

A Didactic Methodology Based in the Fragmentation of Complex Problems of Electrical Engineering

*Ruy A. C. Altafim, Jorge S. Canova, Paulo Veronese, José Sartori, Azauri A. Oliveira Jr.
Centro de Tecnologia Educacional para Engenharia e Departamento de Engenharia
Elétrica*

*Escola de Engenharia de São Carlos (EESC) - Universidade de São Paulo (USP)
Av. Dr. Carlos Botelho, 1465 - São Carlos - São Paulo - CEP 13.560-970
E-mail: altafim@flash.sel.eesc.sc.usp.br*

Abstract - *This paper describes a teaching methodology, where the enthusiasm is the lever of learning. Its nucleus consists in presenting complex engineering problems to students, and, afterwards breaking them into simpler ones. During the discipline, the students are stimulated to solve these simpler problems with special software and hardware tools. As an example of this methodology, syllabus modifications and adaptations in a freshmen course of Electrical Engineering course will be also shown.*

Introduction

During his school life, the applicant for the Electrical Engineering receives technological information through several audio-visual media systems, which triggers the enthusiasm flame in his soul. He is wishful to learn and to develop his own technological projects soon. However, already in a course of Electrical Engineering, he is confronted with a hard reality. There is an excessive load of basic subjects, such as physics and mathematics. Although these subjects are extremely important for his professional formation, the student sees suffocated his old calls.

This problem is not new. In late 1989, the “Phoenix Committee” at Worcester Polytechnic Institute detects the need for more practical, hands-on knowledge to accompany the traditional engineering courses [1,2].

The first idea that emerges in our mind is to change this situation by introducing, in freshmen years, concepts and real problems on electrical engineering and, to put the students to work! However, as the students have not theoretical and practical electrical engineering background, several negative things can occur and more frustrations are expected.

This paper describes a teaching methodology, where the enthusiasm is the lever of the learning and, as it will be implemented in Electrical Engineering course at the Department of Electrical Engineering- EESC-USP.

Methodology Description

Nowadays in the first years, there are some subjects that inform the students about the perspectives of the Electrical Engineering career. Although these subjects have shown to be very important, they do not contemplate the students' longings, because what they want is practicing engineering. The methodology, presented here, aims at changing this teaching philosophy and to form the students with a systemic view of the macro engineering problems.

Its nucleus also consists in presenting complex engineering problems, in the freshmen's years of the course. These problems are gradually broken into simpler problems, which can be solved easily with the current knowledge of the students or with a brief theoretical introduction. In the subject, these simple problems are going to be proposed to students, together with adapted software tools and didactic kits. These tools and kits will not only help the students in this situation, but also during their entire course.

Practical Implementation

To develop and apply these ideas, a group of teachers of the Electrical Engineering Department of EESC-USP is driving their own research into the education area. Graduate students are being involved and guiding their master's degree programs to these educational researches. The first practical objective of the this group is to modify the contents and methodology of an introductory subjects of the Electrical Engineering curriculum, called SEL- 300 “Professional Information about Electrical Engineering” and, that today is only informative.

To make these subjects formative, it needs to have altered its didactic philosophy and its syllabus. In this context, it will be divided in interconnected didactic modules, that will cover the main parts of Electric Engineering.

In the first module, denominated introduction, the entire program will be presented the subjects and a macro electrical engineering problem. There, this macro problem will also be divided into countless simpler problems that will be treated in the different modules of the subjects. The other modules will be: electronic circuits, power electronics, instrumentation systems and sensor, digital circuits, generation-transmission-distribution systems, telecommunication system

and, evaluation module. The figure 1 shows a schematic diagram of the subjects modules.

Each of those modules, which intends to solve a simple problem related with the macro problem previously presented, will also supply the students with computer tools. that will help them in all the tasks proposals. Observing the advantages and disadvantages of using various computer tools in first years of the course [3], the computer programs selected for this subjects were: Work Bench [4], VISIO [5], Origin [6], Word, Internet Explorer 3.0 and Power Point [7].

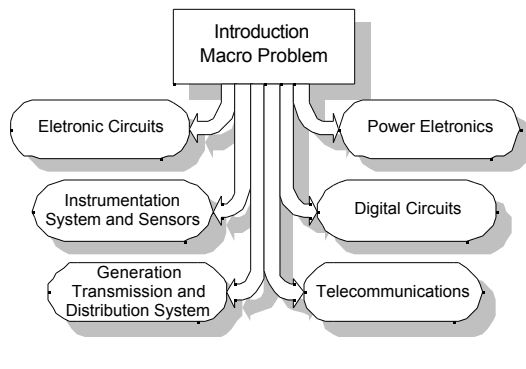


Figure1. Schematic Diagram of the didactic modules

In the Electronic Circuits module, using simulations of electronic circuits, project techniques will be taught. Here the program WorkBench will be also introduced. This module will have duration of three weeks.

In the Power Electronics module, also with duration of three weeks, new simulations in problems of greater complexity will strengthen the knowledge acquired in the first module. Also in this module, using the program VISIO, it will be possible to teach electric diagrams.

In the Instrumentation Systems and Sensors module, still with Work Bench use, measurement techniques will be taught through oscilloscopes voltmeters and current meters. Here the graphical representation of functions will be taught, with the support of the program Origin.

In the Digital Circuits module, the input analog will be converted into digital form. Here the program Word will be presented. This way, the students may elaborate their technical reports.

In the Power System module, a general view of power system will be given. Also, with the program Power Point, it will be possible to teach the students how a technical presentation must be done.

In the Telecommunications module, a general view of the transmission of signals will be given, and it will be introduced the use of the Internet also.

In the module evaluation, the students will be appraised through their report results and, a technical seminar.

All of the software used in this subjects is available in the special Electrical Department laboratory, known as LEI. This lab with 20 Pentium PC-microcomputer is dedicated to serve undergraduate students. LEI has several Ethernet gateways, so that the students can easily use Internet.

For presentation in class, a Pentium PC-computer and a LCD screen will be used mainly to discuss the simulation packages and the simple problems.

Discussions and Conclusions

The systemic view of macro electric engineering problems in a freshmen subjects is the main goal of this methodology. The students can observe all connections between the basic knowledge and the real engineering problem. Already the fragmentation discussions macro problems in simpler problems, allows that the student has the opportunity of solving them with only some theoretical additional knowledge. Adding computer tools in the modules is also possible to reinforce the enthusiasm of the students and to show them the importance of the learning of basic disciplines.

Acknowledgment

The authors would express their sincere thanks to Prof. Baker J. Mass at University of São Paulo for his advice and suggestion on this paper.

Bibliographic References

- [1] DONALD CHRISTIANSEN, Do students really get it? *IEEE Spectrum*, pp 19, Jun. 1992
- [2] DONALD CHRISTIANSEN, New curricula - *IEEE Spectrum*, pp 25, Jul. 1992
- [3] CAÑIZARES, C. A. AND FAUR, Z.T. Advantages and Disadvantages of using various computer tools in electrical engineering courses. - *IEEE Transactions on Education*, Vol. 40, No.3, pp 166-171, Aug. 1997
- [4] ELECTRONICS WORKBENCH -Version 5.0c -Education Lab Interactive Image Technologies Ltd. - 1996
- [5] VISIO TECHNICAL 3.0a for Microsoft Windows -Drag & Drop Drawing for Technical Applications - Shapeware Corporation-Shapeware International Ltd. P.O. Box 4449 - Tallaght - Dublin 24 Ireland -1996
- [6] MICROCAL™ ORIGIN- VERSION 4.10 32 BIT- Microcal software, Inc. - 1991-1996
- MICROSOFT OFFICE for WINDOWS 95 - Microsoft Corporation - 1983-1998