

Engineering and Technology Experience for Liberal Arts Students at
Lake Superior State University

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Abstract

Lake Superior State University, like other universities around the nation, has recognized the need for a new and improved general education component in its curriculum to take the University into the Twenty-First Century. One component of this change has been to expose liberal arts students to engineering and technology. This paper describes two such courses that fall in this category and fulfill the new general education requirements.

Introduction

For the third time this century there is a revival of general education¹. This revival of general education is resulting in an increase in both the quantity and quality of general education. The changes are more than breadth and depth, however, as they encompass several elements including the integration of ideas from a variety of fields². Many new programs also include a fresh look at science education and the use of active-learning methods of instruction.

Consistent with this national trend, Lake Superior State University initiated a general education revision process four years ago. This process involved a committee of administrators and faculty that started by surveying the faculty regarding their attitude towards general education. The committee then proceeded to define a mission statement for general education, the desired outcomes of the general education curricula, and a structure for the new program. With the work of this original committee completed, a new General Education Committee is now responsible for approving courses for general education credit and overseeing the general education program.

During the revision process faculty were encouraged to develop new innovative courses for general education. Two new courses that evolved during this process are *Exploring Technology* (ET 100) and *The Universe, Earth, and Humans* (NS100). These courses qualify as electives for the new general education structure that requires both a freshmen-level, integrated natural/social science elective and a science or science/technology elective.



The *Exploring Technology* (ET100) course was developed with the help of a course and curriculum development grant from the National Science Foundation. This course is team-taught by six faculty members from the School of Engineering Technology and Mathematics, and focuses on the application of science in modern technology. Pre-technology students take the course as a free elective, and non-majors use the course to fulfill a natural science elective⁴.

The Universe, Earth, and Humans (NS100) course was offered as a natural science elective to all students in the university. The course was designed to track the birth of the Universe, its evolution, the birth of our Earth, its geologic evolution, the origin of life, the evolution of humans, our current status, and the future. Six faculty members were selected from departments such as Physics, Chemistry, Geology, Biology, History and Engineering based on their expertise of the different topics outlined above.

Both courses provide liberal arts students with an opportunity to experience engineering and technology. This outreach of engineering faculty to non-majors is encouraged by an ASEE report that recommends helping non-engineering majors better understand the importance and relevance of technology in their lives.⁵ The remainder of this paper will first discuss the students' motivation and expectations for taking the courses. It will then briefly outline the content of the courses, and review the effect of the courses on the students.

Students' Expectations From The Courses

This section will explore some of the expectations and motivation of the liberal arts students who take these courses. With both courses being new, and therefore not listed in a current university catalog, it was necessary to advertise their existence to both the students and to all faculty advisors, especially those who advise freshmen. Both of the courses were advertised as a fairly non-technical coverage of topics with the intent of making them highly attractive to non-engineering and non-science students. It was recognized that because both courses were new and significantly different from other engineering and science courses, the students would need an incentive, and hence both courses were declared as a four credit science elective under the general education criterion.

The ET100 course was advertised as an opportunity for students to explore modern technology. It was advertised as a survey-of-technology course that would provide the students with an opportunity to learn about and use computers, electronics, mechanical systems, and robots. The NS100 course was advertised as a journey through time, right from the start of time to the unknown, but exciting, future. This would be an opportunity for all students to learn about the universe, earth, humans, modern technology, and get an insight into the future.

Most of the students who took the courses did so upon the recommendation of their faculty advisor. The motivation for most liberal arts students was based on the need for a general education science elective, however some students had room for the course and wanted to learn more about the topics. Many of the students had not taken similar courses before and were unsure of what to expect. As will be described later, the students found that the courses were very beneficial and improved their understanding of engineering and its impact on society.



Students' Experiences During The Courses

This section describes the learning experiences of the students while they were taking these courses. Both courses were structured as team-taught and modular courses. This format allowed the students to benefit from the special skills and enthusiasm of several instructors.

ETIOO Exploring Technology

The ET 100 course was structured as 14, one-week modules. The first module provided the students with an orientation to engineering technology. Special "ice-breaker" activities were included in this module to build a sense of community and help entering first-year students adjust to college.^b The second module covered an introduction to computers. The remaining twelve modules were equally divided among electrical, mechanical, and automated manufacturing topics. The students assembled and tested electronics circuits; designed, made, and tested a small mechanical part; and programmed robots and operated an automated manufacturing system. The course was taught by six faculty and used six different laboratories.

The course provided the students with an engineer's view of engineering problem solving. It included the engineering approach to the design of products and processes, engineering heuristics, and discussions of engineering ethics. The course included structured, engaging laboratory sessions, and this experiential learning aspect of the course was particularly well received by the students.

Throughout the course the students worked with computers, kept a weekly journal, and had both communications and problem-solving assignments. All assignments were structured with the intent of providing the students with an exposure to the field of engineering. The students were exposed to scientific and engineering methods and processes, and investigated relationships between engineering and other fields.

NS100 The Universe, Earth, and Humans

The NS100 course was divided into six modules. The course kicked off with the Big Bang Theory, and led to an understanding of the birth of stars, and our own solar system. The second phase of the course covered the origin of the basic molecules, and finished off with the birth of a simple cell. It also defined the requirements for the formation and existence of life. The third phase dealt with structure of the earth, and its evolution with time. The students were introduced to plate tectonics and their role in the formation of the land masses. The fourth phase dealt with plant and animal evolution, and students were introduced to Darwin's theory of evolution. The fifth phase brought the students through their journey of time to human origin and development. It traced the evolution of humans right up till the industrial revolution. The sixth and final phase took the students from the industrial revolution, through the amazing technological marvels of today to the uncertain, but exciting, future. This phase was inter-spaced with numerous discussions on ethics in science as well as a possible society of tomorrow that may have humans living with robots, androids and maybe even aliens. The last part of the course used numerous video clips from *Star Trek*, *RoboCop*, Stephen Hawking's *History of Time*, etc. to spark lively discussions.

All of the six instructors involved in the course agreed that it was a great success in terms of student enrollment and in class participation. All the students, liberal arts and science, took an active part in all the discussions. A common comment by the instructors was that the liberal arts students always had imaginative ideas in the discussions, and were never limited or intimidated by the fact that they were non-science/engineering students in a typical science/engineering course.



Effect Of The Courses On The Students

This section will describe the course outcomes from a student perspective. Both courses were well received by the students. The courses helped to improve the students' awareness and appreciation of engineering and the role of engineering in society.

A review of the assessment instruments for ET100 showed that the students enjoyed the course content and the active-learning structure. They appreciated the opportunity to learn something entirely new in a non-threatening, small-group environment. The students commented on how they gained familiarity and confidence with modern technology, and also became more aware of how engineering affects their lives. All of the students commented on the sense of community within the class, and the ability of the course to help first-year students adapt to college. The experiential nature of the labs was a unique experience for many of the students. The students also felt that the faculty were not only approachable, but a partner in their success. Some of the comments about the course were:

“We didn't learn about engineering - we experienced it.”

“The class I looked forward to the most.”

“I knew everyone in ET100 a lot better than any other class. ”

As far as the NS100 course is concerned, all the students agreed that it was a “fun” and “stimulating” course. The liberal arts students commented on the fact that science and technology had never been as much fun as it was in this course. Some of the comments about the engineering and technology part of the course were:

“I didn't realize until now how much fun robots can be.”

“I will now look at *Star Trek* with an increased knowledge and understanding. Some of the things now actually make sense. ”

“I never realized how closely we all are linked to the technological inventions in our every day lives. ”

“I am actually considering a major in Robotics and Artificial Intelligence. ”

“I was very impressed by the discussion on ethics in engineering, and how we must all be very careful with the use of new knowledge. ”

Conclusions

This paper has presented two courses that are being team taught at LSSU. Both of these courses offer engineering and technology components to liberal arts students, and are part of the new general education requirements that are taking shape at LSSU. The response from all the students has been extremely encouraging in terms of enrollment and class participation. Both courses offer a fairly non-technical coverage of the topics, and endeavor to capture “the child that loves to listen and be amazed by the wonders of nature” in all the students. The courses were also extremely rewarding for the faculty involved in the teaching of the courses as it gave them a chance to relate their field of interest in a much broader picture that was presented to the students. Both of the courses make no distinctions between science/engineering and liberal arts students, and in fact encourage interaction between the students from different disciplines by having them complete lab and home assignments in small groups. In conclusion, the faculty and students showed a lot of enthusiasm for the courses and felt them to be a rewarding experience.



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