Making Social Sciences Relevant To Engineering Students: The Greenfield Coalition Experience

Dylan P. Dizon
Lawrence Technological University, Michigan, USA http://www.ltu.edu
telephone/fax- 517-339-9558, e-mail dizon@tcimet.net

Abstract: The impetus for tremendous gains in Engineering Education in the United States could be traced to the Engineering Coalitions Program initiated by the National Science Foundation. An example of this effort is the Greenfield Coalition, a group of four Universities working with automobile manufacturers to develop an integrated curriculum that reflects industry needs and professional standards for engineers.

A unique feature of the Greenfield Coalition is the collaboration with a Teaching Factory, Focus:HOPE, where all the students are full-time workers at a Precision Machining enterprise producing car parts for GM, Ford, Daimler-Chrysler and their suppliers. This "Factory as a Campus" environment combines state-of-the-art educational technology (Distance Learning, Interactive TV, Online Courses) and time-tested tutoring, mentoring, and lectures. The educational offering leads to Bachelor Degrees in Manufacturing Engineering and Manufacturing Technology.

This paper will focus on an innovative approach in integrating the social sciences into this engineering curriculum that makes it relevant and engaging. The most significant change was to combine Psychology and Sociology into a single course. This was a difficult step because the accelerated program of the Greenfield Coalition condensed the course to half the contact hours of the regular curriculum. The paper will discuss the various issues the author faced as a curriculum developer and course instructor.

The Behavioral Sciences in Manufacturing Course, now in its fourth year, has received excellent responses from the Industry Review Team, from both academic and production staff, and, most importantly, from the students.

The presentation will include a demonstration of the Online Course, and student projects reflecting the integration of social science principles in engineering practice and the workplace.

Keywords: Sociology, Psychology, experiential learning, coalitions

1. About the Greenfield Coalition

Greenfield Coalition is an education-government-private sector collaboration to design and implement a new paradigm in engineering education, particularly in manufacturing. The Greenfield Mission is to prepare manufacturing engineers and engineering technologists who seeks, integrates, and applies deep knowledge to create and implement innovative product realization processes which provide global opportunities and competitive advantage for the manufacturing enterprise.

This Coalition is part of a nation-wide effort to bring engineering education in line with the dramatic changes occuring in industry in the US and around the world. With the impetus coming from the government (specifically the National Science Foundation) and from industry, engineering education in the United States is undergoing fundamental changes in its premises, objectives, approaches and processes.

Greenfield Coalition's area of emphasis is preparing engineering professional for the automotive industry. The major actors in this Coalition are the engineering faculties of five American universities, four of which are in Michigan, the center of car manufacturing in the US. These universities work closely with corporate partners such as Daimler-Chrysler, Ford, General Motors, Detroit Diesel and Cincinnati Milacron, with input from professional organizations like the Society of Manufacturing Engineers,

The most significant feature of this Coalition is that all its activities is concentrated in a Teaching Factory , the Center For Advanced Technologies. Opened in 1993 by a private organization called FocusHOPE, the CAT integrates hands-on manufacturing training and academic learning within a production setting and educates

advanced manufacturing engineer-technologists. The leading-edge curriculum leads to a Bachelor of Science Degree in Manufacturing Engineering and Technology awarded through the partner universities.

The Greenfield Coalition is redefining college-level manufacturing engineering through innovative combinations of learning and experience. The integrated engineering experience produces a better qualified graduate who bring a powerful combination of intense theoretical preparation with the actual workplace experience of running precision machine tools. Industry benefits immediately because CAT candidates require minimum post-graduate training. This advanced paradigm allows the individual total immersion in manufacturing engineering.

Manufacturing training is continuous. Each day, eight hours are spent performing flexible machining contracts under the direction of experienced personnel. Another three hours are devoted to academic coursework, guided by engineering mentors from the university and industry partners. The innovative academic program is radically different from the traditional engineering program in a campus setting. All course offering have been broken down into one-credit hour modules, each module corresponding to coursework covered in fifteen to twenty-contact hours on campus. The Greenfield Approach, however, is not based on contact hours but on achieving learning objectives that can be measured by testing, presentations, projects, group activities and other means of demonstrating knowledge and competencies gained. Lectures have been minimized, with more use of group discussion and the use of self-paced learning resources utilizing the latest multimedia and internet-based tools.

. The Greenfield Coalition Program, therefore, provides the opportunity to acquire both a diploma and highly-sought technical skills. It is therefore not surprising that CAT graduates have been in demand by employers.

2. The Place of Social Sciences in Engineering Education

Social Sciences have not been considered essential components in an engineering degree program. In many campuses, they have been relegated to status of "filler" courses to complete minimum credit hour requirements for graduation. At best, they are optional courses to be taken with more difficult ones in a semester.

However, voices from the professional ranks and from industry are loudly crying for much stronger emphasis on these courses that helps individuals understand human behavior and be able to use this knowledge to become more effective individuals.

For example, the Accreditation Board for Engineering and Technology, in its ABET 2000 Criteria, listed 11 requirements for engineering graduates, including

- an ability to function in multi-disciplinary teams
- the broad education necessary to understand the impact of engineering solutions in a global and societal context
- a knowledge of contemporary issues

The Society of Manufacturing Engineers (SME), in its 1997 publication *"Manufacturing Education Plan Phase I Reports: Industry Identifies Competency Gaps Among Newly Hired Engineering Graduates"*, included among the 14 major competency gaps lacking in engineering graduates hired by leading manufacturers including:

- Teamwork - including interpersonal relations, conflict resolution, understanding diversity, being a team member, and accountability
- Personal attributes - including leadership, sensitivity to others, professionalism, integrity, global awareness, the ability to both teach and learn from others, analytical skills, and consensus building

A government-funded project, the Michigan Virtual Automotive College (MVAC) on a survey to determine the training needs of the automotive industry. found that "People Skills" or "Soft Skills" such as team building, decision-making, and problem-solving, were high priority training areas for present and future employees of car manufacturers. These findings echo those of a number of previous industry surveys putting interpersonal skills as one of the major criteria in hiring decisions.

This concern led Greenfield Coalition to put the social sciences as one of the foundation curriculum areas. The Coalition also looked at completely new ways of looking at how the various social science disciplines could be organized and integrated with the other knowledge areas. One of the more bold moves was to combine Sociology and Psychology into one course. In most institutions, these courses were offered by separate departments that hardly interacted or had any awareness or interest in each other's programs. The experience in developing this radical concept of an integrated Psychology/Sociology curriculum and teaching it these past three years is the essence of this paper.

3. Making Social Sciences Relevant in a Manufacturing Setting

The challenge was enormous, given the Teaching Factory environment, where students are full-time workers, and where the emphasis is on how to connect the concepts, theories, and research that comprise the body of knowledge about human behavior with their daily lives at home and at work.

To make sure that this experiment does not compromise the academic integrity of the course offering, the class was assigned to two faculty members, one an Industrial Psychologist and one a Sociologist, both with Ph.D.'s in their respective fields.

With substantial funding support, the two faculty members were given a year to prepare for the course and develop learning resources students can access through the internet. The first course was offered in the Fall of 1997 and has been offered every semester since then. The average size of the classes is twelve students. Classes are scheduled in the afternoon at the end of an eight-hour work shift. They will have either one three-hour class or two one-and-a-half-hour classes.

To meet the challenge of keeping the stduents focused and engaged in the class, the following strategies were found to be valuable:

- Tight organization of topics into clusters of related ideas or issues ("modules") which they react to with essays that they present for group discussion. Students are provided research and reference materials online on the specific topics. A wide range of online resources are made available to them for further research. Students at the CAT have access to high-speed internet connections to facilitate research on the World Wide Web.
- Connect concepts and ideas to specific issues in their daily lives at home and at work; For example, to help engineering students understand the notion that the study of human behavior is a "hard science" like engineering, discussion focus on the similarities between the rigorous research methods and data analysis used by engineers and social scientists. Illustrations and examples are mostly drawn from their work place and typical urban neighborhoods. Social science statisticss became more meaningful to this group when shown the common basic procedures found in Statistical Process Control engineers use for Quality Control.
- Like a factory, a classroom can be made productive. Our students were more interested in producing written reports and research papers when these became part of Training Manuals which were widely disseminated (with some industrial partners like Ford requesting many copies for their plants) rather than just being termpapers written to satisfy the instructor.

4. Psychology/Sociology: Can they Mix?

While there is an area called Social Psychology, in practical terms, these two disciplines are distinct and, to some extent, opposite fields in the academic arena. Different departments, faculty, research emphasis, textbooks, courses. It was therefore a daring move to combine these two contrasting approaches to the study of human behavior. The combined course sought to provide an integrated framework for the understanding of the scientific, disciplined ways to answer fundamental questions about ourselves, what makes us tick, why we think, feel, react, and behave in certain ways which are more or less predictable, and how we could apply these knowledge to become better and more effective individuals and groups.

- learn, value and apply the scientific approach to understanding human behavior.
- be able to integrate the concepts and principles of the two behavioral sciences--psychology and sociology.
- incorporate and demonstrate 'critical thinking" that undergirds the scientific approach to human behavior.
- be able to apply in their personal lives and in the workplace principles of interpersonal relationships,.which is the development of self-awareness, communication skills, and problem solving skills, through the use of chat rooms, threaded discussion groups, email correspondence and group participatory activities provide a practical learning laboratory for the candidate.

5. Implementing the Course

The Course did not use any textbooks. Rather, students were offered a wide range of learning materias:

- Reading Materials--students will receive course packets containing the text materials from the Online Learning Modules. Interactive, multimedia modules (illustrations, demonstrations, online experiments and projects) need to be accessed online.
- Online Learning Modules--These web-based learning modules will be developed to provide interaction, remediation, collaboration, and high levels of learner engagement. Intecativity will be enhanced by the

application of the the "Learn by Doing" paradigm to ensure that as a part of the students learning experience, they practice concepts and principles covered in the courses in a real life environment. Practice sessions include hints that guide them towards the correct solution to a problem. Practice sessions also contain sample solutions. All practice sessions contain diagnostic and/or prescriptive feedback that reinforce learning and enables remedial learning.

- Online Resources, such as electronic mail for feedback (so candidates can talk to an expert when needed, frequently asked questions (FAQs) to satisfy common user queries, and a newsgroup so that studentss can post questions and problem-solve among themselves Studentss are expected to spend at least three hours per week during the term on reading, writing, and research for individual and group project activities.

- Face-to-Face Sessions--There will be 10 three-hour sessions devoted mostly to group discussion, individual and group presentations, hands-on demonstration and other experiential learning activities.

6. Learning Outcomes: measuring the effectiveness of this new way of offering social sciences to engineering students

The expectations for this course were high considering the value placed on knowledge and skills covered here by ABET, SME and employers. At a minimum, students must be able to demonstrate by the end of the ten sessions a deep understanding of the topics through:

- participation in discussions during class sessions. The instructor will take notes during the sessions which will be incorporated in a Session Report Form.
- papers and formal presentations during the sessions.
  There will be a Peer Review Form where the rest of the class will give scores to each presentation.
  This will be included in the Session Report Form.
- Group Projects done for each course by groups of 2-3 candidates and presented at the end of the course and/or placed into the website for independent review and scoring by readers.
- extensive use of Online Learning Modules. Each candidate's use of the web-based materials will be recorded.

Students were able to articulate the fundamental concepts of the behavioral sciences that are relevant to their careers in Engineering and Engineering Technology in presentations, group projects and written reports. They can analyze and critique assertions relying on professional and scientific standards in judging validity and reliability of data they receive.

Each student will have a Personal Portfolio of presentations, reports, observations, group projects.

Groups developed Training Manuals (examples: "Anger Management and Conflict Resolution in the Workplace", "Making Sense of Quality: a Primer"; "How to Plan, Conduct, and Evaluate Effective Meetings", "Barriers to Implementing Health and Safety Standards in the Workplace").

7. Conclusion

The four years of experience in offering this unique introductory social science course integrating two disparate, often conflicting, disciplines into one compact, on-site, application-oriented, experiential learning for engineering students give us confidence in the validity and value of this approach. Standard criteria such as student attendance, dropout rates, test scores, quality of response, participation and production--all of these support our contentions. The most visible, but not easily measureable, is the heightened interest of the students in the concepts, ideas and methods they encountered in the study of human behavior.