Humanistic Enhancement of Engineering: Liberalizing the Technical Curriculum

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Abstract—The increasing complexity of societal issues, environmental considerations, and technological progress means that engineers are being asked to make decisions that not only require technical expertise but also a keen understanding of broad, socio-humanistic contexts and considerations. However, the engineering curriculum in most academic institutions is generally not geared towards integration of the technical course work with these socio-humanistic issues in any rational way. There is clearly a need to rethink and reinvent the engineering curriculum so that it focuses on producing Humanistic Engineers who are able to initiate and engage in effective dialogue with non-technical audiences regarding socio-humanistic critiques of engineering processes and products and who are able to perform their own socio-humanistic critiques in the absence of such dialogue. To this end, at the University of Colorado, Boulder, we have embarked on several initiatives in developing a model for Humanistic Engineering that integrates technical and humanistic content and methods by way of core concepts and common objectives via collaboration in teaching and research. Many of these initiatives are the result of unique partnerships between colleges. Examples include: “Technology and Culture” multidisciplinary, collaborative courses, the “Dialogues Between Two Cultures” lecture and seminar series, an “Earth Systems Engineering” initiative, and the founding of the student organization, “Engineers without Borders,” among others.

Index Terms — Collaborative, Enhancement, Humanistic Engineering, Integration, Interdisciplinary, Multidisciplinary.

“As research is increasingly interdisciplinary, undergraduate education should also be cast in interdisciplinary formats....because all work will require mental flexibility, students need to view their studies through many lenses.” [1]

21ST CENTURY CHALLENGES TO ENGINEERING

The recent advances of civilization through scientific and technological progress has been nothing less than awe-inspiring. Take, for example, the impressive evolution of the computational ability of machines, which has steadily increased since the 1960’s in accordance with the breakneck rate predicted by Moore’s law [2]. Humankind’s rapidly increasing ability to manipulate natural elements, laws, and systems for human good is unmatched except perhaps by the inspiring if not largely inconceivable promises of future gains in areas such as genetics and nanotechnology.

Our growing awareness of the increasing complexity of societal and environmental issues is largely a function of these remarkable developments in human technological ability: the large scale application of technical solutions all too often brings about unintended consequences of similar magnitude and consequence to the solutions, as in the case of the Aswan Dam, which unwittingly interfered with the fertility resulting from the annual flooding of the Nile. At an alarming rate, relationships that were once invisible or deemed insignificant are now compounded and potentially problematic as our understanding of complex systems and non-technical contexts struggles to keep up with our ability to affect them.

Consequently, engineering can no longer be content to function within the comfortable limits of analytical tools and initially defined objectives and specifications. Ethical, ecological, economic, and aesthetic considerations must be factored in to the analytical, design, and management processes of engineering [3]. Nor can the responsibility for these considerations be shifted exclusively onto policy makers, lawyers, social scientists, professional ethicists, and the like. Decisions made at the early stages of a technical process can lead to weighty consequences down the line, and perspectives that are seemingly irrelevant to immediate objectives can “turn out to be central to the outcome of the case” [4]. And while focused expertise is both necessary and invaluable, its application rarely if ever proceeds along purely disciplinary lines. Those involved in decision-making processes need to know as much potentially relevant information as possible, not the least of which includes information concerning technical aspects such as properties, maintenance requirements, alternatives, options, etc. This, in turn, means that engineers and applied scientists must be able to participate in the decision-making process—often an open-ended and evolving dialogue—on both public and incremental levels, if progress is to be worthy of its name.
The rushed tempo of technological development means that other things move more quickly, too. Contrary to the utopian dream that technology would bring us more leisure, our lives are busier than ever. Along with the present-day confirmation of the Schumpeter models for product lifetime comes higher stress [5]. Consequently, there is little to no time for creativity or contemplation. Reflection on the causes and consequences of the pace of change not only brings a measure of reprieve, which enables creativity, it becomes a societal if not ethical imperative. What is the role of the engineer in determining the lifetime of a product? What are the long-term impacts of following short-term marketing trends? To ask such questions, especially when the parameters are indeterminate and the answers are uncertain, requires engineers to enter into sustained dialogue with humanistic and social scientific counterparts—ideally, both in the workplace and during their education and training.

Nor should the relationship between engineers and humanists be conceived of as playing merely a supplemental role to the engineering process, especially when there are synergistic benefits to be obtained from a fuller interaction between players. This approach is typical, however, as illustrated by the tendency (even among proponents of technical writing) to treat writing composition skills as employed only “after the fact” of invention and design, thereby constituting a missed opportunity to reinforce technical objectives [6]. By enabling more multidisciplinary work in both the curriculum and the workplace, avenues can be found for personal creativity while simultaneously taking practical advantage of the intellectual diversity in industry and the academy.

Finally, national polls indicate that much of U.S. society is technologically illiterate. According to a recent Gallup poll, most Americans equate technology and science with “computers” and “the Internet” [7]. If this is any indication of global trends, the job of engineering educators worldwide thus includes preparing future engineers to interact and communicate with the non-technical segments of our population—including those with limited and even hostile views of technology, engineering, and applied science. Over 40 years ago, C.P. Snow lamented what Collini has described as the “profound mutual suspicion and incomprehension” that existed between the “two cultures” [8]. Such barriers were hardly acceptable then, and we can afford them even less nowadays, when widely divergent areas of expertise overlap and are forced to reckon with multiple aspects of the same global concerns.

CURRICULUM REFORM

Most of these considerations have been implicitly recognized by U.S. educational accreditation and governmental funding agencies for several years. The ABET EC 2000 accreditation criteria require engineering schools to demonstrate that their graduates possess, among other things,

- an understanding of professional and ethical responsibility
- the broad education necessary to understand the impact of engineering solutions in a global and societal context [and]
- a knowledge of contemporary issues [9].

The U.S. National Science Foundation (NSF), in an online document outlining guidelines for engineering educational reform, stated that

success as an engineer increasingly requires, in addition to strong technical capability…[an] understanding of the non-technical forces that profoundly affect engineering decisions… [10].

The document goes on to state that “[a]cquiring such characteristics is unlikely with traditional, lecture-based instruction” and calls for a “new engineering education paradigm” [10]. Evidence from employers confirms that engineers are being asked to make decisions that require, in addition to technical expertise, a keen understanding of broad, socio-humanistic contexts and considerations. To cite a well-known example, the Boeing Corporation regularly publishes a list of desired attributes of engineers that includes a “basic understanding of the context in which engineering is practiced” and makes explicit reference to history, the environment, and societal needs [11]. Perhaps the greatest challenge in attempting to address these objectives is that our efforts do not prove counter-productive.

THE HUMANITIES COMPONENT

Whereas the primary focus of the engineering curriculum is to produce graduates with excellent technical and analytical capabilities, such a focus is no guarantee that an engineer will be ethical, innovative, or work towards sustainable solutions. Typically, the “liberal,” “general,” or “humanistic” component of an engineering education, consisting largely of humanities, social science, and sometimes arts courses, is perceived as the proper place for introducing such considerations; however, several factors complicate the role that humanistic education traditionally plays in the technical curriculum.
For better or worse, the technical demands of the University of Colorado at Boulder’s College of Engineering and Applied Science (CEAS) undergraduate degree program leave little room for the humanities. At approximately 18 semester credit hours of required humanities electives (5-6 courses) out of a total of 129 required for graduation (somewhat typical for U.S. institutions), it is an immense challenge to ensure that engineering students understand the place of humanistic education in their professional, civic, and personal aspirations.

In order to maximize the value of such limited exposure, many technical schools have designed their own liberal studies programs that are geared to addressing widespread issues and concerns, accounting, in part, for the Science and Technology Studies (STS) movement. Encompassing a broad range of course types, STS courses generally consist of the humanistic study of science and technology. Engineering schools that must rely for their humanities education on outside programs that function independently of engineering educational objectives (e.g., ABET EC 2000 criteria), however, are not in much of a position to determine or influence the nature of this component of their student’s program of study.

A commonly held perception among CEAS students is that the socio-humanistic coursework is simply not relevant to their academic or professional aspirations. Surprisingly, this attitude is found to be especially applicable to writing courses. It can also be found among students who actually otherwise enjoy their humanistic coursework. Of course, most humanities courses available on campus are not designed to take into account students who, all said, take only a handful of non-technical courses and who do not have the luxury of building cumulative knowledge culled from in-depth learning in a given humanistic discipline.

More importantly, intellectual and cultural disconnects between technical and humanistic experts only reinforce the general disinterest and frustration of engineering students who view their limited exposure to the humanities and social sciences as burdensome and irrelevant. This observation by a member of the Boeing Corporation, after attending an NSF conference on the role of liberal education in the engineering curriculum, is poignant: “I had not realized how disconnected the "Liberal Studies" faculty were from the Engineering departments that must meet the EC2000 criteria” [12].

Isolated courses and lectures that attempt to take into account but fail to simulate real-world interactions among technical and socio-humanistic contexts and practitioners run the risk of over-simplification, among other things. Ultimately, the lack of perceived relevance between the humanistic and technical disciplines will only tend to reinforce dismissive, divisive, and costly assumptions.

Instead of—or alongside—traditional socio-humanistic coursework, we propose to integrate the humanities with technical and scientific knowledge so that the deeper issues that characterize the separations between, and the common ties linking, the “two cultures” can come to light and thereby be of service to ourselves and our students. In so doing, we believe that the core objectives of both humanistic and technical education must not only be honored, but can be better served.

**HUMANISTIC ENGINEERING**

In light of the lack of coherence, coordination, and perceived relevance between technical and humanistic components of the engineering education, educators need to rethink and reinvent the engineering curriculum so that it focuses on producing what can be termed Humanistic Engineers—21st century engineers who are able to initiate and engage in effective dialogue with non-technical audiences regarding socio-humanistic critiques of engineering processes and products, and who are able to adopt multiple perspectives and perform their own socio-humanistic critiques in the absence of qualified humanistic interlocutors.

This new curriculum, ideally, will integrate technical and humanistic perspectives in both directions in a truly multidisciplinary fashion, drawing from innovative collaborations that reflect the continuous and interconnected fabric of the real world. Such a curriculum will naturally need to take full advantage of the limited time already devoted to the humanities, arts, and social sciences, coordinating them with engineering education objectives but without compromising their disciplinary integrity. To be effective, the “non-technical” components of a Humanistic Engineering curriculum need to go beyond existing attempts that, for whatever reasons, neither represent nor engage engineering perspectives. Otherwise, this component all too easily becomes little more than a counterproductive conscience, lacking convincing authority in the eyes of technical students and reinforcing traditional stereotypes that are carried into professional life. In our experience, engineering students resist what they perceive as efforts that preach to or attempt to convert them—a pitfall of the “one hour ethics lecture” that represents many initial attempts to respond to the genuine need for more sophisticated and ethical engineers.

In addition, the curriculum for the Humanistic Engineer will—wherever possible—weave societal, humanistic, environmental, and leadership contexts and considerations into the technical curriculum itself. As stated above, the goal is largely to reflect practical conditions in order to increase the likelihood that engineers are, at the very least, responsive to non-technical demands and scrutiny and, ideally, are able to consider and take into account such issues and perspectives on their own.

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Finally, such a curriculum will provide an “immersive environment,” made up of internships, exposure to research, and extra curricular activities, which all reinforce a sense of the connectedness among cultural, natural, and technical systems.

The integration of humanistic and technical subject matters, skills, methodologies, and considerations will no doubt strike many as a hopelessly complicated and burdensome task. The traditional alternative, however, is to assume that, despite their fragmented and disconnected relationships, the isolated disciplines will nevertheless somehow work in tandem with one another and that students will perform, on their own, the necessary synthesis of knowledge systems. In light of contemporary issues that face engineering practice, there is not much evidence for the success of the traditional approach. Furthermore, a growing body of scholarship, multidisciplinary research efforts, and collaborative teaching experiments demonstrate that such undertakings are not only possible, but that they are timely and well considered.

European institutions such as the University of Art and Design Helsinki's Media Lab, which integrates artistic and technical design, have been exploring cutting edge multidisciplinarity between humanistic and technical disciplines. The Banff Centre, a center for cultural research in Canada, operates along similar lines. U.S. attempts to effectively bridge the important practical gaps between the “two cultures” are also noteworthy. The Kira Institute, AMD and ART, Inc., and efforts at Rensselaer Polytechnic Institute, the University of California at Davis, and the University of Virginia, to name just a few, promise to produce future educators who can teach others to see their way into and overcome the social and intellectual discontinuities that hamper humanistic and technical expertise and practice.

**CURRICULAR INITIATIVES AT THE UNIVERSITY OF COLORADO**

The University of Colorado at Boulder (UCB), in developing a model for Humanistic Engineering, has implemented several initiatives that integrate “techno-humanistic” content, methodologies, concepts, histories, paradigms, etc. In these efforts, common issues, analogous objectives, and shared contexts are capitalized on and put to rare use, largely by means of collaboration in teaching and research between members of the technical and humanistic faculty. Many of these initiatives are the result of unique partnerships between colleges. In every case, we wish to stress that the humanities, arts, and social sciences are intended to be introduced and pursued as such and without compromising their disciplinary integrity, while at the same time complementing and exposing the nature and context of technical knowledge, skills, and activities.

**“Technology and Culture” Courses**

The Technology and Culture (T&C) curriculum initiative awards competitive grants to multidisciplinary faculty teams who collaboratively design and teach courses that challenge students to compare, contrast, and integrate multiple paradigms; practice dialogue between technical and humanistic viewpoints; and develop critical and creative skills that can enhance both humanistic and technical abilities.

In contrast to many Science and Technology Studies (STS) curricula, T&C courses seek to represent and engage both technical and humanistic disciplines and practitioners—akin to the “deep multi-disciplinary dialogues” described by Gorman and Mehalik’s framework for understanding multi-cultural networks united by a common purpose [13]. In their three-stage framework, “State 3” involves shared mental models between participants who openly and transparently share their evolving mental models, opening black boxes from each other’s domains of expertise as necessary. These shared mental models are not fixed end-states—they continue to grow and change [14].

In relating and juxtaposing socio-humanistic and technical issues, methods, and perspectives, etc., such courses are meant to underscore that both similarities and differences between diverse knowledge systems are valuable to understand and can be taken into account in engineering environments. The courses create a forum that in turn demonstrates that divergent paradigms and “cultures” can engage in meaningful communication and collaboration, mutually questioning and embodying connections—both theoretical and practical. In creating the conditions for dialogue between radically different disciplinary perspectives, an essential goal of humanistic training is thereby addressed: shared, critical, open inquiry. Moreover, an implicit outcome objective is that students will be encouraged to develop more coherent worldviews in the face of the deep fragmentation of knowledge systems.

Both humanities and technical students enrolled in the courses are challenged to explore knowledge boundaries and conceptual frameworks in order to genuinely increase flexibility of mind. We believe such intellectual mobility allows for innovative approaches that enhance the application and research possibilities of all disciplines involved. For instance, innovation requires critical and creative thinking, both of which are characterized and enhanced by the mental action of shifting one’s perspective [15]—a central activity in T&C courses, in which multidisciplinary dialogue and collaboration involves the students as much as the instructors.

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In other words, out-of-the-box questions emerge where disciplines intersect and childlike curiosity is given reign.

Technology and Culture courses have involved collaborations from departments such as Applied Math and Humanities (Connections: Math, Physics, and Humanities), English and Telecommunications (Making Waves: Telecommunications and Society), and Fine Arts and Mechanical Engineering (The Physics and Art of Fluid Flow).

“Dialogues Between Two Cultures” Project

As technical and humanistic knowledge becomes more refined and sophisticated, they are increasingly inaccessible to each other, especially in academia, contributing to stalled public discourse and myopic professional research and practice. In-depth expertise comes at the expense of broader awareness, insight, and effectiveness. The resulting “intellectual divide” separates our students, faculty, and citizens from one another, effectively isolating pockets of knowledge and halting the spread of interdisciplinary paradigms and models of collaboration.

Thus, socio-humanistic critiques of engineering processes are largely unavailable or inaccessible to practicing and student engineers. Additionally, few humanists are able to bring sufficient familiarity with technical issues to perform and offer reasonable critiques of technical activities that, in turn, lead to more publicly visible technologies. Humanistic research that could otherwise assist engineering processes often results in little to no dialogue among technologists themselves, reinforcing the feedback that engineers need not participate, qua engineers, in socio-humanistic conversations about technologies. The notorious series of exchanges between post-structuralist critics of science and self-styled defenders of science known as the “Science Wars” illustrates this in relation to physics: an informal survey of physics professors at UCB revealed that most of these scientists were unaware of these discourses; furthermore, we speculate that those that are aware of them are (understandably) more inclined to react to such exchanges rather than incorporate them into their own practices.

The “Dialogues Between Two Cultures” project embodies an entirely different spirit and approach to such techno-humanistic interchanges: while admitting argument and disagreement as valid responses, we seek to cultivate and enhance communication, understanding, and ultimately collaboration between the “cultures” as we seek to identify and exchange concerns, perspectives, and objectives.

Thanks to a grant from the U.S. National Endowment for the Humanities (NEH), three UCB colleges have contributed to a team of multidisciplinary faculty participants who take part in yearlong project designed “to explore the concept and place of dialogue as a means to understand and overcome the intellectual divide between science and the humanities.” The NEH “Dialogues” project (http://www.colorado.edu/engineering/dialogues/) consists of artists, engineers, humanists, and both natural and social scientists. In both studying and practicing instantiations of “dialogue” between technical and humanistic disciplines, the recursive process is intended to develop an intellectual culture and social framework that inspires and encourages future multidisciplinary collaborations, primarily in the classroom, and for the purpose of growing the T&C initiative suite of courses.

To broaden and stimulate our conversations, visiting scholars from external multidisciplinary, collaborative programs that integrate technical and humanistic disciplines each deliver a public lecture, lead a public discussion and, on the following day, join a small, focused, faculty seminar.

Engineering OWL

Significant evidence that supports the claim that, as an engineer advances to mid and upper-management levels, writing and communication skills can be just as if not more important than technical skills, is fairly abundant [16]. Despite the need to develop undergraduate writing skills, however, engineering students rarely take more than one or two courses that provide solid writing instruction. The situation at UCB is such that engineering undergraduates do not take a writing class until their third or forth year. In an effort to provide both earlier writing instruction and ongoing support for including more technical writing assignments in technical courses, we developed the Engineering Online Writing Lab (OWL). Unique in the depth of feedback it provides to students and the rapid turn around time once a paper is submitted online, OWL is a feasible alternative to the problematic solution of requiring additional writing courses [16]. OWL student editors are recruited from both humanities and engineering departments and work closely with engineering faculty and students to improve the efficacy of existing technical writing assignments, add new ones, and enhance the quality of written reports. OWL integrates writing composition instruction directly into the technical curriculum without increasing faculty obligation or responsibility.

Connections Gallery

In order to provide an aesthetic and intellectual break from the rigor and routines of the technical curriculum, the CEAS gallery is intended to be a public forum to explore connections among “art, engineering, and society.”
The gallery space and the exhibits planned for it were initially intended to stimulate thought and evoke discussion, on the aesthetic, humanistic, and social roles of technology and engineering. An oversight committee, chaired by the Humanities Advisor (see below), solicited and helped curate an inaugural exhibit developed by the Ball Aerospace Corp. Entitled *Imaging the Invisible*, the exhibit presented a wealth of satellite images that could be interpreted not only with regard to the specific technological applications for which they were created, but also within the larger social, artistic, and interdisciplinary contexts within which engineering operates.

Additionally, engineering-artist student teams from a recent T&C course collaborated on projects that were then exhibited in the CEAS Connections Gallery.

**Earth Systems Engineering**

The UCB initiative in Earth Systems Engineering (ESE) is conceived of in accordance with the main characteristics identified by the literature on ESE. In short, ESE hold that “many engineering decisions cannot be made independently of the surrounding natural and human-made systems because modern engineering systems have the power to significantly affect the environment far into the future” [17]. In response, ESE initiatives stress holistic understanding of contexts, systems approaches to problems, and integrating broad understandings of the interaction between natural and non-natural systems into engineering education, practice, and research.

The goal is of this ESE program is to produce “intelligent engineers” who are sensitive to the interaction among built, natural, and cultural systems. The program focuses on “developing sustainable engineering solutions in a complex natural world” [18].

The UCB initiative in ESE is unique in explicitly addressing and making a priority of including social, cultural, ethical, political, and theological/spiritual issues under the general category of “human systems,” rather than focusing almost exclusively on the interaction of natural systems with industrial and economic ones. In 2001, a major NSF conference in ESE was held at the University of Colorado at Boulder, bringing together engineering educators, professionals, scientists, artists, and humanists. One outcome of the conference was the following definition:

The engineer of the future applies scientific analysis and holistic synthesis to engineer sustainable solutions that integrate social, environmental, cultural, and economic systems.

The department of Civil, Architectural, and Environmental Engineering offers an ESE course, *Sustainability and the Built Environment*, that was originally funded as a T&C initiative course, and that is taught by instructors with a wide variety of technical, humanistic, and industrial backgrounds. It introduces students to the fundamental concepts of sustainability and sustainable development, emphasizing the role of natural, sociological, and humanistic issues in shaping technical decisions.

**Engineers Without Borders**

UCB’s initiative in ESE has given rise to what is now a national organization called *Engineers without Borders—USA*. Since the first student chapter of EWB-USA was established at the University of Colorado at Boulder in 2002, the organization has spread to approximately 30 other U.S. schools in the last year alone. This program involves engineering students in appropriate technology solutions for developing communities around the world. UCB EWB-USA projects have taken place in Haiti, Mali, Mauritania, Nicaragua, and Peru.

**Humanistic Nanotechnology Research**

As an integral part of our effort to move to a model for Humanistic Engineering that includes research activities, CEAS faculty have made a conscious decision to collaborate with their colleagues from the humanities and social sciences on writing a series of joint proposals for funding on nanotechnology.

Nanotechnology, dubbed the next industrial revolution, will impact almost every aspect of our lives including health care, communications, consumer products, and electronics. New products, capabilities and markets written about in works of science fiction stand to become reality through nanotechnology. Nanotechnology derives its name from its basic measuring unit, nanometer that is one billionth of a meter. To put this scale in perspective, the width of the average human hair is 80,000 nanometers. Most proteins are roughly 10 nanometers wide, and a virus is about 100 nanometers long. The ability to develop engineering systems at this scale allows us to interrogate living systems and use the knowledge gained to treat disease in fundamentally different ways than before. For example, novel micro/nano biosensors are being developed that can be implanted into the body with the capacity to sense and react to the local biological environment.
Micro/nano technology can provide physicians with localized physiological information by continually sensing variables such as pressure, blood flow rate and oxygen concentration, and communicating the possibility of any potential problems to the patient and physician well before the critical stage. Furthermore, locally implanted micro-actuators such as pumps, valves and motors would provide the physician with remotely controlled on-site surgical tools without the need for further invasive procedures. The field is young but rapidly advancing, and is sure to produce many of the revolutionary inventions of the 21st century.

While the opportunities for exploring new limits and new applications abound, there are some equally important societal and ethical questions that need to be addressed. Some voices in the popular media as well as among well-meaning social scientists are warning us about the possibility of nanotechnology getting out of control and producing unintended consequences that might harmful to humankind. An article by Bill Joy (Co-Founder Sun Microsystems) that appeared jointly in the New York Times and Wired News asked controversial but thought-provoking questions such as whether the human species, as a result of our own activities, is in the process of working ourselves out of the picture [19]. For instance, he discusses the possibility of nanorobots developing their own intelligence and manipulating human beings in fulfillment of their own designs. Michael Crichton in his recently released novel Prey discusses swarms of nanoparticles developing intelligence and evolving at an extremely rapid pace to hunt and destroy human beings [20]. The point is that engineers and scientists need to look at all aspects of the new technologies and make decisions based on an objective understanding of the complete picture, including potential benefits and losses. We need to step back from the fascinating and exciting potential wonders of new technologies to pause and reflect on their potential environmental impacts and their ability to affect the nature of quality of life on planet Earth. Such reflection is greatly enhanced by engaging other perspectives. To this end, UCB faculty from CEAS, the Health Sciences Center, and the College of Arts and Sciences have begun to make a joint case for close collaboration among engineers, scientists, humanists, and social scientists in general, and in particular for any future nanotechnology work at UCB.

Herbst Humanities Program

Modeled after St. John’s College (in Annapolis, MD and Santa Fe, NM), the Herbst Humanities program offers a series of seminars on “great” works of literature, art, and music exclusively for engineering students. The program serves approximately 10% of CEAS undergraduates. Although not a multidisciplinary program, this humanities program is nevertheless tailored specifically to engineers and has all the virtues of being in-house. For instance, courses are not designed to fulfill sequential steps towards a major or minor degree and are thus able to offer a more complete learning experience that allows for creative exploration of the self and general acculturation, rather than mastery of skills sets and concepts necessary for advanced academic work. Naturally, this approach encourages introspection and self-analysis, which are both suitable attributes for genuine and productive dialogue. Much of the value of the program stems in part from the close quarters that Herbst faculty keep with their engineering counterparts. In fact, two engineering faculty have participated in the program—one as an instructor and one as a student.

In-house Humanities Advisor

Most CEAS undergraduates do not take Herbst classes and thus must fulfill their socio-humanistic requirements through other colleges and external programs. The CEAS Humanities Advisor uses a part-time staff position to integrate the humanities into the technical curriculum in both traditional and innovative ways. Initial attempts to meet with all CEAS students and plan out a rational approach to socio-humanistic course selection proved largely unproductive when it was discovered that most engineering students were unable to register for their first, second, or third socio-humanities course choices in any given semester. The Humanities Advisor continues to meet with students, especially freshman; however, much of the services originally envisioned have been automated and made available through an advising website designed to offer practical assistance and flexibility during the course selection and registration periods. In an unexpected outcome, the real value of the position has turned out to be that of a decentralized humanistic agent who acts as a liaison with humanities administration and faculty and, more importantly, as a general resource for identifying, developing, and coordinating programs: the T&C initiative, OWL program, and “Dialogues” project were all conceived and generated directly out of this position.

CONCLUSION

The diverse and yet complementary range of techno-humanistic collaborative efforts described in this paper is only a partial accounting of activities between humanist and engineering educators at the University of Colorado at Boulder. We plan to
follow up these and other such efforts with an outcome analysis and subsequent formal integration of these initiatives into the engineering curriculum. We also envision collaboration between CEAS and humanities and social sciences faculty in the areas of research, joint proposals, and co-advising.

It is our hope that many universities and technical schools have similar innovative and truly multidisciplinary efforts. We would like to assemble as many accounts of such programs as possible, and welcome other efforts to do so as well. Obviously, a single solution to the problems facing 21st century engineering is not likely to be developed. Rather, in-house, collaborative, and local networking efforts are the stuff that will lead to best practices and a growing effectiveness in defining and educating the Humanistic Engineer. At issue are many of the fundamental human questions that remind us not only how far we have come, but how much work still needs to be done for humanity to realize its full potential.

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REFERENCES


[12] Spitzer, R., email correspondence, 9 April 2002


[14] Gorman, M. E., email correspondence, 8 April 2002


