

Transfer Facilitation for Engineering Students Through Distance Education

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Abstract:

Data gathered at The University of Tennessee (UT) show that most students who transfer into engineering programs from two-year pre-engineering programs have not had all of the required prerequisite classes to start their junior year. This causes the student's average graduation time to increase by two semesters. A partnership between UT and the University of Oklahoma are developing three common prerequisite engineering courses to be delivered over the Internet to Community College students to alleviate this unnecessary delay.

1. Introduction

In recent years, pre-engineering programs have been developed across America in Community Colleges, Junior Colleges and Liberal Arts Colleges. These institutions prepare students for transfer to engineering degree programs in the 320 or so U.S. four-year universities with accredited engineering programs. This transfer is usually accomplished after the sophomore year and is often facilitated by an articulation agreement between the pre-engineering institution and the four-year university. The promise of lower education costs and greater personal convenience for students participating in these joint programs has not been fully realized because of the unavailability of certain essential, specialized courses in the pre-engineering programs. Because of this problem, some students may abandon their desired engineering curricula or spend extra time earning their degrees.

Engineering curricula are highly structured and vertically integrated, with each course building on prerequisite courses in mathematics, science and/or earlier engineering courses. In most universities, engineering curricula require major-field courses and out-of-discipline engineering service courses at the sophomore level. It is not cost-effective for pre-engineering programs to offer the specialized, sophomore-level engineering courses needed because the number of students involved is too small at any single institution. Distance education provides a means to serve these students and eliminate a major barrier to the successful completion of an engineering degree program. Distance education providers can serve these students and achieve adequate enrollments by attracting students from throughout their service region or the nation.

The pre-engineering programs in the US are already providing large numbers of transfer students to engineering programs. An ASEE report [1] stated that in 1998, 34.6% of new engineering students were transfer students. From this and other information, we estimate that about one in five junior level engineering students (15,300 students annually) in US universities transferred as junior-level students and that about 13,000 of these students go on to earn engineering degrees every year. Data at The University of Tennessee show that students who transfer to the University as Juniors (60 semester hours of transfer credit) require more time to graduate than

students who earn all of their credits at the University. On the average, students who transfer as juniors require two semesters more (total) than the time spent by those who earn all of their credits at the University. If these students could complete the prerequisites before transferring, they could graduate one year earlier and earn an additional year's salary. At an average salary of \$38,000, the advantage to the U.S. economy would be 500 million dollars a year. If only a fraction of these transfer students make use of the opportunities provided through distance education, the payoff will be substantial making the investment worthwhile.

Approximately fifteen classes have been identified as typical prerequisites for junior level engineering study that are not offered in pre-engineering programs. Most of these courses are fairly specialized and do not draw sufficient enrollments to make their offering cost effective at most pre-engineering institutions. Others like Statics and Dynamics are common, but do not have sufficient enrollment to teach each semester or year at most community colleges.

Objectives

The National Science Foundation has recently funded a project to develop and deliver several Internet-based freshman and sophomore level engineering courses through a partnership between The University of Tennessee (UT), The University of Oklahoma (OU) and area community colleges such as the Knoxville-based Pellissippi State Technical Community College (PSTCC). Of the fifteen courses identified, three courses are being developed through this grant. Additional resources are currently being sought to develop the remaining courses. The long-term goal is to facilitate the transfer of students from pre-engineering programs by developing and offering the entire set of prerequisite classes to pre-engineering students throughout the United States, resulting in the national availability of web-delivered courses to meet a majority of the prerequisite needs.

2. Course Development

The model identified for course development merges several technologies to meet the course delivery objectives. It integrates a phased development methodology to produce highly interactive animated modules designed to engage the student in an active learning process. The University of Tennessee's Innovative Technology Center, Outreach and Continuing Education Division, Center for Advanced Educational Technology, and College of Engineering faculty have significant experience in developing interactive web-based courses [2, 3]. At the University of Oklahoma, the College of Engineering Media Laboratory is headed Dr. Kurt Gramoll who has been involved in web-based, asynchronous course delivery and training for close to ten years [4, 5, 6]. The synergistic combination of these two institutions produces a team of educational professionals with the resources, experience, and desire to successfully meet the objectives.

At OU, Statics and Dynamics have been developed as initial test cases for additional course development. These two courses are located at www.eCourses.ou.edu and are open for others to view and use. The eCourses web portal contains course content (an eBook) similar to a textbook that is viewed online. The eBook uses hundreds of simulations and animations to help students grasp technical concepts. Other resources for the students include Flash-based lectures for the full course. These are 8-12 minute mini-lectures from actual classroom lectures that present a single concept or example. Since they are done in Flash, they have small file sizes and can be scaled for easy viewing. There are also over a thousand online homework problems that can be assigned to the students. The assigned problems can also be graded online.

Each course at UT will be subdivided into a series of modules that address a limited number of the course learning objectives. Modules may include multimedia introduction to the topic; interactive learning exercises, in which students complete problems and receive immediate

feedback for error correction; a summary video clip discussing conceptual implications of problem solutions; opportunity for students to complete new exercises in areas where they still feel uncomfortable; on-line diagnostic tests, with immediate feedback; and summative tests for certification of learning objective competencies. Modules will be completed in sequence; students must demonstrate achievement of the learning objectives of a given module before proceeding to a subsequent module and must complete all specified modules to receive credit for a course.

In addition to course content, course tools, such as collaboration drawing tools and interactive online lecture tools are being developed to permit student-to-student and student-to-instructor interaction. These tools will include video, audio, and CAD-like drawing capabilities. It is hoped that these online collaboration tools will allow constructive dialog similar that students experience with traditional lectures and face-to-face office hours.

An online diagnostic test system that will allow customized responses to address common errors is also under development. At present, it is envisioned that any summative online tests will be administered in a proctored environment to confirm test-takers' identities and adherence to test rules.

3. Role of the Community Colleges

The community colleges, with Pellissippi State Technical Community College (PSTCC) in the lead role, will handle integration of the new distance education offerings with standard curricula. PSTCC will interact with other community colleges in Tennessee and Oklahoma, as well as the two four-year university partners. The community colleges will perform the following functions:

- Provide mentoring and support to participating students to combat the poor retention sometimes encountered in distance education courses. This activity will be carried out during the three-year project. An assessment will be made of the need for continuing this activity after the project.
- Evaluate the desirability and practicality of delivering the courses via distance education themselves. Participation by distance education students outside of their normal service area would overcome the limitations imposed by low enrollments.
- Adapt appropriate modules in the pre-engineering courses for use in their technology programs. This side benefit is viewed as important leveraging of the project's accomplishments.
- Modify the pre-engineering curricula as appropriate to accommodate the new distance education courses.
- Play a significant role in evaluation and assessment activities, including formative evaluation of course materials as they are developed.

4. Current Status

The current grant is providing funding for the development of Chemical Engineering Fundamentals (ChE 200) at UT, and Statics (ENGR 2113) and Dynamics (AME 2533) at The University of Oklahoma. Development of the Statics class was previously underway which allowed the web-based materials to be used to supplement the conventional Statics course taught by faculty at PSTCC during the Fall 2002 semester. This provided the community college faculty and students with experience using the on-line materials and prompted several improvements.

A pilot program is planned for the Spring 2003 semester at PSTCC. Students enrolled in their Statics class will be divided into two groups. One group will complete the conventional course with the other group taking the DE format course. During this pilot program, a PSTCC faculty member will be available to assist the students, proctor tests, and provide feedback for course

improvements. This course will be delivered in an asynchronous mode but the students will complete the course assignments and interactive exercises in time-step with the syllabus.

5. Concluding Remarks

Several web-based courses are being developed and will be offered to students throughout the nation and abroad. The courses are normally needed as prerequisites to begin the engineering curricula in the junior year. The availability of these courses will assist the transfer of engineering students from community colleges to accredited four-year engineering institutions. The results will include the timely completion of engineering degrees and will assist to serve the country's engineering workforce needs.

6. Acknowledgments

This project is funded by the National Science Foundation, Division of Engineering Education and Centers, through the Engineering Education Program grant number 0212224.

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