"Teaching Engineering Technology to the NINTENDO Generation"

Robert J. Hofinger
Purdue University - Statewide Technology Programs

Abstract

The statement has been made that "the students now entering Engineering Technology have spent the last 15 - 18 years with interactive video, educational rock, and VCRs." Anecdotal experience indicates that they have spent considerably less time with erector sets, with lawn mower engines, with the use of tools, and the exploration of the fundamentals of mechanical and electrical structures. This statement would suggest that we, as evaluators and educators, would need to change our approach to teaching Engineering Technology in order to gear our programs to that of our customer's experiences and expectations.

But do we need to do this? Although the buzzwords today are on computer simulations, virtual reality, etc., I do not feel that the needs of the "real world" have changed. There is still a need to be able to have that "hands-on" experience that only an Engineering Technologist has and can bring to the work force.

To this end, laboratory experiments should be laid out in such a manner as to duplicate a "real world" situation. These experiments should be designed so as to build on the previous experiment, just as classroom lectures build on one another, and arrive at a "real world" application. This way, students will gain experience in seeing how a complicated design is built up of many simple circuits. A set of laboratory courses, which are presently used in the Electrical Engineering Technology program at the Purdue University School of Technology site at Columbus, will be presented to show how this has been achieved.

Introduction

Many incoming students in the Purdue Statewide Technology program come to us without having any experience with electrical or electronic pieces of equipment. They have spent more time with interactive video, educational rock, and VCRs and minimal time with erector sets, with lawn mower engines, with the use of tools, and with the exploration of the fundamentals of mechanical and electrical structures.

In this paper I will describe how a meaningful laboratory sequence for undergraduate students in the Electrical Engineering Technology program has been laid out. It is intended for use in lower level freshman and sophomore undergraduate courses. These levels of projects are different from the laboratory curriculum for upperclassmen because of the age, maturity and experience of the students.

Therefore, these projects and the laboratory curriculum, should also be an introduction to electrical devices. It should be motivational, as well as instructional. In this beginning stage of their educational process, it is the laboratory instructor who provides the art, the science, and the incentives for further studies.

Motivation

In the past, our teaching of laboratories has traditionally been a series of unconnected experiments. The typical laboratory program consisted of a sequence of basic laboratory courses. Therefore the laboratory experiments have tended to be cookbook style experiences, where the student has gotten nothing more than just being able to record data. The majority of the laboratories have been characterized as boring, tedious, and lengthy. In addition, sometimes the experiments did not work. Circuits were assembled, data taken, and then disassembled. Never to be seen again.

Does this scenario about teaching laboratory skills sound very much like our traditional engineering laboratory courses? Of course it does. We spend many hours doing fundamental and basic tasks, many of which are repetitious; the students take data, alone or perhaps with a partner, record it and then forget about it. It is not until they enter the job market that they apply their knowledge to real world applications.

Based on experiences such as just described, it has been said, that colleges do a lousy job of preparing engineers for the real world. [1]

Objectives

What are the objectives of a meaningful laboratory course sequence?

- ♦ Laboratory courses should be designed according to the skill level and knowledge base of the students. In our case, for these incoming freshmen, with no prior electronic experience, it is set up so that there are no pre-requisites and no prior electronic or electrical knowledge.

- ♦ Laboratory courses should draw on the pre-requisite and co-requisite courses in the undergraduate program for their experimental topics. They should apply and test theories, which were studied in the classroom. They should be put forth in such a manner as to show connection with "real world" practical applications. This will give support and reinforcement to the theoretical material studied.

- ♦ Laboratory courses need to focus on teaching key concepts by having the students design, build, and test many simple circuits. Laboratory experiments should then be laid out in such a manner as to build on the previous experiments, eventually arriving at a practical circuit. They will then gain experience in seeing how a complicated circuit is built up from many simple circuits.

- ♦ Laboratory courses should progress with a continual increase in the level of difficulty. A continuous but gradual increase in the challenges presented to the student will ensure that the students' attention and motivational levels will not taper off. [2]

- ♦ Experiments should require the use of the student's creativity and innovation. The laboratory curriculum should use experiments that not only show the concept but also show how that concept applies to a real life situation and how that concept could be improved. [3]

- ♦ Experiments should require computer-aided analysis as part of the laboratory work. Computer simulated experiments are economical, fast to realize, and can be tested for the worst-case conditions. The fact that the simulated experiment worked, provides the confidence to the student in his/her ability to build and test the experiment in an expedient manner.

- ♦ Experiments should include a section on interpersonal communication skills. Communication skills need always to be emphasized. Students should be required to write and submit a number of formal forms of reports or presentations. These can range from a one page technical abstract describing the theory behind a portion of an experiment to a written summary of the analytical results of the experiment and finally to a formal written report of some length.

Laboratory Course Sequence

The two-semester sequence of EET Laboratory courses at The Purdue University School of Technology attempts to do all of the above.

EET 169 "Introduction to EET Projects" is our freshman level introductory course. In it, incoming freshmen are introduced to Electrical Engineering Technology and the functions of the Technologist. They are briefly introduced to the theories and fundamentals of Electrical Engineering and how these concepts apply to "real world" applications.

The two-part project is begun in this course and is completed in a second half follow-up course. It is a combination regulated power supply and function generator. In this course, the +5 v, +12v, and the -12v regulated power supplies are enclosed in the cabinet. In the first semester, the unit is in the form of a kit, whereby all the components, PC board, and mechanical parts are provided. The students do the assembly of the chassis and the PC board, thereby becoming familiar with electrical and mechanical components, proper layout techniques, hand soldering, and surface mount assembly.

In EET 296 "Electronic System Fabrication", the second half of the two-course sequence, a standard sine wave, square wave and triangle wave, function generator is added to the chassis and power supply. In this second year level course, the students, either alone or in a group, design their function generator from a block diagram supplied by the instructor. They layout the PC board and route the printed circuitry using MicroSim PCBoards. After their PC boards have been etched, they drill the mounting holes and assemble the components. The function generator is then fully checked for functionality and for meeting specs. Each student then gives a written and oral report.

Summary

The laboratory project needs not only to be a learning exercise, but an exercise in motivation and appreciation. A subtle difference, to be sure. In this laboratory sequence, the final project shows how a functional system contains many parts, how and where each fits into the scheme of things, and how, when assembled together, they make up the complete system.

Also in this laboratory sequence, two things are stressed. Both are consistent with the desires and requirements of ABET/TAC 2000.

1) Have a variety of oral and written presentations as a technique for improving communication skills.
2) Introduce design activities into the first and second year engineering curriculum.

Engineering is about making things work. It is about making things work in the real world. It is also about working together. Although we need the theoretical grounding, which the classroom lessons provide, it is the “hands-on” experiences that will help our engineering and technologist students find their way in the marketplace.

Bibliography

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ROBERT J. HOFINGER

Professor Hofinger is an Associate Professor with Purdue University, Statewide School of Technology Program. He has taught at the Columbus campus for seven years, after having over 30 years experience as an analog and digital design engineer with various electronic related industries, both in commercial and military applications. Professor Hofinger received a BSEE degree from The Polytechnic Institute of New York in 1968 and a MSEE in 1973.