Abstract — The objective of this project was to conduct and report on experiments to determine whether industrial case studies, web-based course materials, and communication enhanced by the Internet can improve the proficiency of student learning in engineering economy.

Index Terms — Engineering Economics, Virtual Classroom, Web-based Instruction, Industrial Case Studies.

OVERVIEW

This paper reports on a project whose focus has been to create and evaluate the effectiveness of a virtual classroom for teaching the economics of engineering design. This project has been a collaborative effort between two universities, Virginia Tech and the University of Massachusetts at Amherst, and industry, GE Industrial Systems. The motivation behind this project was that as decision-makers, engineers must be knowledgeable and competent in multiple aspects of design. A major challenge is to increase student competency in the economic elements that are such a critical part of the engineering process.

The intent of the virtual classroom project was to develop and assess new materials and methods that would go beyond the “traditional” analytical approach to teaching the subject wherein considerable attention is paid to teaching the mechanics of techniques to an approach that engages students with more active learning. As part of two experiments to assess the effectiveness of a virtual classroom, various electronic materials were developed and include six modules. The first five modules are topical in content with examples, quizzes, and frequently asked questions. These modules include:

- The Business/Engineering Environment
- Principles of Design and Systems Analysis
- Cost Estimating Techniques
- Time Value of Money and Comparison of Alternatives
- Consideration of Risk and Uncertainty.

The sixth module, Current Industrial Problems, includes resources that enable student teams to work with industry on open-ended real problems. Industry partners interacted with students through email, a message board, and recorded audio/video of classroom guest lectures directly related to industry problems. Guidance in project management, teaming, and other resources related to projects are also included. The capacity for posting university specific information such as syllabi, announcements, et cetera, is also provided.

RESULTS AND CONCLUSIONS

In the first experiment, it was found that the industry problems resulted in significant improvements in student learning (as measured by the composite score in the course) at the \( \alpha = 0.05 \) level. In the second experiment, the Internet supported course materials were assessed to determine whether learning was affected. Although students in the Internet supported course had higher scores (and grades) than students in the control group, this difference in learning was not significant at the \( \alpha = 0.05 \) level. Overall, the experiments yielded important insights about how students learn in a team based setting and in a course heavily supplemented with Internet usage. Refer to the web site located at http://mielsvr2.ecs.umass.edu/virtual_econ/ for additional information.

As envisioned, the virtual classroom will remain an open resource on the web that can be used by any university in teaching engineering economics. It is also anticipated that it will serve as a continuing resource that students can return to regularly throughout their education and serve as a resource for practicing professionals. Farther reaching, this research is an integral part of a longer-term and broader vision to build an undergraduate “National Technological University” (NTU) for selected core courses in the engineering curriculum. It is anticipated that through computer-based learning methods utilized at the undergraduate level, higher quality core engineering courses can be offered to more students in a very cost-effective manner.

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