, metaphorization, satirization, and instruction. "Eco artists are at liberty to summon imagination, vision, wit, humor, exaggeration, ridicule, glorification, and every other expressive means that artistic license allows" (Weintraub 2012:2).

Arts can reach human emotions—to move their hearts, and thus change the way humans think and act, while showing them new possibilities (such as the visions of a future) without constraints of the known. Two students have stated in the earlier mentioned class self-assessments that by developing creativity/imagination competence they were able to see their wasteful lifestyle and change their behavior since they now have the ability to constantly think of new ways to solutions, adding that they wish to use their creativity to create larger, local and even global solutions in the future. It is important to keep developing students' creativity/imagination competence since it enables them to open up and start thinking outside of box—be open to new and different possibilities. As one student noted, with creativity one can always envision many different things in a new way, and in a different way that others can envision. Thinking outside of box further creates the ability to imagine scenarios and envision the future. Few students have mentioned that by developing creativity in these classes, they develop critical thinking and the ability to see beyond what they think they can do—thus teaching them that nothing is impossible. They stated that creativity helped them envision something and develop an idea that can be applied to real-world situations. One student added that our classes give the ability to students to anticipate for the present and the future.

In art's ability to reach human emotions and inspire behavioral changes, it also lies the opportunity for the creation of empathy toward other humans, as well as non-humans, and thus reconnects with nature in order to solve the ecological crisis that resulted from this disconnect. Eco-arts as new trends in philosophy such as posthumanism, new materialism, object-oriented ontologies, and theories of social assemblage recognize the continuity between all living things as well as non-animate nature—have ecocentric approach oppose to egocentric approach (striving for Post-Anthropocene in reaction to Anthropocene).

Regarding fostering empathy toward other human beings, the world's first Center for Empathy and the Visual Arts was recently established at the Minneapolis Institute of Art with the mission to research and create strategies and tools for museums around the world to promote empathy by using works of art. As museum's director says:

> A visitor to our museum has the opportunity to experience works of art made over the course of some 5000 years, from every corner of the globe. One of the most meaningful aspects of this encounter is the awareness it can awaken of a common humanity—an immediate sense of connection between the viewer and someone who may have lived in a very different time and place… Thanks to the Mellon Foundation, we're proud to take the lead with partners across the country, in studying how to spark and nurture empathy through the visual arts, so that Mia and all art museums can contribute even more toward building a just and harmonious society (Daley 2017).

With the same goal a traveling Empathy Museum is created, where in one of the art exhibits its visitors are asked to walk in someone else's shoes while listening to audio-recorded life story by that person (Empathy Museum 2019).

Climate change effects are not equally distributed today around the world and due to many factors (such as geographic location, income,

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gender, race) some people experience these effects more than other people. For people that do not experience much of the effects at the moment, it is hard to imagine how it feels like to be affected by climate change. It is even harder to imagine what life on Earth would be like in the future. Works of art used in the classroom (such as cli-fi literature, visual artworks, films, documentaries, theatre plays) can help students imagine these scenarios, as well as step into someone else's shoes. Further effects are achieved if students are asked to create their projects that would address environmental issues and create empathy. For example, in our sustainability and environmental justice classes students create theatre of oppressed plays to showcase an environmental injustice case, as well as to enact a solution—bring a justice to the presented case. In another type of group art project, our students are given (or are asked to choose) an environmental problem site (such as polluted river or land, or an abandoned or otherwise non-environmentally sustainable building or structure) and are assigned to create ecologically sustainable remediation of this site, achieving the justice (and feeling of empathy) for not only human, but also non-human nature. On the other hand, in some individual artistic assignments students create their understanding of their connection to environmental problems. In one of these assignments, fashion footprint assignment students are asked to look at the labels of their clothing and accessories, and then create an environmental map based on that data and their research on various environmental injustices caused by the fashion industry, while at the other consumption self-portrait type of assignment students keep a written, photo, or video journal of all items he/she throw in trash in several days or weeks, and then create a visual display of the collected data—of their waste (in any artistic media chosen by students, such as video, poster, drawing, poetry, sculpture, or photo-installation). Learning by teaching (LbT) technique is then applied in our art projects assignment where students are asked to bring environmental problem awareness to the audience (in an ephemeral public art installation, and interactive public art installation proposal) and showcase sustainable solution (in eco-fashion show).

It is not accidental that newly developed course on eco-art and design is very popular among our students and it is gaining in popularity. This interdisciplinary course introduces students to various ways artist and designers (including architects) deal with global environmental challenges and asks students to create their art as part of an engaged cultural dialogue. Already in the third semester, the enrollment for this course reached the maximum. The fourth semester the course was offered online for the first time and right away reached the maximum, which was retained in all subsequent semesters. Due to students' interest, the course now runs four semesters a year with the continuous maximum enrollment.

6.5 Meta-Cognition, Awareness, and Assessment

We employed the New Environmental/Ecological Paradigm – Revised instrument (Dunlap and Van Liere 1978; Dunlap 2008) as a self-assessment pre and post course since it is well established. The instrument consists of 15 questions with no correct answers that can be used to score the degree the participant has the NEP-R viewpoint. Most students show an increase in total score pre and post, indicating a shift in values and attitudes. Ordinarily we do not expect to see larger shifts in values and attitudes in a single class but aim to do so in a program or degree. The changes were not large, but what was most interesting is the student reflection on what questions students changed their responses and why. In addition, what was interesting was students understanding of the wide range of values and attitudes in their classmates by comparing their responses with others. This is a learning outcome we aim for, an awareness and understanding of one's own values, others, and societal values. This is also taught in climate/sustainability communications directly, but it has greater impact when students become aware of it though the NEP-R. This stimulates

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further reflection on differences students had on Discussion Board and class discussion. Of interest is the few students that had a decline is score (one to three students per class). A common reflection in these cases was that the students didn't know how they felt about an answer before class, or that they were trying to give the answer expected or wanted by the instructor pre but had more confidence in expressing their values post. Some students critique some of the questions posing dichotomies, since they felt the issues to be more complex. Overall, most students respond that they are aware of their values and others', achieving our meta-cognitive objective.

We are looking for other instruments to supplement the NEP-R that are more consistent with the virtues of the three ethics of care for self, others, and the environment that Russell and Bell (1996) identified drawing on Carol Gilligan's foundational work (Gilligan 1977, 1993). Ounvichit (2017) reports an instrument her team developed that circumvents the pitfalls of the dualist opposition of anthropocentric vs ecocentric of the NEP assessment with an instrument that assesses three prongs of egocentric (self and family), homocentric (human), and ecocentric ethics, where one does not diminish the other. Ounvichit's case study (2017) found:

> [T]he 11 children who demonstrated ethical development engaged more in the higher-order thinking while the other four did not. The four children who could touch on the ecocentric level were keener about summarizing their knowledge for presentation. Understanding the relation between the thinking patterns and the ethical development tendencies helped environmental educationists understand the value of embedding thinking skills in arranging constructivist environmental education.

The Yale Program on Climate Change Communication (Chryst et al. 2019) developed an open source instrument that categorizes participants into the "Six Americas" of climate change perspectives that they have developed with extensive surveys and analysis and have distilled from 36 questions to 4 questions. Most students chose the top two levels of concern for global warming when reporting to the instructor, these results were not aligned with the NEP-R results, suggesting their responses were influenced by what they expect the instructor or society wants them to be. The instrument does have value of self-awareness and societal awareness, as students try to figure out why they are in the category they were assigned, and see themselves relative to others in society, and understand the diverse points of view. Of note was some students noting that they were not in the alarmed category because although they were concerned about global warming, they realized they have not acted on global warming through their own behavior. This was a wakeup call to personally become more politically active. One of the authors requires some activity that has an impact outside of class, with a report back. The SASSY! self-assessment helps provide the motivation to do so. In a number of students' final reflection essays, they recommended the last class to be devoted on what can they do about climate change, sustainability, and environmental justice. One student lobbied the class to do a class action, like a sit in at a bank that funds fossil fuel.

The Sustainability Literacy Test (SuLiTest) of the Higher Education Sustainability Initiative (HESI) is a UN SDG partner and a work in progress. On the individual student level its greatest value is as a learning instrument of the wide scope of sustainability. When students get the wrong answer, they are shown the "expected" answer with an explanation and a reference. On the course level, the pre and post scores are important for benchmarking and see the gains in overall score. But what is most significant is the change pre and post of three different types of students, the students that score highest and lowest in pre-course assessment, and the students that have the greatest gains. The reflection essays provide the instructor with the self-understanding of the scores of the students. Generally, the students with the higher scores do not change as much as others. Only one or two students with low scores pre have similar low scores post.

One interesting case is a student who was disappointed to receive a B minus on a final multiple choice test (from the publisher's test bank) after receiving the same grade on an online test bank. The instructor was surprised too, as she did extremely well on a team video project, inter-

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views of participants in a March for Science, demonstrating she met many of the learning objectives and competencies of the course. However, she had a 37% increase in her SuLiTest score, indicating she had learned a lot in the course. The instructor noticed there were quite a few B climate science students that did not change much on conceptual knowledge evaluation from midterm and final but did on the SuLiTest. This was surprising, since, although the climate science students were exposed to a few SDGS, the SuLiTest has very few science questions. However, the gains in sustainability competencies evident in their projects and reflection essays must have provided the intuition to have more correct answers on the SuLiTest.

Many students had a similar critical appraisal as the instructor, that the SuLiTest asks too specific subdomain data questions, and not enough key concept or science questions. This is an impression some of the authors also had from taking the SuLiTest themselves. This is perhaps a problem with the validity of the SuLiTest, and/or the large scope of sustainability.

The results for the competencies and SDGs were erratic—in many cases going down while others went up. This implies the total score is more accurate than the breakdown. For instance, a breakdown category may have one to four questions per test. This is too small of a sample to assess a breakdown category for an individual student. This results in puzzlement of many students in their final reflection essay; they can't understand how they declined in a particular area. The class averages have all increased from pre to post, indicating progress is being made, but we are not confident that differences between classes on the SuLiTest are significant at the limited scope of our implementation.

We conclude that the SuLiTest is useful for students to discover what they know and what they don't know but has shortcomings for assessing individual student progress.

We find that conscious use of assignments that draw upon all of the competencies will reveal student accomplishments in the course and program. Quantitative instruments are like models, all are wrong, but some are useful.

6.6 Conclusion

We find that a focus on sustainability competencies in the curriculum design elicits best practices and works well with teaching the sustainable development goals. Place-based teaching and case studies are effective methods to connect all the dots and make practical sense of the complex sustainability challenges we face. Sustainability programs and professional development workshops will benefit from a comprehensive use of the key competencies with the sustainable development goals.

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