Field Trip as Complement to Engineering Technology Education

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Abstract

In many engineering technology programs, the primary focus is to provide students with the educational resources to apply cutting-edge tools of the technology in industry. This objective of technological empowerment is achieved through student projects, capstone courses, and sometimes internships. Such activities are designed to ensure that students acquire a firmer grip of principles and application of concepts and tools. Capstone courses and student projects are designed to encapsulate several essential components of a course or program content. These approaches are effective in institutions that have a wide array of industry standard equipment for students to use in real world applications. Internships, however, allow students to train on equipments whose prices far exceed the financial resources of the institution.

This paper looks at the manner in which field trips to local industries have been used to increase students' understanding, and therefore appreciation of procedures and concepts that have been discussed in courses. Field trips to industries allow the students to appreciate the relevance of the technologies discussed in class and to experience their application in industry. Students are able to discuss with employment opportunities with employers and to find out from operators their experiences in working with specific equipments and to glean additional knowledge about the equipment. For students in institutions that are unable to afford expensive equipment, seeing that equipment in use reinforces the knowledge that they obtain in class.

Between the telecommunications engineering and the surveying technology programs, field trips are conducted to Commonwealth Telephone Industries, Adelphia Cable and Television Company, Verizon Switching Centers, Historic Electronic Museum and the Pennsylvania

Department of Transportation as part of the academic activities. Although the companies differ in their products, the experiences of the students are identical. This paper discusses the relevance of industrial field trips to complement instructions in engineering technology programs.

Introduction

Among the educational objectives for engineering technology programs is a desire to prepare graduates to quickly become productive upon entering the workforce. This objective is even more important in two-year colleges and institutions that offer associate degrees because graduates from these programs are expected to transition quickly and more easily into the workforce and be productive immediately. Engineering technology programs therefore require broader and deeper practical experiences to complement principles and applications of the technology that are obtained during normal lectures.

Institutions apply different methods to incorporate practical experiences and real world applications into their curricula to prepare students for the technological challenges they might face in the workplace. Such methods include capstone projects which are designed to incorporate various aspects of the curricula. Another approach is through student internships whereby students spend some period in the industry to gain necessary practical experience as well as exposure to most recent technology and equipment in the industry. Internships are meant to provide students with the opportunity to operate in real world environment. To qualify for academic credit, student internships are usually supervised by at least one faculty member and a supervisor from the workplace. However, capstone courses and student internships do not always guarantee that students will obtain the needed experience with latest technology

There are valid reasons why field trips can be used to increase understanding of principles and processes that are discussed during lectures and to complement other practical experiences. Capstone projects that are designed to include substantial practical application of equipment are useful in institutions that have the resources to provide up-to-date instrumentation in the laboratories. However, economic situations in most two-year colleges, coupled with the rising cost of equipment for engineering technology, make it impossible to upgrade laboratory equipments at a rate that will keep pace with technological advancements. Furthermore, whereas institutions try to ensure that student interns gain as much practical experience as possible, there exists the possibility that the host company may only have one brand of equipment or may not have the equipments that may be considered among the latest in the industry. It is therefore necessary to complement the classroom instruction with industrial visits to expose students to the use of different types of equipment that are used in industry.

In this paper, three instructors from surveying, engineering, and telecommunications programs in different institutions share their experiences observations and of taking students on field trips.

Field Trips in Surveying Engineering Program

Technological advances in surveying with the aid of Global Positioning Systems (GPS), digital aerial photogrammetry, Laser Swath Mapping, and Geographic Information Systems (GIS) are rapidly influencing both the equipment for capturing, recording and mapping geographic features. These technologies involve expensive hardware for data capture and software for data processing which need to be upgraded regularly.

Surveying institutions such as the Surveying Engineering Program at the Wilkes-Barre Campus of The Pennsylvania Stet University are compelled to modify course content to include latest innovations in the technology. Although it is easy to modify the lecture component of the curricula, laboratory exercises can only be done in small scales within controlled environment which does not justify the expense for some of the equipment. For example, a laboratory exercise in digital aerial photogrammetry requires an aircraft equipped with an on-board GPS receiver, digital aerial camera and many other accessories. It is obvious that the expenses involved in acquiring the equipment for this exercise far exceed the financial resource of the program. There is therefore a need to find innovative ways to expose students to the equipment, technology, and processes without incurring such expenses. An easy option is to plan an educational trip to the Pennsylvania Department of Transportation (PennDOT).

PennDOT is responsible for all Federal and State roads within Pennsylvania. It is the responsibility of PennDOT to conduct all surveys for road construction and to monitor bridges and other infrastructure that are owned and managed by the State. As a federal agency, the department has the resource to acquire the necessary equipment to enable it to perform it duties. Besides, the department is always involved with real world activities which apply most of the principles and processes that are taught in a surveying engineering program. Therefore, the field trip to PennDOT serves to encapsulate a large component of the materials that are covered in the program.

After a brief description of the responsibilities of the photogrammetry division of the Department, the discussion follows with how project requests are initiated, accuracy standards, equipment and procedures adopted for executing projects. For a typical topographic mapping activity during roads realignment, the discussion proceeds from flight planning through pre-marking of control points which includes GPS control network design, computation of endlap and sidelap for each strip of photographs, and hence, the approximate number of photographs required for the project, film processing, aerotriangulation, contouring, and development of orthophotographs. All these discussions include demonstration of actual processes and procedures so students get to see actual operations which help to crystallize the topics that were discussed during lectures. At each point, students have the opportunity to ask questions and to interact with the staff, and even try their hands on some of the equipments. During the discussions, the students are taken through most of the topics covered in the photogrammetry

course, as well as substantial topics in mapping, survey adjustment and least-squares computations, GPS surveying and traditional surveying. Furthermore, students get the opportunity to see the application of Laser mapping equipment to monitor bridges for deformities. The equipments used in all these activities are the latest in the industry. Students are able to relate lecture topics to real world application and thereby, appreciate the extent of technological innovations in the chosen careers.

Industrial Involvement in the Telecommunications Program at Penn State

There is a strong interaction between the members of faculty in the Telecommunications program at the Wilkes-Barre Campus of Penn State University and the experts in the telecommunication industry. Program objectives and curricular content are frequently discussed with members on the Industrial Advisory Committee (IAC). Since some of the IAC members have several years of experience in the telecommunications industry, it is always possible to obtain positive feedback on the relationships between course objectives, expectations of employers in the industry as well as technological trends within the telecommunications industry. Field trips are organized with input from members of the IAC, and often include visits to some of the companies managed by the committee members. Hence there is a connection between the classroom lecture and the demonstrations in industry. Not only does this approach inform the industrialists what topics, and hence pieces of equipment are discussed in class, but they are also able to demonstrate operational processes and advice on equipment upgrades companies are using. This approach helps to make instruction to the student from both the classroom and laboratory, and industry a seamless whole.

To cite an example, as a result of the partnership between the Telecommunications program at the Wilkes-Barre Campus of Penn State University and Commonwealth Telephone Enterprise (C-TEC), different collaborative activities bare undertaken, one of which is industrial visits. Students get the opportunity to have thorough discussions on different aspects of switching and transport as well as the different pieces of equipment employed in these functions. They also receive instruction on related activities such as frequency translation. These discussions are held with professional engineers with many years of experience in the field. An extant to this process is the Educators in the Workplace [1] program C-TEC has through which faculty members are invited to industry for discussions on current developments. These activities contribute to keeping the students current in industrial practices.

To broaden the students' scope in industrial experiences, industrial visits are conducted to other areas of the telecommunications industry such as the Adelphia Cable and Television Company. At this company, the students are informed about different aspects of television broadcast and the types of equipment used to perform such broadcast. Here too, the application of satellite technology in cable and television is presented to the students.

Because of increase in demand, bandwidth usage is a concern. To ease the problem, fiber, which has a larger bandwidth, is incorporated in the applications cited above. The students are given practical explanations on this during both visits. This often leads to discussions on different types of media, their frequency ranges of application and hence the specific applications for which each medium is best suited.

While the number of companies a campus may have the opportunity to visit could be limited due to distances of travel involved, a careful selection of companies from the local industry gives the students a good appreciation of industrial practices in their chosen field. Laboratory work can never be overemphasized, but industrial visits are always useful as a supplement to classroom activities.

Field Trips in Electronics and Telecommunications at Baltimore City Community College

At Baltimore City Community College, hands-on activity is very critical for the Electronics and Telecommunications Technology programs because most students enter the workforce upon receiving their Associate Degrees. Although the two dedicated laboratories for these two programs are well equipped, there are specific equipments that the Department or the College cannot afford. Field trips have been considered the best alternative to provide the necessary practical experience needed for the students. For historical background of electronics engineering, first year students visit the Historic Electronic Museum at Linthicum, near Baltimore Washington International Airport (BWI) Maryland. The objective of the field trip is to help the freshman students to understand the evolution of the technology.

 Besides, a good relationship has been developed between the community college and Verizon Telecommunications in Baltimore. As a result of the generosity of the administrators of Verizon Company, their Central Office (CO) downtown Baltimore has been open to students for carefully planned and supervised field trips.   Filed trips to Verizon is designed for second year students to learn about the flow of information from a subscriber line, terminated at the MDF (Main Distribution Frame) and how the line circuits and switches operate. They are able to see the conversion from analog signals to digital, multiplexes in operation, routers, optical carrier switches, 5ESS (Electronics Switching System in local class 5 exchange), trunks, backup secondary cells, T-Carrier family switches, centrex, loading coil, and connectivity to Class-4 toll centers. These are all equipments whose operational principles are discussed during lectures.

During these field trips, the students have the opportunity to discuss the responsibilities and expectations of the technicians in the Central Office. They learn about academic requirements for various technician positions, and also had the opportunity to ask questions. Tours within the

Verizon Central Office are always conducted by an experienced and knowledgeable technologist is able to answer questions and relate the discussions to the academic work of the students.
Field Trips in Voice Communication at Johns Hopkins University School of Business

The voice telecommunication systems architecture course at Johns Hopkins University School of Business is a graduate course for business students. A field trip was incorporated into the course to provide the necessary industrial experience in voice communications to the graduate students. Even for those students who have had some telecommunications experience, the field trip was used to reinforce what had been taught in class. In addition to the technical experience, the field trip helped the student to appreciate their responsibilities as potential employees in upper level telecommunications management positions.

Observations

Through the students' discussions with engineers and technicians during the trip and also their conversations with faculty after the trip, there is an obvious indication that the students have gained a lot of knowledge as a result of the field trip. In addition, their desire to go on more program-related field trips demonstrates an increase in their motivation to learn as well as their desire to know more about the technology. Verbal comments from students indicate a better understanding of topics that have been discussed in class. During classroom discussions students are better able to relate the appropriateness of certain courses to engineering applications.

Conclusions

Engineering technology programs tend to focus on the application of innovative technologies in the industry. In most two-year colleges students are trained to enter the workforce with extensive skills to be productive as soon as possible. The rate of technological advances in engineering technology areas demand that institutions upgrade their laboratory equipments much faster than they can afford. Furthermore, laboratory conditions within colleges are very different from the situations in the real world. Although capstone courses and internships provide some form of experience to students by applying several of the knowledge acquired during the course of studies they do not always provide students with the opportunities to work in an industrial setting, neither do they offer students the opportunity to experience the use of different equipments. In their own ways, field trips tend to reinforce the theoretical knowledge that has been acquired while offering students the opportunity to experience real world situations in their chosen careers. Most of all, they offer students the opportunity to discuss their fears, concerns, and expectations with people who are already in the field. Such experiences can only be

acquired through educational field trips. Through visits to industry, students also get the opportunity to network with engineers and technicians in the field. They get to appreciate the currency of topics discussed in class. They also get to learn the requirements for the job market, and the requirements for specific companies. Such contacts become invaluable after graduation when the new graduates are seeking employment.

References

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