Discovering Key Competencies for Regenerative Education:

A History of Modern Skills Education and the Future of Work

by: L. Julian Keniry, with Nikko E. Concepcion

Once, we viewed the Earth as an infinite repository capable of absorbing the impacts of human activities—be it environmental degradation, resource extraction, climate change, or pollution. Today, our understanding has evolved. For example, we now recognize the Earth's atmosphere as a thin, protective cocoon. We could traverse its lower troposphere, where most climate regulation occurs, in minutes at 60 miles per hour. We comprehend that human actions can reshape soil, alter climate conditions, and affect ecosystem services at an alarming pace, endangering not only our current generation but also the livability of our planet for future generations of humans and all species.

In this context, skills take center stage. What must we learn to do, in what contexts, why, and to accomplish what? This seemingly simple set of questions becomes more complex when we consider the myriad disciplines, economic sectors, and the diverse aspirations of humanity. Whether it's engineering structures, advancing healthcare, or creating works of art, these pursuits generally use energy and water and rely on natural resources. Understanding how to conserve and reclaim resources is the beginning of the learning curve. Equally crucial is learning to design alongside nature in ways that foster sustainable well-being for all.

In initiatives like Green Teach for Opportunity, which enhances educators' forward-looking approaches to student learning, 'competencies' can serve as a valuable organizing idea. The emphasis on competency-based education applies universally, including green skills education. Here, we delve into the origins and significance of sustainability competencies, their relevance to teachers, and inspiring sources of insight.

Let's start with the fairly straightforward definition of competencies. The National Center for Education Statistics and the US Department of Education define competencies as "a combination of skills, abilities, and knowledge needed to perform a specific task [1]." Focusing on competencies shifts the emphasis from more arbitrary indicators of learning, they explain, such as credit hours, to more practical indicators of applied learning.

1970s US Environmental Education Policy

In environmental education, the effort to define competencies spans more than fifty years. One of the earliest policy efforts in the US was the Environmental Education Act of 1970. Reviewing this national initiative, Sullivan and Schlesinger of Dartmouth University note the need to "differentiate between a simple awareness of environmental issues and the knowledge of the reasons for maintaining ecological balances [2]."

Starting in the 1980s, David W. Orr's essays for *Conservation Biology* [3], books, and precedent-setting projects have encouraged a robust dialogue about the nature of education and its role in engaged, ecologically informed, and conscientious citizenship.

Orr's works, including *Ecological Literacy* [4], *Earth in Mind* [5], and *Democracy Unchained* [6], highlight the need for practical and applied learning, as well as integrated, multi-disciplinary approaches. For instance, noting the need to coordinate fields such as economics and ecology, Orr writes:

> *"We routinely produce economists who lack the most rudimentary understanding of ecology or thermodynamics. This explains why our national accounting systems do not subtract the costs of biotic impoverishment, soil erosion, poisons in our air and water, and resource depletion. We add the price of the sale of a bushel of wheat to the gross national product while forgetting to subtract the three bushels of topsoil lost to grow it. As a result of incomplete education, we have fooled ourselves into thinking that we are much richer than we are. The same point could be made about other disciplines and subdisciplines that have become hermetically sealed from life itself."* [7]
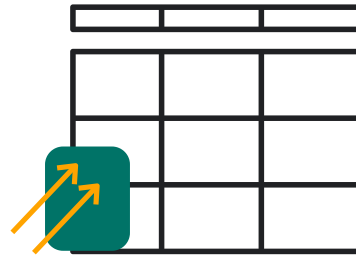
In the linked chart, we provide examples of capabilities David Orr highlights in his book, Earth in Mind, in chapters like 'What is Education For,' 'Politics,' and 'Designing Minds.' Orr suggests educators focus on four key principles when cultivating regenerative skills:

1. Equipping young minds with a foundational understanding of systems.
2. Nurturing habits of mind that seek patterns connecting human and natural systems.
3. Teaching analytical skills for understanding cause and effect.
4. Providing practical competence for solving local challenges.[8]

Education Trends Surveys and Sustainability Skills Statements

In the late 1990s and 2000s, researchers worldwide contributed numerous studies on balancing human affairs with Earth systems. Meanwhile, studies conducted by McIntosh and Keniry (PSRA-I and NWF) found that most students, except those majoring in environmental studies or biology, lacked exposure to Earth systems, pollution dynamics, and solutions to correct the balance (2001, 2008) [9]. This deficit was particularly notable among business, education, engineering, and health sciences students.

In 2012, the ACT published "Proposed Green/Sustainability Knowledge and Skills Statements." This report, co-directed by Debra Rowe, funded by the US Department of Education, and organized by the National Association of State Directors of Career and Technical Education Consortium (NASDCTEc), identified core and enabling concepts related to green and sustainability knowledge and skills. The listed core concepts are: triple bottom line for business, cradle-to-cradle resource use, and materials life-cycle analysis [10].

In addition to core concepts, the ACT study identifies seven vital enabling concepts. They are the precautionary principle, ecological footprint, ecological services, tragedy of the commons, systems thinking, unintended consequences, and quality of life indicators. ACT's skills statements examine students' ability to apply the core and enabling concepts within each of the 16 Career and Technical Education (CTE) Clusters™ with the help of skills assessment indicators [11].

**Consensus About Relevant Competencies Begins to Emerge**

In 2013, Professor Harold Glasser, then the Environmental Program Director at the University of Western Michigan, and his teaching assistant, Jamie Hirsh, initiated a global meta-analysis of sustainability education studies. Through surveys and workshops, the endeavor led to the publication of the article titled, "Toward the Development of Robust Learning for Sustainability Core Competencies" (UWM, 2016) [12].

Glasser and Hirsh identified 14 competencies, ranking them based on participant input:

1. Systems Thinking
2. Ecological Literacy
3. Agency/Change
4. Critical Thinking
5. Awareness/ Sense of Place
6. Reflection
7. Diversity
8. Empathy
9. Focus on Global
10. Focus on Local
11. Multidisciplinary
12. Anticipatory Thinking
13. Collaboration
14. Health and Well-being

They correlated these concepts with participants' perceptions of sustainability, e.g., examining whether ecology held a dominant position in their mental model or was considered equally valuable alongside economic and social dimensions. The authors also address additional critical topics, including distinctions between first and second-order change (e.g., tactical versus systemic educational adaptations) and potential areas for future research, such as methods for implementing these competencies effectively [13].

In a third model, Glasser compares two worldviews. One prevailing view centers around self and shorter-term interests, often seeing technology as a universal solution. In contrast, the other worldview adopts a forward-thinking, community-oriented approach and maintains a more agnostic stance toward technology. [14] See the chart:
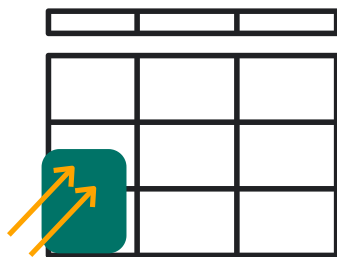
1. Creative and Strategic Competence
2. Critical and Normative Competence
3. Interpersonal and Communication Competence
4. Systems Competence
5. Transdisciplinary Competence

Towards the 2020s

In the summer of 2019, Tina Evans, a Professor of Sustainability Studies at Colorado Mountain College, authored a study titled "Competencies and Pedagogies for Sustainability Education: A Roadmap for Sustainability Studies Program Development in Colleges and Universities." She also curated the *Advances and Innovations in Sustainability: Special Issue: Higher Education as an Avenue for Social Change* for MDPI, in which this article appears [15].

During her sabbatical, Evans reviewed nearly one hundred studies on essential competencies, including oft-cited works by Arnim Wiek et al. such as "Key Competencies in Sustainability: A Reference Framework for Academic Program Development" [16], "Operationalizing Competencies in Higher Education for Sustainable Development" [17], and "Moving Forward on Competence in Sustainability Research and Problem Solving" [18].

These studies explore how teaching and learning shape students' contemporary sustainability skill sets. Assimilating this extensive research, Evans proposed five key competencies to serve as a foundational framework for more specialized skills [19]:

Sustainability Competencies Maturing

In late 2022, The Global Council for Science and Environment (GCSE) gathered input from a substantial membership base of environmental deans and directors, resulting in the distribution of a "Proposal Statement on Key Competencies [20]." This proposal, co-coordinated by Krista Hiser, GCSE's senior lead and advisor for sustainability education, with Katja Brundiers, clinical associate professor, and Jordan King, graduate teaching associate, at Arizona State University (ASU), outlines the following recommended competencies:

1. Futures-thinking
2. Systems-thinking
3. Values-thinking
4. Strategic-thinking
5. Interpersonal
6. Integrated Problem-solving

Several other organizations have made significant contributions to defining student competencies in sustainability in recent times and over many years. The North American Association for Environmental Education (NAAEE), for example, has served as a thought leader in education since its establishment in 1971, working with the US Environmental Protection Agency (EPA) and many other public and private organizations worldwide [21].

Their formative publication, "Excellence in Environmental Education: Guidelines for Learning (K-12)," notes the underpinnings of green skills as follows:

"Environmental education is rooted in the belief that humans can live compatibly with nature and act equitably toward each other. Another fundamental belief is that people can make informed decisions that consider future generations. Environmental education aims for a democratic society in which effective, environmentally literate citizens participate with creativity and responsibility." **[22]**

The Sustainability Curriculum Consortium (SCC) published "Key Competencies: Practical Approaches to Teaching Sustainability" in the summer of 2023 **[23]** and has organized several convenings and webinars. Additionally, AASHE, through its Sustainability Tracking Assessment and Rating System (STARs)**[24]**, and UNESCO, through conferences and publications, including most recently a global survey of trends in teaching sustainability and cultural literacy, have played pivotal roles **[25]**. Overall, the endeavor to delineate essential student competencies is clearly a dynamic and ongoing process.

Emerging Green Industry Standards

Meanwhile, the esdi group's Green Teach for Opportunity initiative has identified more than 100 professional associations across the world in a dozen or more sectors that offer a suite of sustainability offerings for members and staff. The best of these include new performance standards, accreditations for professionals, new software and other kinds of tools, along with training and support for students and other stakeholders.

These resources are relevant for educators for myriad reasons, which is why we offer a map to "Charting Green Industry Skills" as part of the Green UpSkill Challenge and its companion guide, "The GEM Starter Kit." The chart builds on our founder's study in MDPI, "Equitable Pathways to 2100: Professional Sustainability Credentials" (2020) **[26]**. A select example follows:
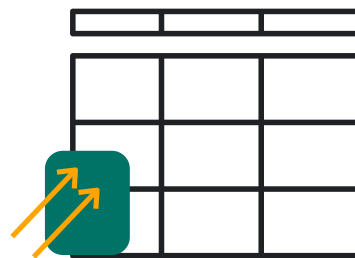
Employers Weigh In

Teachers in academic settings have guided the thought leadership for sustainability competencies in most of the examples featured in this study, but it is important to engage private and public sector employers in fields beyond education and that is beginning to happen, too.

One effort to do this was the "Greenprint: A Plan to Prepare Community College Students for Careers in the Clean Economy" (2015) [27].

Another recent effort is the green skills education survey and benchmarking tool. In the Fall of 2022, esdi group conducted the pilot instrument with more than 100 educators and business leaders in Akwa-Ibom, Nigeria, as part of a green skills education program facilitated by Green Teach for Opportunity held within the green economy conference organized by leaders at the University of Uyo and partners.

Developed with an international team of faculty, industry leaders, and other stakeholders in eight countries in 2020-2023, the green skills education assessment instrument is now in its fourth iteration. It is intended to become a benchmarking and labeling tool for a "Green Skills Friendly Classroom."

At the end of the 2023 school year, the Women in Climate Tech Organization (WiCT+) featured several questions from the aforementioned green skills education survey and benchmarking tool to assess job and skills demand among their network of entrepreneurs [28]. WiCT+ will gather the feedback with the esdi group's Green Teach for Opportunity project in order to share it with teachers across STEM and other fields.

Navigational Support and Credit for Educators

Tapping the input from public and private sector employers, esdi group has engaged advisors, education specialists, and other stakeholders to create the beta version of the GEM™ Credentialing Course, advanced pathways, and green skills identification tools. The program uses a four-pillar framework (Grounding, Adapting, Inspiring, and Advancing, or G.A.I.A.) that recognizes and contextualizes career-aligned green skills education while also supporting continuous learning and improvement [29]. As an additional opportunity to explore in-demand skills and careers for students, the esdi group initiated the Green UpSkill Challenge, a back-to-school campaign in 2023. In three steps over 60 minutes, educators can explore innovation examples, assess employer demand, and set new goals for teaching and learning.

In short, collaboration among groups such as GCSE, WiCT+, dozens of green industry associations, and many others helps to advance understanding and practice for sustainable well-being for all. By focusing on the nexus between classrooms and careers, the esdi group and its project, Green Teach for Opportunity, hope to add a new perspective to the collective view. Together, we can help our students bridge to meaningful career and life callings that elevate themselves, their families, communities, and the broader world. ■

1. National PostSecondary Education Cooperative (NPEC), "Defining and Assessing Learning: Exploring Competency-Based Initiatives." [Online]. Available: https://nces.ed.gov/pubs2002/2002159.pdf. [Last Accessed: 10-Sep-2023].

2. F. Sullivan and W. Schlesinger, "The Environmental Education Act: Where Do We Stand Now?," Semantic Scholar, 01-Jan-1972. [Online]. Available: https://www.semanticscholar.org/paper/The-Environmental-Education-Act%3A-Where-Do-We-Stand-Sullivan-Schlesinger/2f95121c46aeee69e1aefc00e199537753df774c. [Last Accessed: 10-Sep-2023].

3. Society for Conservation Biology, "Conservation Biology," www.jstor.org. [Online]. Available: https://www.jstor.org/journal/consbiol. [Last Accessed: 10-Sep-2023].

4. D. W. Orr, "Ecological Literacy," State University of New York Press. [Online]. Available: https://sunypress.edu/Books/E/Ecological-Literacy2. [Last Accessed: 10-Sep-2023].

5. D. W. Orr, "Earth in Mind," Island Press, 01-Jul-2004. [Online]. Available: https://islandpress.org/books/earth-mind. [Last Accessed: 10-Sep-2023].

6. D. W. Orr, "Democracy Unchained," The New Press, 22-Aug-2018. [Online]. Available: https://thenewpress.com/books/democracy-unchained. [Last Accessed: 10-Sep-2023].

7. D. W. Orr, Ecological Literacy, op. cit., 180.

8. D. W. Orr, Earth in Mind, op. cit.

9. M. McIntosh, K. Gaalswyk, L. J. Keniry, and D. Eagan, "Campus Environment 2008: A National Report Card on Sustainability in Higher Education: Trends and New Development in College and University Leadership, Academics and Operations," National Wildlife Federation, https://www.nwf.org/-/media/PDFs/Global-Warming/CampusReportFinal.ashx (accessed May 3, 2023).

10. CareerTech, "Green Sustainability Knowledge and Skills Statements," www.careertech.org. [Online].Available: https://cte.careertech.org/sites/default/files/I3FolkersCCI%20Slides%20June%20CCI%20Green%20Panel.pdf [Last Accessed: 10-Sep-2023].

11. Ibid.

12. H. Glasser and J. Hirsh, "Toward the Development of Robust Learning for Sustainability Core Competencies," www.wmich.edu, Jun-2016. [Online]. Available: https://wmich.edu/sites/default/files/attachments/u159/2016/2016%20Core%20Competencies.pdf. [Last Accessed: 10-Sep-2023].

13. Ibid, P.50

14. H. Glasser, "Toward Robust Foundations for Sustainable Well-Being Societies: Learning to Change by Changing How We Learn," in *Sustainability, Human Well-Being, and the Future of Education*, 1st ed, J. W. Cook, Ed. Palgrave Macmillan, Cham, pp. 31–89

15. T. L. Evans, "Competencies and Pedagogies for Sustainability Education: A Roadmap for Sustainability Studies Program Development in Colleges and Universities," MDPI, 07-Oct-2019. [Online]. Available: https://www.mdpi.com/2071-1050/11/19/5526. [Last Accessed: 10-Sep-2023].

16. Wiek A et al., "Key Competencies in Sustainability: A Reference Framework for Academic Program Development." [Online].Available: https://www.researchgate.net/publication/220040512_Key_Competencies_in_Sustainability_a_Reference_Framework_for_Academic_Program_Development. [Last Accessed: 10-Sep-2023].

17. Wiek A et al., "Operationalising Competencies in Higher Education for Sustainable Development," Jan-2016[Online].Available:ttps://www.researchgate.net/publication/283295405_Wiek_A_Bernstein_MJ_Foley_RW_Cohen_M_Forrest_N_Kuzdas_C_Kay_B_Withycombe_Keeler_L_2016_Operationalising_Competencies_in_Higher_Education_for_Sustainable_Development_In_Barth_M_Michelsen_G_Rieckmann_M_. [Last Accessed: 10-Sep-2023].

18. Wiek A et al., "Moving Forward on Competence in Sustainability Research and Problem Solving," 2011. [Online].Available:https://www.researchgate.net/publication/254339529_Moving_Forward_on_Competence_in_Sustainability_Research_and_Problem_Solving. [Last Accessed: 10-Sep-2023].

19. Op cit, Competencies and Pedagogies for Sustainability Education: A Roadmap for Sustainability Studies Program Development in Colleges and Universities, Figure 1

20. Proposal Statement and Input Process," Global Council for Science and the Environment (GCSE). [Online]. Available: https://www.gcseglobal.org/proposal-statement-and-input-process. [Last Accessed: 10-Sep-2023].

21. "About EE and Why it Matters," North American Association for Environmental Education, https://naaee.org/about/ee [Last Accessed: 10-Sep-2023].

22. "Excellence in Environmental Education Guidelines for Learning (K-12) Executive Summary and Self Assessment Tool," EPA, https://rb.gy/97f37 [Last Accessed: 10-Sep-2023].
(The Learning guidelines draw on input from thousands of educators and numerous earlier frameworks. These include the Tbilisi Declaration of 1977 and the contributions of Stapp and Cox in 1974, along with goal levels proposed by Hungerford et al. in 1980. Additionally, the guidelines acknowledge influential studies from the 1990s, such as those by Iozzi et al. (1990), Marcinkowski (1991), the Wisconsin Center for Environmental Education (1992), Roth (1992), and the EE Literacy Consortium (1994), all rooted in research and foundational literature. Lastly, the guidelines address the impact of sustainable development on environmental education, including a framework from Canada in 1994.)

23. "The 2021 Sustainability Curriculum Colloquium," Curriculum for sustainability, https://www.curriculumforsustainability.org/scc-aashe-key-competencies-book/ (Last Accessed May 3, 2023).

24. "About stars," The Sustainability Tracking, Assessment & Rating System, https://stars.aashe.org/about-stars [Last Accessed: 10-Sep-2023].

25. "Teachers have their say Motivation, skills and opportunities to teach education for sustainable development and global citizenship," UNESCO, https://unesdoc.unesco.org/ark:/48223/pf0000379914 [Last Accessed Sep. 11, 2023]

26. L. J. Keniry, "Equitable Pathways to 2100: Professional Sustainability Credentials," MDPI, 17-Mar-2020. [Online]. Available: https://www.mdpi.com/2071-1050/12/6/2328. [Last Accessed: 10-Sep-2023].

27. Mwase, G., L. Julian Keniry, et al., "GREENPRINT: A plan to prepare community college students for careers in the clean economy" National Wildlife Federation,https://www.nwf.org/-/media/PDFs/Greenforce-Initiative/Greenprint-FINAL-121515.ashx (accessed Sep. 11, 2023).

28. "Who we are " Women+ in Climate Tech," (WiCT+) , 22-Nov-2021. [Online]. Available: https://womeninclimatetech.org/who-we-are/. [Last Accessed: 10-Sep-2023].

29. "GEM Starter kit," WWW.GTO.ECO. [Online]. Available: https://gto.eco/starterkit. [Accessed: 04-May-2023].

Green Teach
for Opportunity™

esdi group

4000 Tunlaw Road, Washington DC, 20007
support@esdigroup.org▲www.gto.eco
202.794.9244▲888.884.0862

SCAN ME