Engineering Design Graphics Across the Atlantic – An Experience Using Asynchronous and Synchronous Technology

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Abstract

This paper describes an experience using a combination of asynchronous and synchronous technology to deliver an introductory Engineering Design Graphics course to a Lawrence Tech student participating in LTU’s Global Engineering program in Germany. During the Fall 2003 semester a Lawrence Tech student required an Engineering Design Graphics course that was not offered at the German partner university. As a pilot project, this American student located in Germany was allowed to participate in an Engineering Design Graphics course being taught in Southfield, Michigan during the Fall 2003. The author used a combination of e-mail, screen capture animations, Gradepoint, and Blackboard software to include this student in lectures, assignments, and projects. Because of a 6 hour time zone difference between Germany and Michigan, a combination of asynchronous and synchronous methods were used to facilitate two way communication between the student and instructor. This paper discusses the results, challenges, and opportunities for using distance education technology to deliver an Engineering Design Graphics course based upon this pilot experience.

I. Background

Lawrence Technological University, a private undergraduate and graduate institution located in the center of the Detroit Metropolitan Area, has an enrollment of nearly 5,000 students in day and evening degree programs and continuing education/professional development programs. Lawrence Tech has been a dynamic partner to the Detroit area’s engineering, manufacturing, and automotive industries for nearly 70 years.

Engineering, technology, and advanced manufacturing are becoming increasingly global. Nearly every technical product is designed, engineered, and/or manufacturing globally. At some point in their career, most of today’s engineering graduates will likely be working on projects that require interfacing with engineers in other countries. In Oakland County, the home of Lawrence Tech, there are currently over 130 German owned companies.

Recognizing the growing need for engineering graduates with a global perspective and experience, LTU created the undergraduate Global Engineering program in 2002. Lawrence Tech’s Global Engineering program requires both a study abroad component and an international engineering co-op or internship component.

Lawrence Tech has partnered with three universities (German Fachhochschule, FH – Universities of Applied Science) located in the Stuttgart region of Germany. LTU’s German partners have programs similar to those at Lawrence Tech, applied engineering with an automotive emphasis. The partner institutions offer English language engineering courses satisfy the graduation requirements of the LTU students. Due to limited
course offerings in English, LTU students occasionally find that they need a course that is not being offered at one of its German partner institutions.

This was the case during the fall 2003 semester for one LTU Mechanical Engineering student. The student was scheduled to take EME 2012, Mechanical Engineering Design Graphics, a freshmen/sophomore level engineering design graphics course that was a pre-requisite for upper level engineering design courses. An equivalent course was not offered in English at FH Esslingen that semester, so the author agreed to have this student enroll in his ME Design Graphics course being taught a the Southfield, Michigan campus. Although this LTU student was located in Germany, she was “virtually” enrolled and participated in the Michigan based course. The author and this student used a variety of distance education technology to communicate, instruct, question, and evaluate the content of this course while located in Germany and separated by a 6 hour time zone difference.

II. Background - Mechanical Engineering Design Graphics, EME2012

EME 2012 was restructured in 2001 to fully utilize LTU’s laptop program and initiative. Prior to this restructure, EME2012 combined board drafting with 2D CAD. Beginning in 2000, LTU initiated a laptop program, with every engineering student receiving a high-end laptop computer with various office, programming, CAE, and CAD software installed. In 2001 LTU adopted the Solid Edge 3D solid modeling CAD program, as it’s standard mechanical engineering graphics standard. Solid Edge was installed on approximately 1200 engineering student’s laptop computers and therefore available to these students for use in their engineering courses. To fully utilize LTU’s laptop program, EME2012 was restructured in 2001 to emphasis the engineering design process and 3D geometric representation of solutions to engineering design problems. At that time, the student’s laptop computers were integrated with the lab session of this course in lieu of the dedicated computer lab. Topics of 3D part modeling, assembly modeling, and generation of associative 2D drawings were taught in the context of the engineering design process.

III. Applications of Distance Learning Technology

A Blackboard course management web site is created on LTU’s web server for every course offered at that time. Blackboard is a commercially available web based course management system that can be used to post course information, syllabus, assignments, etc. A student grade book, assignment manager, bulletin board, and mailing list are included with Blackboard. LTU’s student information system automatically assigns students to the course Blackboard site when they enroll in a LTU course. Beginning in 2002, the author eliminated “paper” from his Engineering Design Graphics course and used Blackboard exclusively for posting assignments, exams and receiving CAD files as homework, projects and examinations from the students. Assignments were posted on Blackboard using electronic files and students submitted the electronic CAD parts, assembly, and drafting files using Blackboard’s assignment manager. The instructor grades and annotates these part files and posts the grades and markups on the Blackboard site for students to view. Therefore, students can log onto the site at home or from a remote location and check grades, review homework, and ask the instructor questions. This capability greatly enhances
communication between the students and instructor and facilities learning from a distance.

During the Fall 2003 offering of EME2012, a LTU Global Engineering student took a LTU issued laptop computer to Germany and enrolled in EME2012 from Germany. Her laptop had Solid Edge CAD software installed. In addition to the laptop, her German dormitory room was equipped with a high-speed Internet connection. Therefore, she was able to access Blackboard and other web based applications from her dorm room. The high-speed network provided adequate bandwidth to download and upload large CAD files in a reasonable time period.

Blackboard is primarily used for asynchronous communication between the instructor and students. Although it contains an electronic discussion board, the author did not find that useful for the subject of “engineering graphics”. The instructor would post weekly assignments and activities on Blackboard including sample part files and instructions. Because the global engineering student was working in a time zone six hours ahead of Michigan, she would begin the weekly work at the end of her day upon returning to the dormitory. The Michigan based class was offered from 1 to 4 pm once per week. While the Michigan based class was in session, the student was able to work synchronously at 10:00 pm in Germany due to the 6-hour difference in time. She would occasionally have problems with an assignment or concept and would e-mail the instructor questions and attach a CAD file if necessary. In most cases the solution was simple and the instructor was able reply to the question by e-mail including screen captures if necessary to illustrate the answer. She would sometimes send her problem CAD part as an attachment to the e-mail. Because Solid Edge files are “feature based” the instructor could open the file and re-create the problems that the student was having.

On a few occasions, however, a “live” demonstration and two-way communication were needed between the student and the instructor. For those occasions a distance technology toolset, GradePoint, was used to allow for synchronous communication between the student and instructor. GradePoint is a web based, server hosted system that provides screen and application sharing between remote computers and two-way audio and video conferencing (with adequate bandwidth).

The student was having difficulty completing one of the homework assignments and had e-mailed her CAD file to the instructor. She was struggling with some fundamental concepts that would have been easy to demonstrate with an interactive “live” session. Although she and the instructor had exchanged CAD files with a written explanation of how to build the
part, a visual session was required to fully explain and understand the concepts. The student and instructor made an appointment to review these concepts using Gradepoint. The session was scheduled for 4:00 pm Michigan time and 10:00 pm German time. A Gradepoint session begins by logging onto the Gradepoint live site with a user account and password that was previously assigned by LTU’s instructional technology staff.

A “virtual classroom” was created for EME2012 and a live chat session initiated. The instructor asked to take control of the student’s desktop using the “App Share” feature of Gradepoint. At that point, the instructor’s computer displayed the screen of the student’s computer located in Germany. Both the student and instructor could see the same computer screen. The instructor took “control” of the students computer and opened the problem CAD file from a distance.

The instructor was able to open the problem CAD file and began demonstrating the steps to fix and build the part. The student was able to view her own computer with the instructor controlling the mouse and applications from 6000 miles away. Gradepoint has audio chat capabilities and both the student and instructor attempted to “talk” over the display using the microphone and speaker built into each other’s laptops. Unfortunately, this proved to be a one-way conversation and the instructor was unable to hear the student. At this point a conventional phone call was initiated to provide auditory communication to supplement the screen displays and visual display. Upon further investigation, it was determined that the two way audio was rendered inoperable by the firewall in the German dormitory. After a relatively short session, the student was able to grasp the concept and logged off.
IV. Conclusions and Recommendations

Engineering graphics and computer-aided design are subjects that are not easily grasped from a textbook only. The spatial visualization skills required for success require visual aids and interaction with an instructor. Learning a modern 3D solid modeling program generally requires interactive demonstrations and live interaction with a knowledgeable instructor. These subjects do not easily lend themselves to instruction via distance education technology.

In spite of these challenges, it is the conclusion of the author and student that this experiment was a successful experience. Although it required additional effort and motivation from both the instructor and student, the outcomes of this course as measured by competency in engineering design graphics were identical between this student and others in the class. All students in EME2012 are required to demonstrate competency in using the CAD tools to create 3D solid models, assembly models, and associated engineering drawings for an open-ended engineering design problem. The student studying in Germany demonstrated a competency at a level equal to or greater than the students taking the same course in Southfield, Michigan.

Based upon this single experience, it is the conclusion of the author that Engineering Design Graphics can be effectively taught using modern distance education technology tools with a high-speed Internet connection. Distance learning requires a greater degree of independent work and motivation by the student than when face-to-face interaction occurs in a classroom. A successful distance-learning paradigm for engineering graphics requires students with a high level of motivation, discipline and maturity. The student participating in this experiment was one of the top students at LTU and therefore successfully completed this course in Germany. It was the experience of the author that questions and problems were more difficult to answer and solve from a distance than in a classroom with face-to-face interaction with the students. This was primarily due to the graphical nature of the subject matter and difficulty of explaining the subject matter with words only. Availability of learning toolset such as “Gradepoint” facilitated communication and resolution of problems. Difficulties with the firewall and bandwidth will need to be addressed for future offerings of this course using these tools. Although this experience was manageable with only a single student it would most likely prove to be overwhelming with a large class due to the additional effort required by both instructor and students.