Engineering America

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Abstract

Technological developments in the 19th and 20th centuries made America a modern, industrial nation. These engineered objects changed the way Americans saw their country and themselves. In a course designed for American Studies and other liberal arts students at Lafayette College, this complex, interdisciplinary narrative is investigated. Students learn about these technological developments, in historical and societal context; study the scientific principles behind their operation and the engineering design process involved in their refinement; perform hands-on experiments to help them understand each innovation in engineering terms; analyze the reflections of these breakthroughs in literature, art, and other societal products; and gain an understanding of the complex interrelationship of science, technology, and society.

Introduction

Introducing non-engineering students to engineering methods, values, accomplishments and challenges enhances a liberal arts education and better prepares non-engineering students for careers in law, medicine, policy, or other fields. Courses developed for non-engineering students at Princeton University [1], Hope College [2], and other institutions have proven to be effective.

In his popular course and in his book, David Billington highlights the evidence of technological progress in two Thomas Cole paintings of a Hudson River landscape. In the first painting, the landscape is forbidding, wild and hostile; but by the time a few decades later Cole painted the second work, it has become a welcoming spot for a picnic. In the intervening years, the inventions of the steamboat and the railroad opened up this bit of landscape to Americans.

However, Thomas Cole and his fellow Hudson River Valley school artists had a complex relationship to technology. Cole is careful to include at least one savagely jagged tree stump in the foreground of most of his works, not wanting us to focus on the joy and comfort of the picnickers without awareness of the costs and unintended impacts of the "machine in the garden."

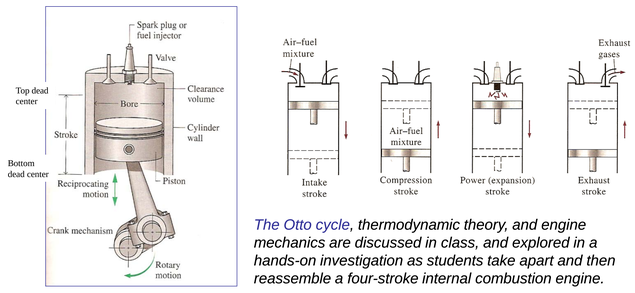
It is the goal of the course designed and implemented at Lafayette College to discuss the technologies themselves, and to analyze the response to these advances in art, music, and literature. Because of the interdisciplinary educational goals of the course, it is cross-listed in Engineering Science and American Studies, as ES/AMS 252: Engineering America,

Clockwise from top left: 1898; 1918; 1925; 1933; 1939; 1957; 1969; 2000.

How stuff works and how it made America modern

Innovators such as Henry Ford were products of the society and times in which they lived; they created objects and processes in this context; and American artists and writers responded to these technological objects in their own work.

For example, the automobile made more of the country accessible; and offered new perspectives to Fitzgerald, Stieglitz, Steinbeck, Kerouac, Oldenburg, and Frank. In AMS 252/ES 252, "Engineering America," the science underlying Ford's innovation, the political aspects of his success, and these cultural reverberations are each important parts of the story and the discussion.



The Otto cycle, thermodynamic theory, and engine mechanics are discussed in class, and explored in a hands-on investigation as students take apart and then reassemble a four-stroke internal combustion engine.

Implementation

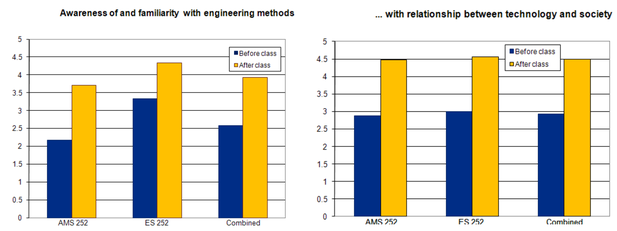
The technologies addressed, in roughly chronological order of their introduction, are:

- Steamboats
- Railroads
- Electricity
- Automobiles
- Airplanes
- Rockets
- Computers

Class lectures present the scientific fundamentals and engineering development history; class discussions delve into the students' assigned reading and the attitudes toward technology reflected in various art forms. The course reading list is a mixture of primary literature and historical perspectives. Students write ten essays and four technical reports during the semester, complete one midterm exam, and produce a research paper applying the course's interdisciplinary methods to a technology of their own choosing.

Assessment

Students were surveyed before and after the course about their experience and about which instructional methods they had found most effective. Their responses were analyzed separately for **engineering** students enrolled in ES 252 and **non-engineering** students enrolled in AMS 252. (Although no restrictions were placed on registration, no liberal arts students chose to enroll in ES 252.) A representative survey result is shown below, illustrating the improvement students felt the course had caused in their "awareness of and familiarity with" both engineering methods and the interrelationship of technology and society.



Acknowledgments

This work has been supported by a Lafayette College Fund for Faculty Innovation grant.

References: [1] Billington, e.g. NAE/CASEE Miller Symposium, San Diego, CA, 2006 ; [2] Krupczak, e.g. ASEE/IEEE FIE 2007; and [3] Hertzberg & Sweetman, e.g. ASEE 2004 and *Journal of Visualization* 2005. *Image credits: far left,* Thomas Cole, 1828 and 1846; *center,* Alfred Stieglitz, 1933; Claes Oldenburg, 1969; *at right,* US Highway Map, Department of Transportation, 2010.

Questions? Contact rossmanj@lafayette.edu