Integrating Humanities and Engineering Technology Education in the Classroom: A Case Study

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Abstract

Historically, humanities education in engineering technology curricula has been governed by accreditation requirements. Students are required to take a certain number of hours of humanities and social science classes, which are generally not integrated with the rest of the curriculum.

In light of the ABET 2000 accreditation criteria, which focus on outcomes rather than on specific course requirements, we developed an experimental course that fully integrates instruction in both history and materials science. Titled "Materials in the Modern World," the course was offered in the Spring of 2000. This paper describes the development of the course, its advantages and disadvantages, and our plans to use what we learned to offer similar courses in the future.

I. Introduction

Humanities instruction has often been an afterthought in engineering technology education. While required by accreditation agencies, humanities courses typically are taught by faculty outside of engineering technology programs and are not integrated with engineering courses. Some schools have sought to deal with this situation by offering courses in the history of technology or Science, Technology, and Society (STS), with a humanities focus on technology. However, full integration of humanities and engineering technology courses has been rare.

In light of the outcomes-based orientation of the ABET 2000 accreditation criteria, we felt that we finally had the flexibility to integrate humanities instruction more fully into the engineering technology curriculum. We decided to develop a course that would expose both engineering technology and humanities students to technical concepts. Our hope was that this course would serve as a test for our ideas and, if successful, would be a model for changing the way humanities is taught within the engineering technology curriculum.

II. Goals

We set the following goals for our course:

1) Linkage of historical and technical material for engineering technology students
2) Exposure of non-engineering students to technical concepts
3) Improvement of communication skills for all students

III. Planning

Planning for our course took into account a number of factors, most notably instructor background and experience, the target audience for the course, the overall course structure, and assessment.

Dr. Clark's education and teaching experience is in the history of technology, with a particular focus on the 19th and 20th centuries. Dr. McMurchie's background and teaching experience is in manufacturing engineering technology, with a particular focus on materials science. We had known each other for three years when we began planning the course, but had never taught together before. Given our interests, we decided that a course that focused on the impact of changes in materials on society over time would allow both of us to play to our strengths. A list of topics covered is included in the appendix.

We gave careful consideration to what our target audience would be. We decided to offer the class as a lower division elective (with no prerequisites) so as to appeal to the broadest audience possible. We also decided to offer the class to both engineering and non-engineering students. We offered the class as a 3 credit seminar, meeting three times a week.

The most significant innovation, from our point of view, was our decision to fully integrate humanities and technology instruction. Our plan was that both of us would be present in the classroom for all class sessions, though the exact structure of class sessions was not worked out in advance.

To assess the strengths and failures of the class, we decided to give all students an initial inventory questionnaire, and both a mid-term and exit assessment of student satisfaction. During the course of the term we decided to add a focus-group discussion with all students during the ninth week to obtain additional feedback.

IV. Implementation

After obtaining permission to offer the course from our administration, we both recruited students. We found it was essential to reach out to students and explain to them personally what the class was about, since it was unlike others previously taught at our institution.

Our plan to teach cooperatively worked out well. We typically alternated lecture presentations in short segments (five to ten minutes), or engaged one another in Socratic question and answer dialogues. We both answered student questions and conducted discussions.

In addition to lecture and discussion sessions, we also had a number of hands-on exercises. A good example of these was a bridge design contest, where we paired engineering students with humanities students. Each two-person team built a small bridge using materials we provided, and prepared a report describing the bridge and why it was the most suitable design. We then tested the bridges to destruction in class, and awarded prizes to the teams with the best looking and the strongest bridges.

We also used humor to get our points across. Dr. Clark appeared once in a toga as the Scottish-Greek philosopher "Harry Stotle," giving him the chance to discuss classic theories of motion in a badly-done Scottish accent. Similarly, Dr. McMurchie appeared as "Vinny (Mr. Gravity) Galileo," a slightly shady character who liked to drop things off of high buildings and see what happened. These and other humorous techniques kept the students attentive during what otherwise would have been dry discussions of theoretical matters.

Examinations were conventional, but oriented towards written expression to help students develop their communications skills. Regular written assignments on assigned readings constituted the homework portion of the class, and a mid-term and final examination (both take-home essays) the major test instruments.

V. Results

From the point of view of the students, the class was very successful. We conducted written surveys at mid-term and just before the final examination, and an open class discussion during the last day of class. Feedback from all three sources indicated that students enjoyed the class a great deal. Students cited three factors that they felt improved the course. First, having two instructors in the classroom, so that material was presented from two perspectives and was thus easier to grasp. Second, the hands-on projects, particularly the bridge-building project. Third, the humor, such as the "Harry Stotle" impersonation, that made instructional material more memorable

A significant majority of students specifically requested that more courses with this structure be taught in the future.

From our point of view as well, the course was also a success. The format made teaching easier, since each of us could rely on the other for help in preparation and lecture delivery. We also enjoyed the higher than normal level of student interest and class participation. We had no trouble getting students to participate, and we developed a positive rapport with everyone. We also noticed that students did careful and extensive work in their written assignments, and showed a marked increase in the quality of their writing over the course of the class.

The only difficulty we experienced was the limited time available to cover all of the topics we wished to. We decided that future combined classes needed more hours per week to be successful.

VI. Future Plans

Based on our experience with this course, we will teach a similar course the following academic year. Students will receive credit for two existing courses: a freshman materials science course and a sophomore history course. However, instruction will be fully integrated over five lecture hours and three lab hours per week. Most students will be freshman Manufacturing Engineering Technology (MET) students, but the course will also be open to other students as well. If the class is successful, we hope to make it a permanent part of the MET curriculum.

Our institution is currently exploring a major restructuring of general education requirements. We also hope that courses similar to ours will be integrated into the new curriculum structure.

Appendix - Course Syllabus

ENGT 207: Materials in the Modern World
HIST 207: Materials in the Modern World

MWF 11:30-12:20, SO 476

An introduction to modern materials intended for freshmen and sophomores. The course is taught in a non-mathematical format with a focus on the historical and social context of materials use and development. The first half of the course introduces various fundamental scientific and engineering principles. In the second half we will learn how these principles can be applied to the classification and study of materials in the real world. Engineering majors should enroll in HIST 207, non-engineering majors in ENGT 207. Prerequisites: none.

Course Objectives

At the completion of this course, students should be able to:

1. Describe in general terms the origins of the Scientific Revolution
2. Describe Newtonian mechanics in non-mathematical terms
3. Define terms used in the study of statics (tension, compression, and moment) and explain their historical origins
4. Define friction, fatigue, and vibration, and briefly describe in quantitative terms how they influence the behavior of materials
5. Describe the system used to classify materials
6. Describe in general terms the differences between at least three classes of materials
7. Describe in general terms the impact of the industrial revolution on the types materials used for construction and manufacturing

Readings:

Reserve material in Library

Class Schedule

Week 1 Introduction and Overview
- Newton's Laws: Force and Moment
  - -The structure of the human body and how it moves

Week 2 Statics
- -Bending Beams
- -House Trusses
- -Bridges and How to Build Them

Week 3 Friction, Adhesion and Cohesion
- -Walking Around
- -The Inclined Plane: Galileo
- -Ball and Feather: Air and Vacuum

Week 4 Fatigue
- Vibration & Harmonics
- Surface Engineering
  - -Paper Clips and Railroads
  - -Pianos, Guitars, and Loudspeakers

Week 5 Classification: Allotropic Materials
"The Many Faces of Carbon"

Week 6 Classification: Metals
"Out of the Fiery Furnace: Iron and Steel"

Week 7 Classification: Polymers
"I'm Rubber, You're Glue"

Week 8 Classification: Ceramics
"Some Clever Phrase"

Week 9 Classification: Composites
"United We Stand, Divided We Fall"

Week 10 Conclusion and Review

MARK CLARK
Mark Clark is an Associate Professor of History at the Oregon Institute of Technology. He was a Fulbright Research Fellow at the University of Aarhus, Denmark in 1997, and continues to work closely with a number of Danish scholars on the history of magnetic recording. Dr. Clark received a B.S. degree in Mechanical Engineering from Rice University in 1984 and a Ph.D. in the History of Technology from the University of Delaware in 1992.

DONALD MCMURCHIE
Donald McMurchie is an Associate Professor of Manufacturing Engineering Technology at the Oregon Institute of Technology. He is currently involved in OIT's distance education efforts and the integration of humanities instruction into the engineering curriculum. Dr. McMurchie received a B.S. degree in Manufacturing Technology from Oregon Institute of Technology in 1991 and a Ph.D. in Materials Science and Engineering from the Oregon Graduate Institute of Science and Technology in 1996.