The Use of Self-Directed Learning to Promote Active Citizenship in STS Classes

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The purpose of this article is to outline the viability of a student-directed assignment within collegiate-level STS curricula for the improvement of the utilization of scientific knowledge and technology in society. The assignment, christened the Do Something! assignment, is a novel teaching tool that utilizes students' individual interests to encourage in-depth learning across disciplines and capitalizes on their personal skills and talents to solve real-world problems. The Do Something! assignment has been utilized in two STS courses at The Pennsylvania State University (STS 100: The Ascent of Humanity and STS 200: Critical Issues in STS). The structure of this assignment allowed students to make small but concrete contributions toward a sustainable future by applying STS principles. Outcomes indicated that (a) students had an overwhelming positive attitude toward the assignment; (b) students developed an in-depth understanding of STS issues outside of their individual fields of study; (c) students perceived a high level of attainment, which resulted in personal fulfillment; and (d) this positive perception encouraged students to attempt similar socially beneficial actions outside of the classroom.

STS education offers an academic approach that bridges the gaps across disciplines in order to meet the increasing educational demands of a hypertechnical society. STS education fosters critical examination of current science and technology and provides students with the foundations for responsible citizenship (Waks, 1987). However, even with a firm understanding of the inappropriate uses of some sci-tech applications, students are often reluctant to attempt to change society's use of science and technology.

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In the majority of disciplines, students are required to replicate memorized information at the expense of higher order cognitive skills that are associated with critical thinking (Cross, 1993; Twombly, 1992). Even in courses involving problem solving, creativity is downplayed in favor of standard algorithms for solving problems that have been solved innumerous times before. This often leads to student burnout, a state of depleted energy due to the excessive psychological and emotional demands on the student and the feeling of low personal accomplishment (Neumann, Finaly-Neumann, & Reichel, 1990). In addition, when students are taught to replicate the work of their predecessors, they tend to more readily accept the status quo without questioning it. This system breeds apathy that is evidenced in students' lack of enthusiasm for their coursework and a general lack of civic involvement. This apathy can be attributed to the fundamental structure of our society and our educational system (Weiss, 1965). Students often believe that their work/effort does not make a difference, since they have not had experiences to challenge this perception. A self-directed project that utilizes students' individual interests to encourage in-depth learning across disciplines and capitalizes on their personal skills and talents will not only enable students to solve real-world problems but demonstrate to the students that their work has value and, thus, encourage them to be active citizens in the future.

Motivation

The underlying motivation for the Do Something! assignment is to encourage students to make changes in the utilization of science and technology by society as measured by the goal of sustainability. The broad definition of sustainability demands that economic development be pursued in such a way as to meet the

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needs of the present generation without compromising the ability of future generations (World Commission on Environment and Development, 1987). A more rigorous definition of sustainability indicates the need to maintain natural capital (such as biodiversity, natural ecosystems, land quality, freshwater sources, air quality, etc.) (Hawken, Lovins, & Lovins, 1999), or the total capital stock over time (Barbier, Pearce, & Markandaya, 1989; Daly, 1991), and to preserve the productive capacity of the global resource base for the indefinite future (Solow, 1992). As Harper (2000) proposed, the problem of contemporary society can be stated succinctly: "We need to get (probably) 11 billion people through the transition complex to 'Sustainia,' the sustainable state, before irreversible damage is done" (p. 378). Simply achieving a sustainable state does not guarantee a utopia or even a high quality of life. However, it does make these universal goals possible, unlike our current society, which, owing to the inappropriate use of science and technology, sacrifices the quality of life of future generations for the material comfort of a few living in the present (Anderson, 1997).

Background

Historically, many educators have productively encouraged their students to be active citizens (Minkler, 1997, 1998). In many instances, students have been tremendously successful at effecting positive change. Student-initiated projects have led to the development of everything from teen centers, and new classes, to the removal of hazardous waste from local communities, and in some cases even the alteration of government policies (Lesko, 1992). Thus, there is precedence that students can and do effect community change, and this assignment builds on that by institutionalizing student active citizenship in an STS curriculum. In the broadest sense, STS education can be viewed as citizenship training, and "citizenship training that does not result in practical and effective political action is misdirected and fails in achieving its primary objective" (Mosher, 1943, p. 59).

The primary objective of an STS education is to present contextual understanding of current science and technology to provide students with the intellectual foundations for responsible citizenship (Waks, 1987). Unfortunately, to merely educate students on any issue of social concern does not guarantee their acting on their beliefs (Oliver, 1984). This gulf between "knowing" and "doing" must be overcome if STS education is to reach its full potential.

The educational model found in the assignment also fits well within the STS framework of teaching and learning and supports the standards set forth in the National Science Education Standards (NSES). STS is an approach to teaching and learning within the context of human social experience, focusing on student-identified problems with local interest and scientific and technical components. The NSES outlines the development of self-directed learning by stating that "students need the opportunity to evaluate and reflect on their own scientific understanding and ability" (National Research Council, 1996). The Do Something! assignment is an ideal synthesis of self-directed learning and STS citizenship instruction within a classroom environment.

The basis for this particular application of self-directed learning originated in The Pennsylvania State University's (Penn State) STS 200: Critical Issues in STS course in the spring of 1999 when the option to do a self-directed active project rather than a standard paper was made available to the class (Foltz, 1999). Since this time, the concept of a self-directed active citizenship assignment has been formalized in the now infamous Do Something! assignment and instituted into the curriculum of two classes at Penn State.

Description of the Project

Objectives

The purpose of this article is to outline the effects of a student-directed assignment within college-level STS courses on active citizenship and is guided by the following questions:

1. In what ways does self-directed learning influence student attitudes toward STS instruction?
2. Is self-directed learning effective in encouraging the in-depth learning across disciplines demanded of STS courses?
3. Is a self-directed assignment a viable method for improving the sustainable utilization of scientific knowledge and technology in contemporary society?
4. Will students who have engaged a self-directed learning assignment continue socially beneficial active citizenship in the future?

Design

The self-directed active citizenship project was used in the spring semester of 1999 in STS 200: Critical Issues in STS, and in the fall of 2000 in STS 100: The Ascent of Humanity, with 77 and 45 Penn State students, respectively. Both classes consisted of students of both sexes from all academic years majoring in a variety of disciplines. Each student was asked to do a project to make changes in the utilization of science and technology in the Penn State community or larger society. The change would be evaluated by sustainability criteria. The projects were either chosen from a list provided by the instructor or designed by the students. The assigned list of projects was generated from suggestions found in resources governing sustainability in educational institutions and from the personal experiences of the instructor (Creighton, 1998; Green Destiny Council, 2000). The text of the spring 2001 Do Something! assignment is included in the appendix.

To guarantee initial student support, the project was introduced as an alternative to a final examination. It was also designed to be a positive foil to the negative and unintended consequences of the misuse of science and technology throughout history that the courses addressed. To inspire the students further, the short video titled *Power of One* was utilized (Earth Communication Office, 1994). Its objective is to convey to students the potential of individual actions and to motivate them to tackle real-world problems.

The assignment was divided into four parts. Part 1, the plan of action, entailed a student choosing his or her own project based on his or her skills and interests. As part of the plan of action, the students were required to do preliminary research to determine the benefits of their project, set realistic goals, and make a list of steps to accomplish their goals. In addition to supplying a framework for students to organize their projects, the plan of action provided an opportunity for the instructor to assist in the success of the project by supplying advice, references, and contacts. Part 2 was a progress report. It was designed to encourage students to begin the assignment as early as possible, increase the chances of their success, and allow time for feedback and guidance from the instructor. Part 3 was the implementation of the plan. In part 4, students wrote a report summarizing their background research, a formal definition of the problem, how their solution effected a change toward sustainability, factual information that was necessary to solve their problem, a list of references, and an executive summary: a review of their work and the outcome and any of their own written pieces used to accomplish the goals of their project.

The grading of this assignment was based on the demonstrated effort that the students put into their projects, original thought used in overcoming problems that surfaced during the implementation of their project, and the depth of learning demonstrated by the quality of their background research and executive summary. The diversity of projects, different skills students brought to their projects, and the difficulty of implementation in one semester's individual Do Something! assignments were taken into account when grading the projects. The instructor determined the depth of students' interdisciplinary learning from the synthesis of their research.

The instructor ascertained the students' perceptions of the assignment from class discussions, a midproject questionnaire, and students' comments in their final reports. Quantitative data were collected from the students' final reports concerning the concrete improvements that students were able to make toward sustainability and their intended future plans.

Results

In the past two years, progressively more refined versions of the Do Something! assignment have been administered with numerous successes. The outcomes of the assignment indicated that (a) students had an overwhelming positive attitude toward the assignment; (b) students developed an in-depth understanding of STS issues outside of their individual fields of study; (c) students perceived a high level of attainment, which resulted in personal fulfillment; and (d) this positive perception encouraged students to attempt similar socially beneficial actions outside of the classroom.

Overwhelming Positive Attitude

Both STS 200 and STS 100 are popular general education courses at Penn State. In the sections where it was offered, the Do Something! assignment proved to be by far the most popular assignment. The vast majority (> 90%) of students took advantage of the opportunity the assignment provided to demonstrate their ability to effect positive change. Although the original incentive for initiating a project was a "good grade,"

the assignment quickly became personal for most students. They took pride in the work they were doing and the changes they were making.

Students became self-motivated during the course of the assignment and maintained a high interest level in the success of their project. In his final paper, a senior in telecommunications wrote, "It was gratifying for me to see the progress made throughout the course of the semester and to know that I was a part of it." The students also reveled in the newly discovered ability to affect their communities. A sophomore in computer science wrote, "After my experience with this project my advice is . . . remember you can do anything you put your mind to." Students learned that they could make a difference. A junior studying electrical engineering concluded, "I think this result [the successes of his project] goes to show how much difference one person can make, and how being smart with our technology usage really does make a difference."

In-Depth Learning Across Disciplines

Due to the nature of the assignment, even those students who chose a project related to their major were forced to explore disciplines outside of their specialty to succeed in their goals. The projects entailed a detailed scientific component to understand the nature and the consequences of pushing one technology over another. For example, one student compared the advantages and disadvantages of liquid crystal flat panel computer displays to conventional cathode-ray tube (CRT) displays. On the technical side, the engineering student determined that flat panel displays use less energy, take up less desk space, use less material (and thus contribute to less pollution during fabrication and at the end of life), give off less radiation, have better resolution, and take less time to turn on. At first blush, the newer technology seems blatantly superior and an easy "sell" to Penn State computer administrators. However, the assignment also entailed a societal component, which demanded the understanding of the economic or social barriers to the adoption of one technology over another. In this case, the student found that the flat panel displays were more expensive than CRTs and that they would not make up for the additional cost in energy savings over their predicted lifetimes. Penn State already owns thousands of monitors that can continue to be reused even if the central processing unit is updated. Thus, the student's final recommendation was to not replace the old CRT displays with flat panel displays.

This multidisciplinary approach to complex problems challenged most students who were unaccustomed to attacking problems from more than one direction. A sophomore in business administration explained, "When I chose this [project], I did not, by any extent, realize the challenges that it would incur." However, the majority quickly learned through necessity (of success) how to span the bridge across the relevant disciplines to gain success for their projects.

Unlike in conventional assignments, students were actively encouraged to utilize assistance from their peers. In fact, many students were successful because of recruiting friends to help them complete their projects, thereby adding expertise from relevant disciplines, seeding interdisciplinary collaboration, and spreading the STS paradigm outside of the classroom. For example, an education major had help from her friends to educate other students on the bioavailability of nutrients in processed foods. In her final report, she stated, "I enjoyed doing this project a great deal, I also enjoyed working with my roommates and friends on this project on the same level because they have never done something like this before."

One would assume that students would choose projects centered on their majors because that is where their interests and experiences would be the strongest. Surprisingly, many students chose projects completely outside of their disciplines. For example, a junior studying hotel, restaurant, and institutional management was curious about the quality of water he was drinking and tested several sources around Penn State and his home. Over the course of the semester, he learned a staggering amount about chemistry and environmental regulations on his own with only modest input from the instructor. He stated, "This project was educational and also provided a chance to get out and explore, rather than going through the regular class routine." When students explored detailed projects outside of their disciplines, the propensity for intellectual growth was enormous. This extensive learning was enabled by the straddling of disciplines, which STS education in general cultivates. A sophomore business major's feelings toward the assignment were indicative of those of her classmates: "Overall I learned a great deal from this assignment."

Perceived (and Actual) High Level of Attainment

The following case studies are indicative of the breadth of interests that this assignment encouraged and demonstrate the viability of students applying

their understanding of science and technology for making positive changes in their universities and communities.

A female sophomore human development and family studies student was intrigued with recent research on the roles that animals play in human development. She reviewed literature that found the presence of a friendly animal significantly lowered heart rates in people and that a year after having heart surgery pet owners had the highest survival rates (Burke, 1992). A similar study found that elderly persons who owned a pet were less likely to make visits to their doctors than elderly persons who did not own a pet (the pet owners averaged only 13 encounters with the health system, whereas non–pet owners visited 37 times on average) (Raina, Bonnett, & Waltner-Toews, 1998).

The student decided to try "pet therapy" on her own. She and her dog began visiting an adult day care center (a place for the elderly to spend the day to socialize and have someone take care of them while their loved ones are at work). Her bimonthly visits, which lasted over the entire semester, were extremely popular with the people at the center. They made her promise to return in "two Mondays" every time she was preparing to leave. She observed remarkable changes in the people. One woman, who was well into her 90s, was always sleeping during the first few visits. However, after she became acquainted with the dog, she always awoke to enthusiastically play with the dog and talk about her own pets in the past. The student wrote, "I like to think that I have given them something to look forward to." She plans to continue this project over the remainder of her stay in State College.

Another student was an employee of Residential Computing (RESCOM), the technical support for all Penn State computing. His job entailed going to students' dorms room and fixing their computer problems. For his project, he chose to enable the sleep mode in computer monitors in order to conserve energy and thus reduce air pollution because the majority of students leave their computers on 24 hours a day. Over the course of the project, during his 12-hours-per-week shift, he worked on approximately 80 computers. Only 10% of these computers already had the power saving options enabled. The owners of the other 90%, or 70 students, all allowed him to change their settings in order to save power once the benefits were explained to them. The majority of students were ignorant of the technology and the implications of their energy waste.

The results of the student's rather modest effort (it took only ~30 seconds to enable the power saving functions per monitor) are astounding. When extrapolating the savings for his project over 1 year, he found that he saved the university more than $2,200. This figure was determined by estimating that the average computer monitor draws 200 W and is only in use for 8 hours a day, and that the discounted price of electricity to the university is $0.03082 per kilowatt hour). The economic savings are impressive, but the environmental savings are even more remarkable. This project prevented the use of 45,000 gallons of water, the emission of more than 75 tons of carbon dioxide (the gas most responsible for the greenhouse effect and global warming), more than 400 pounds each of sulfur dioxide and nitrogen oxides (major contributors to acid rain), and more than 20 pounds of particulates (which have been implicated in numerous health problems). These numbers were determined by calculating that the fraction of pollutants offset from a 500-MW coal plant produces 3.5 billion kilowatt hours per year (Union of Concerned Scientists, 2000).

The student explained in his final project summary, "Never in my wildest dreams would I have imagined that I would make an impact like this just by attending an STS class. I really feel good about making a difference at Penn State." This particular project further demonstrates how even small changes at large educational institutions can have massive positive effects. He is now expanding this project by encouraging the other RESCOM employees to do the same. Recall that these results were for only 70 monitors—there are more than 10,000 currently being used at Penn State.

Two students (freshman undecided and senior engineering) became concerned with the material resource efficiency of fellow students. At the end of every semester as students move out, thousands of dollars of material goods are discarded (sometimes for no better reason than space in the ride home). Thus, they decided to run a Good Will donation drive on move-out week. They blanketed the East Hall Residences (freshman dorms) with fliers and boxes. They succeeded in collecting several carloads of clothes and other goods for the underprivileged. They also succeeded in reducing the solid waste from these dorms and at the same time diminished the amount of money Penn State pays in tipping fees for "donations" to the central city landfill.

An electrical engineering student noticed that although the majority of Penn State's campus is illu-

minated with compact fluorescents, many of the older buildings that make up West Halls (where he lives) were lighted with incandescent light bulbs. Incandescent light bulbs are enormously inefficient light producers, expending more than 90% of input energy as waste heat. He chose to convince housing officials to make the change to compact fluorescents in the older buildings. Compact fluorescents last more than 13 times as long as standard incandescent light bulbs and use only a fraction of the energy while providing the same quality of illumination. He estimated that the savings would be more than $9,000 for every 10,000 hours of illumination for the buildings he concentrated on. Penn State officials agreed that his plan would save an enormous amount of energy but were concerned about the possibility of theft (compact fluorescents cost approximately $10 per bulb). The project ended in a compromise—all public areas and fixtures such as outside lights would be retrofitted with compact fluorescents; however, the university refused to place compact fluorescents in individuals' rooms. His final report included several photographs of the recently installed lights. He is also continuing his project by trying to get the private room lights treated similarly to furniture (which students are financially responsible for) to eliminate the risk of theft for the university. In this way, compact fluorescent light bulbs could then be placed in all the dorm rooms on campus.

A fifth-year architectural engineer who had done his honors thesis on fluorescent lighting took lighting to the next level. His senior thesis involved computer simulating different types of lighting environments for a fictitious computer laboratory. He found that the new state-of-the-art fluorescent bulbs with a smaller diameter not only used less electricity to provide an equivalent amount of light but also offered superior illumination. For his project, he fought through the economic considerations necessary for Penn State to replace all the conventional T8 fluorescent lights with the new T5 lighting system. It turned out that the buyback time was within the economic criteria set by the university, so Penn State has begun the transition. One can observe the new lights in the Dieke Library and most recently in the STS offices in Old Botany Building. The economic and environmental benefits for this particular project are enormous and will continue to grow as Penn State continues the transition.

A less direct but equally effective method of encouraging the responsible use of science and technology that students found is to invest in businesses that are doing so. Several business majors and a restaurant and resource management major chose to do their Do Something! assignment on ethical (or socially responsible) investing. Socially responsible investing allows people to take responsibility for what their money is doing for the world around them by screening investments to match their ethical standards based on social and/or environmental criteria. The students' initial research found that aside from the satisfaction that comes from acting consistently with one's moral principles, there is proof that over the long term, social investors can expect to do as well as other investors. For example, social investment indexes have consistently outperformed the S&P 500. Twice as many socially responsible mutual funds, across all major asset classes, get top Morningstar ratings (Social Investment Forum, 1999).

All three students had initially planned to research ethical investing in general, then look at a few companies in detail, and change the investment habits of their relatives (who were all successful investors). All three succeeded in convincing their relatives to attempt socially responsible investing. One business major felt so strongly about socially responsible investing after completing initial research that she presented a formal talk to her peers on the subject. This project also has not ended with the semester—several students are attempting to get Penn State to consider ethically screening its endowment.

Socially Beneficial Actions in the Future

Not every student was able to accomplish all of their goals; however, all the projects obtained some level of success by educating the student on some facet of the need for sustainability in his or her community. For example, an exercise and sports science major became concerned about the emissions from the Penn State on-campus coal-fired steam plant. The coal plant possesses a bag house to avoid emission of particulates but unfortunately lacks a scrubber and, thus, is a heavy polluter of nitrous oxides and sulfur dioxide (gases responsible for acid rain). His project was to encourage Penn State to purchase a scrubber for the coal-fired steam plant. Through numerous interviews with Penn State coal scientists and employees at the plant, the student was able to gain a thorough background on both the science and operation of the coal plant and its environmental hazards. Unfortunately, he found that a scrubber would cost ~$80 million and, unlike the other projects that would pay for themselves, the pollution from the coal plant was being externalized. Slightly

demoralized but still hopeful, he gathered several hundred signatures on a petition asking the university to install the scrubber for the betterment of Pennsylvania's environment. He sent copies of the petition along with his summary of scrubber technology to key administrators and public officials. Regrettably, he was never answered. Although he did not meet his primary objective of installing a scrubber, he did educate many fellow students and faculty about the ramifications of energy use at Penn State.

Even students who were not successful in accomplishing their goals were overwhelmingly in favor of this assignment and felt that they learned a great deal. The vast majority of unsuccessful students displayed a desire to continue their projects in the future without any academic reward (after the semester ended). For example, a junior psychology major was not successful at convincing the Penn State dining halls to add organic food to the menus. She was, however, successful at generating a network of other students interested in sustainable agriculture. She explained in her final report, "After looking over my outcomes I feel that I was not that successful. But I think I did reach a lot of different students who I believe will encourage the dining commons to include organic foods in the menus. I will continue to persuade and contact as many people as possible to achieve and accomplish my goal." Other students also expressed a desire to attempt socially beneficial actions concerning the use of science and technology in the future. A freshman engineering student planned for future actions in his final report: "Next time I embark on a challenge such as this, I will have to be more adamant about my proposal for change and try to get other students in support for my plan of action."

Subverting Risks

Although this assignment can be extremely fulfilling for both the instructor and the students involved, it does entail a degree of risk. First, extreme care must be taken in generating the initial lists of projects. Students are not acclimated to "doing" things for assignments. Thus, if given the opportunity, some students will opt for the project that is most similar to a conventional assignment and accomplish nothing. For example, the first Do Something! assignment included a project that entailed making a list of "25 things to save the earth while at Penn State." Some of the lists were quite insightful and included policy suggestions that were incorporated into future assignments. However, the majority of the projects were feeble in comparison with the projects in which students were actively involved in some type of STS-effected change.

This is a high-maintenance assignment that demands both considerable time and involvement on the part of the instructor. Positive support from the instructor is also imperative to provide motivational enhancement (Wills, 1985) and to maintain high morale in students whose projects are not relatively "successful." Fortunately, the key to ensuring enthusiastic collegiate student involvement (the liberating structure of self-direction) is provided in the framework of the assignment itself. The majority of college students, as young adults, prefer to be self-directed learners. The assumption that adults prefer to be self-directed learners gained early prominence and popularity with Knowles's (1980) model. Cranton (1994) also supports the idea that self-directed learning is the adult educator's goal. However, the educator must be cautious that the attempt to develop self-direction through coercion does not become self-contradictory (Torbert, 1978) and thus ineffective. The easiest method to subvert this obstacle is to provide the students with the option to select the project of their choice and then guide them into topics in multiple disciplines that complement the learning on a particular project. Using this method, the student becomes responsible for the content of his or her own education while the instructor is able to ensure the necessary breadth and depth of material covered.

Conclusion

This article clearly establishes the viability of a student-directed assignment within college-level STS courses for the alteration of the utilization of scientific knowledge and technology in society toward sustainability. There is a clear ability of student-directed assignments to utilize student's individual interests to encourage comprehensive learning across disciplines. This article showed that (a) students had an overwhelming positive attitude toward the a self-directed assignment; (b) students accomplished in-depth understanding of STS issues outside of their individual fields of study; (3) students perceived a high level of attainment, which resulted in personal fulfillment; and (d) this positive perception encouraged students to attempt similar socially beneficial actions outside of the classroom.

Appendix
Text of the Spring 2001 Do Something! Assignment

Find an Aspect of STS That You Feel Passionate About and Do Something About It!

This is your chance to make Penn State University (and the entire world) a better place, to leave your small mark on history, and get points for it! Below is a list of activities related to STS and a short list of ways to accomplish the challenging ones. Your assignment is to pick a project from the list or choose one of your own (with my prior approval jmp228@psu.edu) and work for a more appropriate use of science and technology in our society.

What to Do

1. Plan of Action: Decide what project you would like to do, why it is worthwhile, set a reasonable goal, and make a list of the steps you will take to accomplish it. This is your game plan and a chance for me to give you some feedback and help you accomplish your goal. It should be ~2 pages long. Due 1/30.
2. Progress Report: How are you doing? Is your plan working? Let me know in one page or less. Due 3/15.
3. Work to accomplish your project throughout the semester. This is the key part of the assignment—the actual doing!
4. Final Report: All of the projects will entail some amount of independent background research. Thus, you should include a definition of the problem, how your solution will effect positive change, any factual information you needed to solve your problem, and a list of references. Finally, include an executive summary. This is simply a review of your work and the outcome. You should also include any of your own written pieces used to accomplish your goal (i.e., letters to congressman). Due 4/26.

Suggestions for Compelling Penn State to Change

1. Your best bet for success is to show by means of a well-researched idea that it will SAVE the university MONEY without lowering the quality of life here.
2. By way of e-mail, calls, letters, and fighting through the red tape—schedule an appointment with the head of an academic department or a university service (HFS, EHS, OPP, CAC, etc.).
3. E-mail Graham Spanier (He'll read it) at gspanier@psu.edu or write letters to the university planners.
4. Write to local and state politicians.
5. Hold a demonstration. Bonus points if you make the news (and it was legal).
6. Sponsor a petition drive.
7. Publish an editorial in the *Collegian*.

Projects You Can Do on Your Own

- Research ethical investment and either invest yourself, design a method to get your friends and relatives to change their investment habits, or write a proposal to the Board of Trustees to encourage them to pass PSU's investments through ethical/sustainability filters. www.socialinvest.org
- Write a lesson plan for grade school or high school students for an STS-related topic and try it out in your hometown or a State College school (i.e., Shaver's Creek).
- Sponsor your own ad parody or anti-ad in the *Collegian* or distribute around campus in order to encourage responsible consumption of sci-tech products. www.adbusters.org
- Join the Penn State Indicators Report staff and work on a specific environmental-sustainable topic here at PSU. Http://www.bio.psu.edu/greendestiny/indicators.shtml
- If you are a compsci, engineer, or physical science major, consider undergraduate research on solar cells. (Pump up your resume, save the planet, and get in good with your favorite teacher.)
- Get a friend (or two or three) to stop smoking by inundating them with information and thus save their lives, reduce unnecessary health costs for society, and preserve precious resources (arable land and water).
- Find out what chemicals are behind the "keep off grass" signs. Are there alternatives? What about the elm tree sprays—what are their health effects? Educate the rest of PSU with an editorial in the *Collegian*.
- "Anti-flyer" college avenue on an STS-related topic to educate your fellow students.
- Intern with www.thetruth.com/ or start similar antics here to discourage tobacco use.
- Research home energy conservation and then go door to door doing free "energy audits" for State College homeowners.
- Encourage off-campus property owners to replace all incandescent light bulbs with compact fluorescents (on campus is fair game too in a few remaining locations: stairwells, married student housing, and Nittany Apartments). www.lightsite.net/
- Turn the State College ride board into a success to encourage car pooling. Http://www.statecollege.com/rideboard/index.phtml
- Run a Good Will/charity donation drive for move-out week in order to encourage closed-loop consumption and material conservation.
- Pull off a large (harmless) prank which gets the PSU community to enter into dialogue on an STS-related

topic (in the spirit of MIT "hacking" http://hacks.mit.edu/ Hacks/)

- Write a computer program that calculates the number of trees killed, water used, and energy consumed for the number of computer pages printed—then distribute freely.
- Test the Penn State drinking water for chemical contaminants (not hardness test).
- Start a "Nittany-hours" bartering scheme modeled off "Ithica-hours," which has generated millions of dollars in their local economy. Www.lightlink.com/hours/ithacahours/
- Take an alternative spring break, take a friend, and keep a journal (you have to love a class which gives you credit for spring break). www.clubs.psu.edu/asb/
- Start a "Free University" at PSU (example: http://www.freeu.com/index.html) or help organize the "classroom without walls" coming in April.
- Start an anti–sports utility vehicles information drive (start it at Old Main). www.howard.net/ban-suvs.htm

Projects That Entail Altering University Policy

- Restart Housing's "Energy Conservation Competition" between dorms—pizza party and creamery ice cream for the winning dorm.
- Lobby for campus (or off-campus) housing to separate electricity from total bill in order to encourage responsible energy use.
- Start a free-bike program modeled off of programs in Europe: the Copenhagen system provides free bikes for a small refundable deposit and Zurich's free-bike program accepts passports as bike deposits. You could start the program with the several hundred bikes auctioned off by the university police service every summer.
- Dissuade the university from adding paper towels to the dorm bathrooms in order to reduce material waste.
- Get PSU to add the classroom and administrative building's bathroom paper towels to the list of composted materials.
- Calculate the buyback time for triple pane, argon-filled, low-e windows. Then, get PSU to replace the single-pane relics peppering the campus that literally burn thousands of your tuition dollars.
- Get PSU parking passes for "prime" spaces to the new no-emissions hybrid vehicles.
- Lobby for new bicycle-friendly laws "moving vehicle" (e.g., bike cops could sell bike lights rather than fine lightless bikers, open the PSU College Avenue sidewalk to bikers).
- Determine viability of installing pool covers for natatorium to conserve H_20 and energy.
- Find out the price per square foot of the new windows in the HUB. Could the scribed partially transparent solar cells replace them? Would it make sense to start investing in construction materials that produce free energy?
- Replace vacuum aspirators with vacuum pump systems in chemistry labs to conserve water and money.
- Institute parking rates dependent on gas mileage to discourage energy waste.
- Bike paths—Where are they? Why would PSU be better with more than one?
- Investigate the possibility of adding organic food to the dining hall menus.
- Get CAC to make Lion Aid the default welcoming screen for university Web browsers. www.lionaid.com/
- Convince PSU libraries to stop storing anything on microfiche and go straight to scanning and storing on CDs and when copyright laws provide—put on the Internet for everyone's use.
- It would cost only 8 cents more per student per year more to use recycled paper in the CAC labs—and we still do not use it. Fix this.
- Get Student Loan Services to e-mail before sending written notice to transfer and continuing students to save paper and money.
- Develop a realistic model of economic buyback for university-financed buildings.
- Petition the library to place signs discouraging elevator use (where are those stairs anyway?).
- Is there any recyclable that PSU does not currently recycle? Find out and fix it. Hint: tires.
- Encourage CAC to donate retired PCs to grade schools or retirement homes rather than giving them to salvage or scrapping them. Www.psu.edu/spacegrant/scrounge.htm
- Get CAC to set up the lab computers to go into sleep mode after 15 minutes of nonuse (saving energy/money) and to turn them off entirely at night when not in use.

Are you down with OPP? Lobby the Office of the Physical Plant to institute the following in order to save tuition money and energy and, thus, reduce greenhouse gas emissions and pollution:

- Monitor the temperature in all campus buildings and set temperatures at a reasonable level. Who among you likes to sweat while you take notes? Who wants to pay a higher tuition for the energy costs?
- Have the thermostats removed from classrooms where socially unaware students turn up the heat as a pathetic excuse for a prank.

- Put parking lots and parking deck lights on either a light schedule that follows daylight saving time or install light detectors.
- Install low-flow faucets or faucet aerators on all sinks.
- Find out how much energy/money is wasted by the uninsulated heat pipes running underneath most university sidewalks. Then get the university to insulate them.
- Start a campaign to purchase a scrubber for our on campus coal steam plant to limit SO_2 and NO_x emissions.
- Does it make economic and environmental sense for PSU to burn nonrecyclable paper in the coal plant?
- Use water-saving flush toilets wherever possible or composting toilets wherever applicable (Beaver Stadium?).
- "Buffalo grass" limits its growth to a short length—what would be the economic and environmental benefits of replanting all the quads? Is it viable?

References

Anderson, R. C. (1997). *Interface sustainability report*. La Grange, GA: Interface Corporation.

Barbier, E. B., Pearce, D. W., & Markandaya, A. (1989). Environmental sustainability and cost-benefit analysis. *Environmental Planning*, *A1 22*, 1259-1266.

Burke, S. (1992, February 24). In the presence of animals. *Science and Society*, 64.

Cranton, P. (1994). Self-directed and transformative instructional development. *Journal of Higher Education*, *65*, 724-744.

Creighton, S. H. (1998). *Greening the ivory tower: Improving the environmental track record of universities, colleges and other institutions*. Cambridge, MA: MIT Press.

Cross, P. K. (1993). Improving the quality of instruction. In A. Levine (Ed.), *Higher learning in America: 1980-2000* (pp. 287-308). Baltimore: John Hopkins University Press.

Daly, H. E. (1991). Towards an ecological economics. In *The World Bank working paper.* Washington, DC: Environment Department, World Bank.

Earth Communication Office. (1994). *Power of one*. Available: www.oneearth.org.

Foltz, F. (1999). *Science, technology, and society 200: Critical issues in STS: Spring 1999*. State College: The Pennsylvania State University.

Green Destiny Council. (2000). *Penn State indicators report: Steps toward a sustainable university.* State College: The Pennsylvania State University.

Harper, P. (2000). The end in sight? Some speculations on environmental trends in the twenty-first century. *Futures*, *32*, 361-384.

Hawken, P., Lovins, A., & Lovins, L. H. (1999). *Natural capitalism: Creating the next industrial revolution*. Boston: Little, Brown.

Knowles, M. (1980). *The modern practice of adult education*. New York: Association Press.

Lesko, W. S. (1992). *No kidding around! America's young activists are changing our world and you can too*. Kensington, MD: Information USA.

Minkler, J. (1997). Active citizenship. *Social Studies Review*, *37*(1), 64-67.

Minkler, J. (1998). *Active citizenship: Empowering America's youth: Social studies curriculum for Grades 7-12*. Center for Multicultural Cooperation, Coarsegold, CA. Available: www.activecitizenship. org.

Mosher, W. (1943). Citizenship—As action. *Journal of Educational Sociology*, *17*(1), 55-60.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.

Neumann, Y., Finaly-Neumann, E., & Reichel, A. (1990). Determinants and consequences of students' burnout in universities. *Journal of Higher Education*, *61*(1), 20-31.

Oliver, P. (1984). "If you don't do it, nobody else will": Contributors to local collective action. *American Sociological Review*, *49*, 601-610.

Raina, P., Bonnett, B., & Waltner-Toews, D. (1998, September). *Relationship between pet ownership and healthcare use among seniors*. Paper presented at the 8th International Conference on Human-Animal Interactions, "Changing Roles of Animals in Society," Prague.

Social Investment Forum. (1999, November 4). *1999 report on socially responsible investing trends in the United States*. Washington, DC: SIF Industry Research Program.

Solow, R. (1992). *An almost practical step towards sustainability* (RFF discussion paper). Washington, DC: Resources for the Future.

Torbert, W. R. (1978). Educating toward shared purpose, self-direction and quality work: The theory and practice of liberating structure. *Journal of Higher Education*, *49*(2), 109-135.

Twombly, S. (1992). Student perspectives on general education in a research university: An exploratory study. *Journal of General Education*, *41*, 239-272.

Union of Concerned Scientists. (2000). *Briefing: How coal works*. Available: www.ucsusa.org/energy/brief.coal.html.

Waks, L. J. (1987). A technology credo. *Bulletin of Science, Technology & Society*, *7*(1-2), 357-366.

Weiss, J. (1965, Summer). The university as corporation. *New University Thought*, 31-45.

Wills, T. A. (1985). Supportive functions of interpersonal relationships. In S. Cohen & S. L. Syme (Eds.), *Social support and health* (pp. 61-82). New York: Academic Press.

World Commission on Environment and Development. (1987). *Our common future*. Oxford, UK: Oxford University Press.

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