Teaching Upcycling to Impact Environmental Attitudes

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Abstract

With the hope of positively impacting environmental attitudes, student interest in prototyping and product design were leveraged to create and deliver a course called Green Prototyping and Upcycling to undergraduates and graduate students. Pretest and posttest surveys with the Environmental Attitudes Inventory (Milfont & Duckitt, 2010) showed significant increases and showed no significant decreases in students' environmental attitudes along one or more of the 12 scales in that survey. Students' comments from their reports provided further evidence of evolving environmental attitudes. The course included several activities in which students designed and created products recycled from postconsumer materials.

Keywords: recycling, environmental attitudes, sustainability, prototyping

Within technology education, curricular attention to environmental sustainability has often focused on the impacts of technology in a somewhat reactive manner. Technological Literacy Standard 5 is "Students will develop an understanding of the effects of technology on the environment" (International Technology Education Association [ITEA], 2007, p. 65). Leaders in the field ranked highest the following "essential" goal for technological literacy: "Describe social, ethical, and environmental impacts associated with the use of technology" (Ritz, 2009, p. 59).

In other instances, there is a more proactive approach for the inclusion of environmental sustainability within technology education. Rose and Flowers (2008) described a technology education course in technology assessment that included environmental impact assessment; they suggested that the primary purpose of technology assessment was "informing [future] policy decisions" (p. 13.1187.4). Benchmarks 5G and 5H (Grades 9–12) in the *Standards for Technological Literacy* (ITEA, 2007) are proactive: "Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling," and "when new technologies are developed to reduce the use of resources, considerations of tradeoffs are important" (p. 71). Rose (2012) called for actionable environmental education: "In the face of complex environmental problems, we must learn how to facilitate a student's ability to conduct inquiry, synthesize knowledge and skills from a variety of subject areas, and make informed decisions that lead to environmentally sustainable actions” (p. 87).

In the hope of promoting attitudes in students needed for environmental stewardship, and considering the historical emphasis in the field on both technological materials and product design, it would make sense to encourage students and preservice teachers to engage in proactive activities in which they design, create, and test products that promote environmental sustainability and recycle postconsumer materials into new products. They can “identify ways in which various resources can be recycled and reused. Evaluate the viability of recycling based on economic and technological factors, spatial variables such as distance from recycling facility to markets, and possible future developments” (North American Association for Environmental Education, 2010, p. 62).

Increasing interest in rapid prototyping technologies coupled with the acknowledgement of a growing global necessity for environmental sustainability have prompted technology education faculty at a Midwestern U.S. university to create a course called Green Prototyping and Upcycling (Flowers & Gorski, 2017) in an effort to leverage student interest in prototyping technologies and to positively impact their attitudes concerning environmental sustainability. Existing technology education coursework in additive and subtractive manufacturing at this institution was felt to lack sufficient attention to environmental concerns regarding material streams and the need to develop products and processes that promote environmental sustainability. It was hoped that in this new course, educational experiences involving student product design and recycling technologies could leverage student creativity, possibly impacting the environmental attitudes of future technology and engineering teachers and others in the class. The purpose of this article is to distinguish upcycling from other forms of recycling and to describe a course in this area that was created in an attempt to impact students’ environmental attitudes.

The creation of this course was prompted by the course developer’s decades of experience teaching manufacturing, construction, material processing, and product design courses at the secondary and postsecondary levels in industrial arts and technology education. In these courses, there had been a focus on materials, processes, and product design and creation with little attention to the social need for a product or to the environmental costs of manufacturing it. As such, creating this course was an attempt by that faculty member to better reflect their evolving environmental ethic and not continue to promote pro-technology materialism without adequate regard to environmental and social impacts.

Literature Review

Recycling and Its Subset: Upcycling

A main focus chosen for this course was the engagement of students in upcycled product design and development, empowering them to take on the role of product designer and manufacturer rather than merely a consumer. In an effort to reduce the negative effects and growth of our material waste stream, there has been a push to suggest to consumers that they reduce, reuse, and recycle (United States Environmental Protection Agency [EPA], 2018).

> Recycling is defined as the recovery of useful materials such as paper, glass, plastic, metals, construction and demolition (C&D) [materials] and organics from the waste stream (e.g., municipal solid waste) and the transformation of that material to make new products, resulting in a reduction in the amount of virgin raw materials needed to meet consumer demand. (EPA, 2016, p. 10)

Thus, recycling entails the reprocessing or remanufacturing of the materials making up a product to create a new product and is typically done with professional manufacturing technology rather than by an end user. Recycling rates can be promoted by efforts to evolve into a stronger culture of recycling, possibly through educational interventions: "Education should emphasize the environmental benefits of recycling to encourage a culture of recycling for the environment" (Loughlin & Barlaz, 2006, p. 320).

When a product's materials are recycled to create a new product, we can compare the value of the new product to the original one to classify this as downcycling, upcycling, or neither. *Upcycling* can refer to "the creation or creative modification of any product out of used materials in an attempt to generate a product of higher quality or value than the compositional elements" (Sung, Cooper, & Kettley, 2014, p. 237). Although this is likely to suggest a comparison of the economic value between a new product and the product from which it was made, this distinction may be based on an increase or decrease in a value that is not economic. Because recycling involves remanufacturing, it can have an impact on product quality. "Repeated recycling causes fibers to become less suitable for papermaking. The fibers become less flexible and shorter than virgin fiber and do not conform as well" (Abubakr, Scott, & Klungness, 1995, p. 123). Similarly, during recycling, "when some plastics are melted and combined, the polymers in the plastic—the chains that make it strong and flexible—shorten" (McDonough & Braungart, 2002, p. 58). Thus, "most recycling is actually *downcycling*; it reduces the quality of a material over time" (McDonough & Braungart, 2002, p. 56). Due to material degradation during reprocessing, upcycling can pose a challenge. However, students charged with designing products that are examples of upcycling can find this challenge inspiring.

Teaching Recycling

For some, recycling education may be seen as important only to the extent that it increases consumer use of local materials recycling programs. Blumstein and Saylan (2007) assert that "if teaching recycling [to children] were effective, then we would expect to see a specific increase in recycling in the class where there was a lesson on recycling" (p. 976). Even when conceptual learning outcomes are studied, the value of recycling education may still be seen in terms of consumer participation. Nadi, Aghaabedi, and Radnezhad (2016) found that with a sample of sixth grade female students in Iran, recycling education "had an effect on the perception of the concept of recycling" (p. 116), among other key concepts. However, they went on to draw conclusions about the purpose of recycling education as connected with recycling behaviors rather than only with conceptual learning outcomes:

> Therefore, educating people in this regard will have to follow the following objectives:
>
> - Promoting public awareness on solid waste management and recycling.
>   - Changing consumption patterns in society.
>   - Encouraging producing less garbage.
> - Performing the project of separating wet, dry, and burial garbage.
> - Improving the city's environment and public health conditions. (Samiifard, 2008; as cited in Nadi, Aghaabedi, & Radnezhad, 2016, p. 118)

Several examples of recycling education go beyond addressing the appropriate diversion of waste stream materials to engage students in both design-related and manufacturing-related content. Brusic (2014) suggested that teachers "explain to students how we live in a 'throwaway' society" (p. 12). In her "creative upcycling design brief," she outlined an activity for elementary grade teachers that would challenge their students to "create a useful and appealing product by transforming and combining throwaway goods in unique and creative ways" (p. 13). There have been numerous examples of upcycling education in higher education in which students are challenged to design products to be made from postconsumer materials and then to make those products, including the following:

- The British Council's (2015) Upcycling Design Workshop of Industry Leftovers Event (six UK Universities travelled to Wuxi China to attend a collaborative upcycling design workshop);
- The University of Sydney's (2018) Upcycled Glass course, which "examines conceptual and practical applications of up-cycled and found glass through contemporary art and design" ("2000 level units of study: Selective," para. 14); and
- Fashion and textiles students' upcycling of postconsumer shirts into newly designed clothing (University of Wolverhampton, 2016).

However, this raises a question as to whether a single college course is sufficient for a meaningful change in students related to environmental sustainability.

Ryu and Brody (2006) studied changes in ecological footprint (EF) throughout a graduate course on sustainability and found that:

> Graduate level education can significantly increase sustainable behavior as measured by their [students'] EF. Findings support the effectiveness of PBL [problem-based learning] techniques in teaching the principles of sustainable development and the ability of a single course to change student consumptive patterns in a period of only three months. (p. 169)

Ecological footprint analysis (EFA) uses results from a 27-item survey on respondents' demographics and reported behaviors related to four elements: food, mobility, housing, and goods and services (Center for Sustainable Economy, n.d.).

Studying actual behaviors (as opposed to reported behaviors) can be problematic because these behaviors occur at times and locations where there is no direct observation by researchers. Instead, conclusions may be drawn regarding some outcomes of sustainability education by surveying self-reported behaviors (as in the EFA) and self-reported environmental attitudes. "Environmental attitudes are a psychological tendency that is expressed by evaluating perceptions of or beliefs regarding the natural environment, including factors affecting its quality, with some degree of favour or disfavour" (Milfont, 2007, p. 12).

Milfont and Duckitt (2010) proposed the Environmental Attitudes Inventory as an "attempt to develop a tool for measuring the overall structure of EA [environmental attitudes]" (p. 88). The assessment consists of 120 items with 10 items for each of 12 scales; the shortened form, the EAI-S, consists of 72 items. All items use a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Within each scale or factor, five of the items are phrased so that 7 is associated with positive environmental attitudes, and five others are worded so that 7 is associated with negative environmental attitudes. "The twelve factors were established through confirmatory factor analyses, and the EAI scales are shown to be unidimensional scales with high internal consistency, homogeneity and high test-retest reliability, and also to be largely free from social desirability" (Milfont & Duckitt, 2010, p. 80).

Methodology

A university-wide elective course called Green Prototyping and Upcycling was developed and offered at a Midwest U.S. university in the spring semesters of 2015, 2016, and 2017 with the same instructor. Pretest and posttest surveys as well as student reports provided data on their environmental attitudes.

Subjects

Subjects included students of different levels, from freshman to doctoral-level students, across a broad range of majors (including technology and engineering teacher education) in the three sections agreeing to participate (16, 11, and 10 students). This study went through the university's Institutional Review Board approval for human subjects research.

Treatment

The semester-long course had each student participate in four hands-on projects with written reports through which they studied "the life cycle of the material and learn[ed] about material streams and environmental responsibility" (Flowers & Gorski, 2017, p. 9) in addition to their creative design work.

- Upcycling with a Laser: Each student designed and created a higher value product using a 150-watt CO_2 laser cutter or engraver and postconsumer materials they found.
- Upcycling with a Vacuum Former: Each student designed and created a higher value product using a vacuum former, finding postconsumer thermoplastic sheet stock and designing or finding a model over which to thermoform that material into a useful product.
- Design for Sustainability: Each student designed and created a 3D prototype for a product that in some way promotes environmental sustainability, and then the student justified how the product promotes sustainability. Students were provided instruction on and were free to use filament-based, powder-based, or resin-based 3D printers, laser cutters or engravers, and a wide variety of power and hand tools.
- Recycling PostConsumer Plastic into 3D Printer Filament: Working in a team of about six, students found, collected, identified, and researched a postconsumer thermoplastic. They granulated it, dried it, performed a melt-flow index test on it, and attempted to extrude their plastic into viable 3D printer filament. They then used a filament-based 3D printer and experimented with parameters in an attempt to produce viable objects.

With no technical course prerequisites, much of the instruction in the class addressed the technical nature of materials and processes and required student experimentation. Additional instruction was provided on life cycle analysis, material streams, design for sustainability, and similar areas.

Data Collection and Analysis

This study examined changes to students' reported environmental attitudes from the beginning to the end of this course. Pretest and posttest data were collected using the Environmental Attitudes Inventory (EAI), which consists of 120 items and uses a 7-point Likert scale. The EAI was administered on the first day of class and again on the last class day as a course assignment with full credit for all who completed it. EAI pretest and posttest responses were compared according to the 12 EAI scales. During analysis, responses to "reversed coded items," as identified by Milfont and Duckitt (2010, pp. 91–92), were flipped on the 7-point Likert scale so that higher numbers always indicated values aligned with positive environmental attitudes. The critical level of significance ($p = .05$) was divided by 12 using a Bonferoni approach to control Type I error, resulting in a two-tailed critical value of $p = 0.004$. Nonparametric procedures were used.

With students' permission, additional data were collected from their assignment reports. Comments from students' reflections in these reports were studied to look for evidence of changes in a student's understanding during the course and were reviewed to identify common themes.

Results

EAI Data Analysis

For the 2015 course offering, data from the 120 EAI items were recorded from the pretest and posttest for all students. Student identifiers were not included, so paired analysis was not possible. For data from the 16 students who had taken both surveys, a Mann–Whitney *U* test was performed. As shown in Table 1, although there were increases in the means for each of the 12 scales, only the increase for Scale 6 was significant, and Scale 6 had the highest mean in the posttest. There were no significant decreases for any scale.

Table 1
Increases in Means for 2015 Data Aggregated by EAI Scale

		M				
Scale	***n***	**Pretest**	**Posttest**	**Increase**	***U***	**Two-sided sig**
1	160	5.56	5.61	0.013	13,029	0.773
2	160	5.58	5.83	0.244	14,145	0.090
3	160	5.20	5.44	0.244	14,652	0.020
4	160	4.46	4.52	0.056	13,188	0.634
5	159	3.72	3.86	0.138	13,190	0.479
6	160	5.52	6.06	0.538	16,457	0.000*

7	160	4.33	4.38	0.056	13,049	0.760
8	159	5.08	5.09	0.013	12,890	0.832
9	160	5.20	5.53	0.331	14,444	0.039
10	160	4.95	5.04	0.094	13,410	0.450
11	158	5.79	5.90	0.111	13,527	0.252
12	160	3.91	4.30	0.394	14,612	0.026

* Significant with Mann–Whitney *U* test at $p = .004$

In the second year, data from the 2016 pre- and post-tests were paired for each of the 11 students in this class. Using the same two-tailed critical value of $p = 0.004$, a Wilcoxon signed ranks test was performed. As shown in Table 2, significant increases were seen in Scales 1, 7 and 8. Two scales showed decreases, though not at the level of significance used.

Table 2
Increases in Means for 2016 Data from Paired Pre- and Post-Tests by EAI Scale

		M				
Scale	***n***	**Pretest**	**Posttest**	**Increase**	**Z**	**Two-sided sig**
1	110	5.78	5.99	0.21	2.956	0.003*
2	110	5.59	5.66	0.07	0.467	0.641
3	109	5.27	5.45	0.18	2.648	0.008
4	107	4.49	4.42	-0.07	0.381	0.704
5	110	4.05	4.33	0.27	2.414	0.032
6	108	5.48	5.75	0.27	2.824	0.004
7	108	3.95	4.47	0.52	3.231	0.001*
8	110	5.27	5.56	0.29	3.108	0.002*
9	109	5.22	5.00	-0.22	1.76	0.078
10	109	4.69	4.87	0.18	1.601	0.109
11	110	5.84	5.96	0.13	1.442	0.149
12	110	4.32	4.58	0.26	1.909	0.056

* Significant with Wilcoxon signed-rank test at $p = .004$

The paired data from 10 subjects in 2017, the third year, produced significant increases in Scales 1, 2, 4, 6, 7, 8, and 9 using the same two-tailed critical value of $p = 0.004$ with a Wilcoxon signed-rank test (see Table 3). A different scale than in 2016 showed a decrease, but again this was not significant.

Table 3
Increases in Means for 2017 Data from Paired Pre- and Post-Tests by EAI Scale

		M				
Scale	***n***	**Pretest**	**Posttest**	**Increase**	**Z**	**Two-sided sig**
1	100	5.98	6.26	0.28	3.313	0.001*
2	100	5.84	6.37	0.53	4.508	0.000*
3	100	5.83	5.9	0.07	2.002	0.045
4	100	4.53	5.12	0.59	3.37	0.001*
5	100	3.89	3.57	-0.32	-2.093	0.036
6	100	6.11	6.46	0.35	3.207	0.001*
7	100	4.55	5.12	0.57	3.664	0.000*
8	99	5.25	5.76	0.51	3.275	0.001*
9	100	5.73	6.08	0.35	3.326	0.001*
10	100	5.31	5.46	0.15	0.933	0.351
11	100	6.23	6.35	0.12	1.16	0.246
12	100	4.54	4.72	0.18	1.502	0.133

* Significant with Wilcoxon signed-rank test at $p = .004$

The 12 scales in the EAI (Milfont & Duckitt, 2010) are as follows, with descriptions provided for those scales associated with significant changes from pretest to posttest in at least one of the years: (1) *enjoyment of nature*, (2) *support for interventionist conservation policies*, (3) *environmental movement activism*, (4) *conservation motivated by anthropocentric concern*, (5) *confidence in science and technology*, (6) *environmental fragility*, (7) *altering nature*, (8) *personal conservation behavior*, (9) *human dominance over nature*, (10) *human utilization of nature*, (11) *ecocentric concern*, and (12) *support for population growth policies* (pp. 89–90).

Scale1: Enjoyment of nature. This construct was defined as the "belief that enjoying time in nature is pleasant and preferred to spending time in urban areas, versus belief that enjoying time in nature is dull, boring and not enjoyable, and not preferred over spending time in urban areas" (p. 89). There were significant increases from pre- to post-test on this scale in 2016 and 2017.

Scale 2: Support for interventionist conservation policies. This construct was defined as "support for conservation policies regulating industry and the use of raw materials, and subsidizing and supporting alternative ecofriendly energy sources and practices, versus opposition to such measures and policies" (p. 89). There was a significant increase in 2017 on this sale.

Scale 4: Conservation motivated by anthropocentric concern. This construct was defined as "support for conservation policies and protection of the environment motivated by anthropocentric concern for human welfare and gratification, versus support for such policies motivated by concern for nature and the environment as having value in themselves" (p. 90). For this scale, there was a significant increase in 2017.

Scale 6: Environmental fragility. This construct was defined as the

> belief that the environment is fragile and easily damaged by human activity, and that serious damage from human activity is occurring and could soon have catastrophic consequences for both nature and humans, versus belief that nature and the environment are robust and not easily damaged in any irreparable manner, and that no damage from human activity that is serious or irreparable is occurring or is likely. (p. 90)

There were significant increases in 2015 and 2017 for this scale.

Scale 7: Altering nature. This construct was defined as the

> belief that humans should and do have the right to change or alter nature and remake the environment as they wish to satisfy human goals and objectives, versus belief that nature and the natural environment should be preserved in its original and pristine state and should not be altered in any way by human activity or intervention. (p. 90)

For Scale 7, there were significant increases in 2016 and 2017.

Scale 8: Personal conservation behavior. This construct was defined as "taking care to conserve resources and protect the environment in personal everyday behaviour, versus lack of interest in or desire to take care of resources and conserve in one's everyday behaviour" (p. 90). There were significant increases in 2016 and 2017 for Scale 8.

Scale 9: Human dominance over nature. This construct was defined as the "belief that nature exists primarily for human use, versus belief that humans and nature have the same rights" (p. 90). On Scale 9, there was a significant increase in 2017.

Each year did produce a significant increase in at least one scale, and there were no significant decreases. Several of the scales showed increases in more than one year. Still, it seems likely that the individual student's relationship with the curricular content and activities, as experienced through that student's creative product design, reading, troubleshooting, experimentation, and reflection, may be responsible for shifts seen from one year to the next. Year-to-year differences would therefore be expected in future offerings of this course, and results related to specific EAI scales cannot be generalized to those future offerings. Larger sample sizes may lead to results that are more generalizable.

Student Comments

Changes to students' reported environmental attitudes could also be seen in the reports they submitted that were associated with each project.[1] Unlike data from the EAI, students' reflections sometimes suggested causal relationships between course experiences and changes in their understanding or environmental attitudes. In general, most reflections by students on their assignment reports were technical in nature rather than reflections on their learning about or their relationship with environmental sustainability. The new technical content had been demanding and intriguing and, therefore, seemed to be central to what many students primarily gained from these activities. However, several comments did indicate impacts on their environmental attitudes.

One of the major shifts illustrated in student projects and reports was the change in their perceptions of "trash." One student, Tyler Carey, wrote: "I learned that even though some things may look like trash, with a lot of hard work, they can be redeemed into usable items." Brian Symanski stated that there was "very little difference" between his upcycled product and one that could be bought for over $100.

One student pointed out some societal factors that impact material use. To some, the end-goal may not be worth the effort based on time, money, or potential needs. Philip Borkowski summarized: "It has become too common of a task in our society to run to [local hardware stores] to pick up building supplies when we might be able to obtain what we need for free." He wrote,

> I found that it all comes to what you value . . . when using materials in ways that they are not intended to be used, there is an extra amount of labor

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[1] Permission to use information contained in students' project reports was given on a student-by-student basis. Some granted permission under the condition that their name would be associated with content from their reports; others granted permission electing to have their names omitted.

> involved. Problems could also arise more frequently when reusing materials.

This shows growing insight into understanding the complex nature of technical issues and of attitudes related to promoting environmental sustainability.

A graduate student charged with making good use of relevant literature (e.g., Szaky, 2015), reflected on his experiences recycling plastic into 3D printer filament:

> I feel challenged to design a practical and useful product or service utilizing these processes to get more value out of the throwaway objects we encounter every day. The major challenge lies in having to segregate plastics by manufacturer and even by the batches of plastics used by each manufacturer. As Tom Szaky notes, "If plastic products were consistent in their resin composition, color, transparency, weight and size, we probably wouldn't be having this conversation, as everything could be recycled together" (Szaky, 2015). This challenge seems to be a chief obstacle in the way of utilizing recycled goods as means of recycling products in the 21st century (Szaky, 2015).

One problem encountered by many students who worked in teams to attempt to extrude postconsumer plastic into viable 3D printer filament emerged because the students found postconsumer plastic products to use in this assignment that had originally been injection molded. These often were made from injection-grade rather than extrusion-grade plastic, and therefore tended to have low viscosity when melted, frustrating some attempts to extrude the plastic into viable filament. Grace Douglas wrote: "The project was challenging and enlightening. This project made me realize how many different polymers are used in our day to day lives; however, many of these polymers cannot be successfully extruded."

The idea that material choice was critical surfaced in other activity reports, for example, when Michelle Loconte reflected on her design for a bird feeder made from postconsumer materials:

> I realized early on that by choosing litter as my main material I risked the uncertainty of materials . . . their unknown compound origins. This choice forced me to be conscious of my overall usage because of the uniqueness of each item.

In some instances, students' experiences in this class were the beginning of initiatives that could grow after the course ends:

> When I first introduced my idea, I was told that I should get it patented. After creating a prototype and physically seeing how the product works and how it will impact social and environmental systems, I may have to look into it more. (Phoebe Sherer)

One (anonymous) student mentioned learning a great deal about how energy can be saved around a home, writing the following reflection about the product the student designed: "There are definitely flaws with the design, but I can confidently say that I can use the concepts of this project and incorporate them into another product that will promote sustainability." Kandice Grimme, who designed and prototyped a compost bin, reported that she hadn't known it was possible for her to design and create a compost bin. She stated,

> In the future, I would like to build one that could be insulated to prevent the unpleasant smell. This definitely taught me that there are even more ways I can proactively engage in environmental sustainability besides just recycling and conserving energy.

Conclusions and Recommendations

In each of the 3 years that a course in Green Prototyping and Upcycling was offered to undergraduate and graduate students, students' environmental attitudes for at least one EAI scale showed a significant increase. Although there was no scale that showed a significant increase in all 3 years, there were four scales that showed a significant increase over 2 years: enjoyment of nature, environmental fragility, altering nature, and personal conservation behavior. Seven of the 12 scales showed an increase in at least one of the 2 years. There were no significant decreases in any scale in any year. Many student comments addressed technical learning associated with materials and processes, and other comments described changes in their environmental attitudes due to course experiences.

These students likely are not representative of students at this institution because this elective course likely appealed to some students who were predisposed to sustainability efforts. "Students enrolled in the biological and environmental sciences would be more pro-environmental in their attitudes than those enrolled in other science-based discipline" (Sutton & Gyuris, 2015, p. 28). This, coupled with the small sample size, confounds the ability to generalize to a broader population.

Although the EAI is a powerful tool, this particular context involved student creativity and students' interaction with technologies, two areas not addressed by the EAI. An instrument with greater focus on material streams, creative design, technological processes, and related environmental attitudes and behaviors would be a welcome addition.

Changing societal values toward greater environmental stewardship is a huge undertaking involving a variety of initiatives and spanning decades. Teachers can play a role here, especially technology teachers. Even if existing programs of study do not contain coursework related to environmental sustainability, teachers at the primary, secondary, and postsecondary levels can infuse sustainability into current course offerings. In some instances, experimental new courses, such as the one discussed here, or new programs could be offered. Such courses or programs would be likely to impact not only the students of those courses but others who may in turn be impacted by those students.

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