

More than a Dream: The Developing Reflective Engineers through Artful Methods (DREAM) Project

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Extended Abstract

The Developing Reflective Engineers through Artful Methods (DREAM) project seeks to help engineers better appreciate uncertainty and to address complex, poorly defined, and under-constrained sociotechnical engineering problems. DREAM is an interdisciplinary collaboration of faculty and staff at Texas Tech University from the fields of engineering, education, cognitive psychology, studio art, media/communication, and the museum. The project began under an internal seed grant and is now supported by the National Science Foundation (NSF) through its Innovations in Graduate Education (IGE) Program. DREAM fosters the holistic development of engineering students and uses distinctive approaches to cultivate reflective habits and critical thinking skills that are essential for engineering practice today and tomorrow. To do this, we integrate the arts and humanities as well as group-discussion and reflective writing to help improve engineering students' understandings of the implications of their work, especially the ethical, sociotechnical, and sustainability challenges. One example of an "artful method" we employ is Visual Thinking Strategies (VTS),^[1] a technique originally created for museum contexts that uses visual art to develop observational skills, critical thinking, and communication skills. The objectives of our project are to (1) develop an innovative, transformative pedagogy and curriculum for graduate engineering education using methods seldom found in engineering curricula, (2) assess and evaluate its effects, and (3) disseminate our findings, experiences, and materials. We provide here an overview of the DREAM project, discuss some of our approaches, and present a selection of our findings to date.

Can the arts and humanities provide key perspectives for engineers in developing awareness of and interest in the environmental and sociotechnical impacts of engineering? How might essential habits and skills necessary for engineers to meaningfully address these impacts be learned using the arts and humanities? We are exploring questions like these via mixed-methods research on an experimental course that includes such activities as autobiographical writing, reading about and discussing ethical dilemmas, practicing visual thinking strategies (VTS), writing weekly reflective essays, reading and discussing fiction with strong environmental justice themes, and even collaborating on art projects with graduate students in the School of Art. Incorporating aspects of the arts and humanities to complement engineering thought and action is a critical component of our work, which we describe as developing reflective engineers through artful methods. The objective of our course is to develop engineers with reflective habits and skills so they are better able to: (a) understand and address the complexities of modern real-world challenges, (b) make better ethical decisions, and (c) serve the public not only with technical engineering skills but with mindfulness of

and sensitivity to the complex social, cultural, and environmental contexts their work. Informed by the ideas of John Dewey, Elliot Eisner, Donald Schön, and King & Kitchener,^[2] we present a selection of findings from two instantiations of a newly designed graduate course in civil/environmental engineering.

Aggregate results ($n = 19$) from the pre/post Likert-type surveys showed statistically significant increases in Insight, which is a metacognitive factor central to the process of purposeful & directed change^[3] ($p < 0.02$, $d > 0.3$) and in Contextual Competence,^[4] which is an engineering-specific measure of contextual understand ($p < 0.001$, $d > 0.8$). We also observed potentially significant increases in Reflective Skepticism ($p < 0.1$, $d > 0.3$), which is a measure of reflection regarding the tendency to learn from one's past experiences and be questioning of evidence,^[5] and in Interdisciplinary Skills^[6] ($p < 0.3$, $d > 0.3$).

This work contains elements of many of the conference topics listed in the call for papers, especially Innovations in the Classrooms and Preparing the Future Engineer. Our results to date have been encouraging from our surveys (see above) as well as from our analyses of student writing and interviews (reported elsewhere, see ^[7] and ^[8]). Our results are consistent with the premise that engineering students can develop their capacity for reflection through arts- and humanities-based activities. Work is ongoing to support this claim (e.g., see ^[9] and ^[10]).

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