Online Ethics Center
FOR ENGINEERING AND SCIENCE

Terrascope

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Description

This activity is considered an NAE Exemplar in Engineering Ethics Education and was included in a 2016 report with other exemplary activities. This activity describes an activity where first-year students are given a big problem and asked to solve it as a group.

Body

Exemplary features: Use of alumni mentors; integration with engineering projects

Why it's exemplary: Learning about ethical practices and issues is "baked into" the program as a core component of the students' work. Alumni of Terrascope thus come to see ethical practices and issues as fundamental to any problem they take on, rather than an afterthought or external requirement. Another exemplary aspect of the program is the way it empowers students to take control of their learning process, shaping goals and problems as they proceed. Finally, the program provides students with the opportunity to work on real-world, complex problems during their first year at MIT, a time when most of their other classes focus on acquiring the tools to do great things at some future time.

Program description: Terrascope is a freshman learning community at the Massachusetts Institute of Technology in which students take on complex, real-world problems in a radically student-driven, project-based, team-oriented setting. The primary participants are first-year students, but upperclassmen continue to participate as undergraduate teaching fellows and mentors. Other participants include faculty, teaching staff, librarians, and alumni mentors. The educational goals are to prepare students to take on big problems that involve ethical, political, economic, and social factors as well as scientific and technological ones; empower students to take charge of their educational experience; give students the opportunity to do important and creative work during their first year of college; enable students to understand the social, ethical, and political contexts in which their more technical work will take place; and provide students with the tools to work in diverse teams on large projects.

In the fall semester students take Solving Complex Problems, in which they are given one big problem, as a class, and told that they have a semester to solve it. A typical problem might be “Devise a plan to provide adequate fresh water to western North America for the next century.” Problems always involve issues beyond science and technology and are selected such that any solution must involve multiple tradeoffs, with no “right” or “perfect” answer. They always involve environmental questions and are real-world problems that must be addressed by society. Students form teams around different components of the problem and, with facilitation by undergraduate teaching fellows and aid as required from librarians and alumni mentors, they work on a comprehensive solution. Their first deliverable is a website that describes their solution in technical detail. Their other deliverable is a public event in which they present and defend their solution before a panel of global experts.

In the spring, students may take Design for Complex Environmental Issues, in which they split into teams to do hands-on research and development on problems related to the year’s topic. Often projects involve technological solutions to specific aspects of the year’s problem. At the end of the semester students present their prototypes in a public “bazaar,” during which they describe their work both to members of the public and to an expert panel. This class gives students the opportunity to take part immediately in implementing solutions to the problems they have studied and also to participate in a formal design and fabrication process. Students in the spring may

also take “Terrascope Radio,” in which they create a radio program for the general public about the year’s topic. The format and content are up to students to decide, and shows have ranged from documentaries to magazine-style programs to radio dramas. Students learn how to use this evocative medium to communicate key aspects of the year’s problem to an audience without particular technical expertise. In producing the program they also develop a deeper sense of the broader aspects of the problem and its context. Every year there is also an optional field trip to a place deeply relevant to the year’s topic problem; students meet people who would be affected by their proposed solution and see details and human elements that they might previously have overlooked. The trip provides deeper, contextualized learning to complement the learning done back on campus.

Assessment information: The first measure of the program’s success is the quality of the students’ work. Every year the expert panel is deeply impressed by the creativity and thoroughness of the students’ solution. Especially telling is the question-and-answer period of the defense, usually 2 hours (following an hour-long presentation), during which panelists grill the freshmen on both general and detailed aspects of their work. Students and panelists alike are generally amazed at the depth of knowledge and sensitivity the students have acquired in just one semester. Similarly, programs produced in Terrascope Radio have been licensed and broadcast by more than a hundred stations across the country, testifying to the effectiveness with which students have learned to communicate these important issues to the public. In addition, we conduct a detailed assessment of the students’ experience every year, focusing on the degree to which the program has helped them learn to work in teams on complex problems, the progress they have made in team building and project management, and the degree to which the program has deepened their appreciation of their own potential. (Anecdotal evidence agrees with students’ responses: one of us teaches a project-based, team-oriented class for sophomores and has found that he needs to be sure former Terrascope students who take the class are divided equally among teams, since they are so far ahead of their peers in group work and project management.)

Perhaps most importantly, we observe the work students do in later years, after having participated in Terrascope. They tend to be campus leaders in big projects that take on difficult societal problems, eagerly seeking out challenging issues to address. Details are given in some of the papers to which we have provided links, but examples include development of earthquake-tolerant housing that can be built

with local materials in mountainous regions of Pakistan; detailed analysis of the effectiveness of MIT's recycling program; and plans for ecologically sustainable temporary housing of refugees. For these students, prepared by their Terrascope experience, ethical and societal issues are at the core of their objectives and practice, motivating and shaping the work they do.

Additional resources:

1. Team-Oriented, Project-Based Learning as a Path to Undergraduate Research: A Case Study: https://www.dropbox.com/s/pzbz0c7kx2n57wi/CUR-ResearchSupportive-Ch5.pdf?dl=0
2. Building a Freshman-Year Foundation for Sustainability Studies: Terrascope, a Case Study: https://www.dropbox.com/s/1yvw2o3ehdz9qkh/Sust.Sci.-Epstein%2CBras%2CBowring.pdf?dl=0
3. Helping Engineering and Science Students Find Their Voice: Radio Production as a Way to Enhance Students' Communication Skills and Their Competence at Placing Engineering and Science in a Broader Societal Context: https://www.dropbox.com/s/h2jtoguwjefqdjz/TerrascopeRadio-ASEE2010.pdf?dl=0

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Resource Type

Educational Activity Description

Parent Collection

NAE Exemplars in Engineering Ethics Education

Discipline(s)

Computer, Math, and Physical Sciences
Engineering
Environmental Health
Life and Environmental Sciences
Teaching Ethics in STEM