Global Engineers' Education Course

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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 a course where students work with a community in rural India to address local sanitation challenges. During the course, the students learn about care ethics and puts it into practice in their research and developed prototypes.

Abstract

Exemplary features: Use of care ethics in engineering education and teaches learning how to listen

Why it's exemplary: This course enables students to work with a community in rural India to address local sanitation and hygiene challenges. In addition to lectures, they collaborate via Skype with community members to develop solutions. The regular connection with India exposes them to the reality of ethical challenges in engineering practice. Students learn about care ethics and how to put it in practice by developing individual "care statements," which, including the community's care statements, serve as design requirements for their prototypes. A combination of experiential learning, active reflection, interdisciplinary readings,

and community interaction makes students aware of the ethical implications of engineering work and of their responsibility as engineers, but instead of feeling burdened this class offers them the discourse of care as a means to navigate and practice their ethics. The course is low-budget and has a deep impact on students who have continued to engage in research for years after the class.

Program description: Stanford University's Global Engineers' Education (GEE) course provides the opportunity for students to collaborate with an underserved community globally and conceive solutions to challenges faced by the community in ways that are safe as well as mindful of and responsive to the local economic, environmental, social, political, ethical, and cultural conditions. Engineering for underserved communities has frequently imposed solutions that have proved successful in prosperous countries but that fail to have the desired impact on impoverished communities. Local conditions, both environmental and cultural, affect the solutions and their efficacy. Attempted solutions that do not incorporate local support or take into account the aspirations of the local community do not last. This has also become apparent in the growing literature on engineering for development and social justice. GEE addresses this challenge by blurring the distinction between the student engineers in their role as solution providers and the underserved community in their role as consumers of the engineering solution. The engineering students are as much consumers as the underserved community members are designers and architects of the solution and the experience of creating it together. The aim is to educate student engineers to work with rather than for the underserved communities.

GEE currently focuses on the systematic, complex, and existential problem of lack of sanitation and hygiene facilities faced by 2.6 billion people the world over. The course addresses education, safety, and dignity while enabling better hygiene and health monitoring by making the toilet a desirable, affordable, and the preferred alternative to open defecation, starting with field sites in rural India. The course is geared toward undergraduates and has attracted students from different engineering disciplines as well as nonengineering majors. The GEE curriculum fosters collaboration through three unique elements:

- Regular video calls with experts at the partner organization in India, the Environmental Sanitation Institute (ESI), allow students to engage directly with community members.

- Readings and discussions from various disciplines encourage students to consider the complexity of the problem space of sanitation and hygiene as they prototype technologies.
- The course focuses on the idea of designing with care by inviting students and community members to express their values and goals and incorporate each of these "care statements" into the final design. Students thus have the opportunity to examine daunting concerns they may have about bridging language and cultural barriers and connecting with the harsh realities that the underserved communities experience in a nonthreatening environment. The fact that the communities are real, coupled with the regular real-time connection with them, imposes an ethical responsibility on the students and provides direct experience of real work conditions.

The GEE course has two lecture hours, a weekly Skype call with field partners in India, and weekly team meetings with the instructor. It also has a strong reflection component as students maintain daily reflection journals. The curriculum is based on Dewey's philosophical understanding of learning (as a combination of active doing, undergoing, and reflection). In class students discuss literature from different disciplines such as economics, sociology, and gender studies. They share new facts they have learned as well as what they felt the authors of the papers cared about and why. Class discussions focus on discerning the methods followed, the theories that the papers built on, and most importantly how the insights from the papers reshaped or affected the problem space. Through the readings, the students are encouraged to add detail and gradually expand the complexity of the problem space. This approach exposes students to think more broadly about not only the technical aspects of their design but also the societal, environmental, ethical, and other implications. It trains them to be mindful of the different stakeholders and an appreciation for where their views may be coming from and helps them to anticipate these differences and not be surprised by them in the future.

The class follows the Stanford process closely but is differentiated by the fact that, before commencing the designing itself, the GEE team members reflect on and articulate what each of them personally cares about in the challenges faced by the underserved community. This serves as their point of view for the remainder of the design process. It becomes a method for balancing the need to provide immediate assistance with the ability to thoughtfully create breakthrough engineering solutions collaboratively with the community. The care statements are individually created as

a combination of visuals and text. The process does not require building consensus or arriving at one point that the GEE team collectively cares about; rather, individual members of the ecology are responsible for ensuring that what they care about is represented in their design solution. The ecology collectively agrees to create a solution that embodies what each member cares about. This approach ensures that the community continues to stay engaged in the process. It also prevents reducing the input received from the community to mere facts and instead ensures continuity of community engagement as they continue to share what they care about and why. By sharing stories and their lived experiences they contribute to coming up with design requirements, constraints, and ideas.

The course has served as a starting point for a sustained dialogue and inquiry into how to be a good engineer and how to navigate the complex and often burdensome ethical situations that one encounters in engineering practice. The discourse of care and reflecting on care statements has proven to be an effective means for students to persevere in their reflections and develop a personal sense of ethics that is consistent with the global ethics of engineering. The course also allows students to appreciate the importance of research in improving engineering practice. Several students from the class have continued working on their inquiry, developed research projects, and coauthored papers presented at the ASEE conference.

Assessment information: To measure the effectiveness of the curriculum, a metric called Global Preparedness Efficacy (GPE) is being developed (see link below). This metric was developed in response to measuring whether the course would satisfy ABET criterion 3h, which is "the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context." The metric is built on recognizing the challenges that can prove overwhelming when working with global communities; these include the diverse cultural, social, political, economic, and linguistic contexts and accompanying ethical dilemmas. Viewed through the lens of discontinuity theory these circumstances can be disorienting and restrict students' ability to learn. By bringing a Deweyan lens we can see these moments as opportunities for learning provided there are means to restore active engagement (active doing) by the students. The measurement scheme analyzes students' reflection journals to take note of discontinuity events and examine how many resolved and unresolved discontinuity events occurred. GPE is the ratio of resolved to total discontinuity events and reflects the ability to navigate the complexity and novelty of the

problem space and to create solutions to the problem at hand consistent with the global socioeconomic, political, and cultural realities. In addition to the metric, the fact that students engage with the course contents for several years after they have taken the course is a significant indicator of having achieved the goal: Students have shared anecdotes, written conference papers, added minors to their engineering degrees, and write their undergraduate thesis on subjects that they care about, articulating how their exposure to using the discourse of care to develop a personal sense of ethics has served them in navigating their undergraduate life and studies.

Additional resources:

Developing Global Preparedness Efficacy: https://circle.ubc.ca/handle/2429/53819

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Resource Type

Educational Activity Description

Parent Collection

NAE Exemplars in Engineering Ethics Education

Topics

Cultural Awareness and Sensitivity
Ethics and Society

Discipline(s)

Engineering
International Perspectives
Teaching Ethics in STEM