An Educator’s Experiment to Promote Technical Graphics Education

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ABSTRACT - To promote the interests of technical graphics education, the author decided to use an experimental project to demonstrate that the technical graphics is not just a required course for a degree, it could also be fun and economically beneficial. The project is to design a house that is unique and can be built at a cost much less than the market value. Although it is the author’s personal house, the designs as well as the topographic data were shared with students. Surprisingly, almost all students showed great interests and presented their own ideas at the graphic design stage. The design must include every aspect of the house building such as appearance, structure, electrical and mechanical installation, plumbing, as well as landscape. After the start of excavation, students can drive by and see the progress with their own eyes. Even the project is still on-going, it attracted attention of people outside the classroom too, since the house looks different from neighborhood. Furthermore, viewing the three dimensional solid models of the design, many sub-contractors were impressed and indicated the desire of training in the computer 3-D graphic modeling. In this paper, the project details will be given, the author will present his experience to share with readers.

I. Introduction

Engineering technology has been defined as that part of the technological field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer. Engineering technology is oriented less toward theory and more toward practical applications. The term "engineering technician" is applied to the graduates of associate degree programs. Graduates of baccalaureate programs are called "engineering technologists."

Missouri Western State University is a public, state supported institution providing a blend of traditional liberal arts and sciences and career-oriented degree programs. Professional education programs such as teacher education, nursing, engineering technology, and business have played an important role at Missouri Western for many years and have come to be seen as an area of strength for Missouri Western throughout the northwest Missouri region. The University has chosen to retain its open access policy while continuing its commitment to pursue academic excellence and quality teaching. (Missouri Western State University, 2008).

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With a long history of career-oriented education as a primary part of its mission and function, Missouri Western State University has a solid undergraduate program in engineering technology accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). It valuably serves both its students and the employers of the City of St. Joseph, the northern fringes of the Kansas City metropolitan area, and its five-county regional service area by providing highly skilled engineering technologists and technicians to help the region grow and prosper. It wishes to continue to serve the people of Missouri in this way. (Zhu, et al. 2008).

II. Degree Programs and Career Goals

The Department of Engineering Technology offers two- and four-year degree programs in Engineering Technology with majors in Construction; Electronics; Electronics and Computer; and Manufacturing Engineering Technology. In addition, the Department offers a two-year engineering transfer program and a one-year architecture transfer program in cooperation with various area universities.

The two-year degree program in Construction Engineering Technology prepares individuals to become entry-level construction inspectors, job estimators, testing lab technicians, expediters, and surveyors. It also prepares individuals for positions related to construction cost accounting and quality control. The four-year degree program prepares individuals as entry-level field construction coordinators, estimators, job schedulers, and construction management trainees. It also prepares individuals for positions related to construction document control, purchasing, equipment superintendent (renting) and quality assurance/quality control. The B.S. degree program in Construction Engineering Technology is accredited by the Technology Accreditation Commission (TAC) of the Accreditation Board for Engineering and Technology (ABET).

The program educational objectives of BS CET graduates are:

i. Demonstrate the ability to produce and utilize design, construction, and operations documents related to building and/or heavy construction industry.

ii. Function effectively in a group environment in the workplace through demonstration of technical and communication skills.

iii. Understand professional, ethical, and social responsibilities.

iv. Show respect for diversity and knowledge of contemporary professional, societal and global issues.

v. Demonstrate a commitment to quality, timeliness, and continuous improvement.

vi. Continue professional development through life-long learning.

Career opportunities for two-year associate degree graduates of Electronics Engineering Technology include entry-level positions with computer maintenance/repair companies, design/testing companies and electronics instrumentation companies, telephone companies, and other companies that use electronic equipment such as automated control (microprocessor/microcomputer) systems. Four-year degree graduates also qualify for jobs related to operation control, testing, trouble shooting, supervision and management, marketing, technical sales and field services including installation and commissioning of equipment in plant or on site. The B.S. degree program in Electronics
Engineering Technology is accredited by the Technology Accreditation Commission (TAC) of the Accreditation Board for Engineering and Technology (ABET).

The program educational objectives for BS EET graduates are:

i. Demonstrate the ability to analyze, design, and implement electronic systems in one or more of the areas related to control systems, instrumentation systems, communications systems, computer systems, or power systems.

ii. Function effectively in a group environment in the industrial workplace through demonstration of technical and communication skills.

iii. Understand professional, ethical, and social responsibilities.

iv. Show respect for diversity and knowledge of contemporary professional, societal and global issues.

v. Demonstrate a commitment to quality, timeliness, and continuous improvement.

vi. Continue professional development through lifelong learning.

The B.S. with a major in Electronics and Computer Engineering Technology degree will provide the student with an understanding of microcomputer hardware design, troubleshooting, upgrading, and maintenance as well as a moderate level of computer software programming experience. The student will also be trained in Programmable Logic Controller Functioning as well as utilization of hardware and software knowledge to enter into the field of Human/Machine Interface work. The B.S. degree study program enables the student to obtain work in the programmable controls area of the industrial sector of the economy. The degrees in this program focus on studies which integrate computer software and computer hardware subject matter. The A.S. degree will prepare the student to have a practical understanding of computer components as well as an understanding of their functioning sequences. A basic level of computer programming is also a part of the student's experience.

Manufacturing Engineering Technology is the profession in which an understanding and application of a broad range of technologies is necessary for production and control of manufacturing processes. Manufacturing includes methods of production of industrial commodities and consumer products. The manufacturing professional must be able to plan, design, and implement sequence of operations using current technologies to produce products at competitive prices. Career opportunities for two-year associate degree graduates of Manufacturing Engineering Technology include entry-level positions with industries engaged in plant design, machine and tool design, robotics and industrial automation, and computer-integrated manufacturing. Four-year B.S. degree graduates qualify for jobs related to production, productivity improvement, and process design. They also qualify for supervisory and managerial positions in plant engineering.

III. Technical Graphics Education

Currently, two technical graphics courses are offered for regular students to fulfill their degree requirements. They are:

EGT 205 Computer-Aided Drafting I: Techniques in drafting with computer applications. Students will use a CAD software to produce mechanical, electrical and/or architectural drawings and will explore other software with their applications. The emphasis is on orthographic projections, sections, auxiliary views, dimensioning, component libraries and the applications of drafting using descriptive geometry.
And

**EGT 215 Computer-Aided Drafting II**: Advanced techniques in drafting with computer applications. Students expand their drafting skills by creating computer generated multi-detailed drawings using 3-D techniques. Architectural, structural, mechanical, and/or electrical applications will be discussed with emphasis in detailing, tolerances, and symbol libraries. Importing/exporting of files, customizing the CAD software, and productivity techniques will be used. Principles of drawing for residential structures using various construction materials and methods will be included.

Both courses are 3 credit hours. EGT 205 is a required course for all degrees in the Engineering Technology department. EGT 215 is only required for degree programs in Manufacturing Engineering Technology and A.S. degree program in Construction Engineering Technology.

They are open to anyone who is interested in this subject with out pre-requisite. People in the community can take one or both as a special non-degree seeking student. Students in other majors can take them as electives too.

For over ten years, the author has been teaching one or both courses. In later 90s or earlier years of this decade, there was huge demand for these classes. We used to offer 4 sections of EGT 205 and 2 sections of EGT 215 with full enrollment (15 seats). Roughly 50 percent of those students came outside of the Engineering Technology degree programs. Recent years, the demand has decreased. Currently, we only offer 3 sections of EGT 205 and 1 section of EGT 215, there are still open seats in some sections. Almost all students are in the Engineering Technology degree programs. It indicates that students take the course to fulfill the degree requirements.

### IV. The Experiment

To promote the interests of technical graphics education, the author decided to use an experimental project to demonstrate that the technical graphics is not just a required course for a degree, it could also be fun and economically beneficial. The project is to design a house that is unique and can be built at a cost much less than the market value. Although it is the author’s personal house, the designs as well as the topographic data were shared with students.

Figure 1 shows the building lot, which is a normal city lot. Things that cause difficulties for building on the lot include: 1. it is a hill, there would be a lot of excavation, which could dramatically increase the cost; and 2. the lot is very rocky, which will also increase the excavation and backfill cost. According to city’s building code, a house has to situate at least 30 ft from the street curb. Those are the factors that have to be taken into account to achieve the goal of the experiment: save cost through design.

![Figure 1. The Building Lot.](image)
V. Results and Discussion

In our technical graphics courses, we teach students both technical graphics theory and software. Many students get frustrated in technical graphics theory such as subjects of geometric construction, descriptive geometry, the theory of perspective view. Some students, especially the traditional students who just came out of high school, often ask, “Why do we need to learn this? What is the use of it?” At the beginning stage of the design, there were a lot of practical questions that demonstrate the importance of the technical graphics theory. To give an example, how do you “precisely” estimate the elevation of the hill using a simple tool such as a tape measure. Certainly, there are professional survey companies available. However, that will cost the designer’s money and time. At the designing stage, a quick no-cost estimate is usually preferable. The theories of geometric construction and descriptive geometry can easily solve this problem. Through this question, students obtain first-hand experience with the applications of the theory.

With the topographic data, the author then discussed different design concepts with students. Figures 2 and 3 are the two finalists.

Looking at the three dimensional models, many students were really intrigued. This is a real project, they came to realize the capacity of computer graphic modeling.

Figure 3. Design option 2.

After the start of excavation, students can drive by and see the progress with their own eyes. Even the project is still on-going, it attracted attention of people outside the classroom too, since the house looks different from neighborhood. Furthermore, viewing the three dimensional solid models of the design, many sub-contractors were impressed and indicated the desire of training in the computer 3-D graphic modeling.

Figure 4 shows the house under construction that is similar to the design option 2 with modifications.

Figure 4. The on-going project.
VI. Conclusion

A real project is always a wonderful tool to demonstrate the usefulness of computer-aided drafting and technical graphics theory. Students are able to get hands-on experience with the applications of theory learned in class. The economic benefits justify the cost in education of technical graphics. The activities in completing the project also promote the public interests in technical graphics education.

VII. References

University Catalog, Missouri Western State University, 2007-2008.