Teaching and Curriculum Development of Electronic Classes in Malaysia

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Abstract

Electronics classes with comprehensive laboratory training components were developed at the newly established University at Batu Pahat in Malaysia. The students had previously earned their bachelor's degrees and were pursuing teaching positions at new institutions being built in Malaysia's rural areas. The curriculum development included process/computer control and real time simulation using the latest microprocessor technology. The laboratory exercises included feedback and control systems, computer control in process and real time simulation. Research activities outside the classroom included computer-based activities and power engineering library research. The gender mix of students was about 50/50. This teaching experience posed a number of questions in terms of the use of existing resources (electronics hardware and software) to direct transfer of previously developed technologies at a new university, or to develop the programs that followed the increase of faculty skills.

I. Introduction

The Midwest Universities Consortium for International Activities, Inc. (MUCIA) was selected by the Ministry of Education-Malaysia to implement the World Bank funded Malaysia Polytechnic Development (MPD) Project in 1994. This six-year-old project has been very successful and now enters a new phase of development with an anticipated extension of the funding. This project focuses on extensive in-service training and development involving exchange of personnel for both short and long term consultancies. This paper discusses teaching and curriculum development for a new university in South Malaysia where the consultant worked with local students on a daily basis for one year. The consultant's work was performed at the Institute of Technology Tunn Hussein Onn (ITTHO), Malaysia. Lecturing covered the areas of Automation & Control Systems and Real Time Systems. Supporting curricula were developed for the classes and laboratory. The contract between the Malaysian Government and MUCIA required the production of a report each semester by the consultant, which would be published in the US and shelved in a Malaysian library.[1,2,3] The objective of this program was to bring primarily American faculty to teach students who had previously received bachelor degrees. The lecturers and instructors were expected to arrive with class notes used at American institutions and to continue their work as experts in their fields. The students lived at the campus residency and were expected to develop a complete set of notes from each course. After program completion, the students were relocated to rural areas where new universities were planned. New curricula introduced at the institute were Process and Computer Control (BEE 6223)[4-15] and

Real Time Simulation (BEE 5243).[16-25] Each course was scheduled for 45 lecture-hours per semester, however the total contact hours were over fifty. Curricula were developed for two laboratories: Feedback and Control Laboratory[26,31] and Microprocessor Laboratory.[27-29] The Feedback & Control Laboratory was equipped with a Feedback Servo-Control System and a Process-Automation Training System. The Microprocessor Laboratory educated the students in microcomputer technology and application. This laboratory was equipped with the Microprocessor Development System (MDS) and a network of 486-computers. I provided instruction in the following fields:

Process and Control Systems
Feedback Systems
Real Time Simulation
Power Electronics Systems

Over fifteen laboratory exercises were assigned. In the feedback lab, a British-made servo system was used. The microprocessor lab was equipped with British-made Flite, Inc. Boards (FLT-68K) using the M68000 microprocessor and two HP 68000 real time emulators. The power lab had AC/DC motors, a Van Leonard assembly and several standard power benches.

II. Cultural Description

The students were in theirs twenties or thirties and it was pleasure to work with them. Our electronics technology program was aimed at increasing their theoretical knowledge and hands-on experience. In general, new curricula were similar to those used in the US. It was customary for a lecturer to use a textbook during the lecture while the students took notes. The Malaysian students were typically more analytically oriented than their American counterparts. They could easily solve equations, but many of them lacked understanding of the underlying principle of the problem. To use a “common sense” design was often challenging for them. They preferred to memorize and repeat what they found in the textbook. Thus, they were excellent at memorizing the equations. However, not all assignments were memorized. In my classes, I required each student to present his/her own article to prove that he/she understood the essence of the problem presented. There have been a number of questions raised in connection with these teaching programs. Should academic funding be used to support previously developed experiments available on commercial market or should new ones be developed? Should students buy their own textbooks to keep them after finishing their studies or should textbooks be available through the local library? These issues cannot be generalized, but I believe that they should be addressed and solved based on local conditions.

III. Curriculum Development

IIIa. Process and Computer Control (BEE 6223)

The Process and Computer Control (BEE 6223) course is the continuation of the 5th semester course - Instrumentation and Control (BEE 5223). The course introduced process-control principles and computer control implementations. The semester schedule consisted of two equal parts: Process Control and Computer Control.

This course was primarily developed to fulfill the instructional needs of an applied process engineer, technologist and/or electrical engineer. The lectures covered system elements, signal conditioning and final control elements.[4-15] The overall objective of this course was to provide instructional material for a general understanding of process-control characteristics such as elements modes and stability along with detailed understanding of measurement techniques, control mode implementation, and final control element functions [4]. In keeping with modern requirements, the digital aspects of process control technology were stressed, while the students were required to have a general prerequisite knowledge of physics and analog, as well as of digital electronics. The instruction included basic terminology currently used by the American National Standards Institute (ANSI) and the Instrumental Society of America (ISA).[4]

At the end of the semester, each student was familiar with distributed control systems as well as both low-level human and high-level human interfaces. The students learned about powerful communication networks able to provide complete, integrated, process control solutions to computer interface devices, shared communication facilities and electrical power systems. In the distributed control field, major issues from the industrial customer's viewpoint were also explained.[5]

IIIb. Real Time Simulation (BEE 5243)

The Real Time Simulation course (BEE 5243) was provided to the fifth semester students specializing in Instrumentation and Control, Figure 1. The course focused on integration of real-time operating system software and system architecture for applications with time-critical constraints.[16] The students in this course learned about real-time systems, including requirements concerning timing conflicts and the application of timing analysis. The fundamental concepts of real-time operating systems in a multitasking environment were analyzed. Task management, concurrent processing, interrupt handling and intertask communication were introduced. The high-level language for real-time application showed an advantage in computer memory management, task priorities and task synchronization. It was assumed that students had basic knowledge of at least one high-level programming language and with assembly language.[16-25]

The students understood that the development of design and production techniques for software necessary to operate computer systems has not kept pace with advances in hardware. This concern of computer programs was presented in both its aspects of developing design and production requirements.

This course was also laboratory-based. Students were trained to operate the real-time debugger (MDS 64700) for the FLT-68K board without the microprocessor in two laboratory sessions.[27-29] A heat-exchanger system of process control was also held in two sessions. The assignments enhanced the role of microprocessors in instrumentation and control of mechanical and process equipment. Case studies were used to introduce concepts and then applied to each laboratory assignment. Problems of increasing complexity were developed. It was assumed at the beginning of the course that only a limited knowledge about microprocessor hardware and software existed among the students.

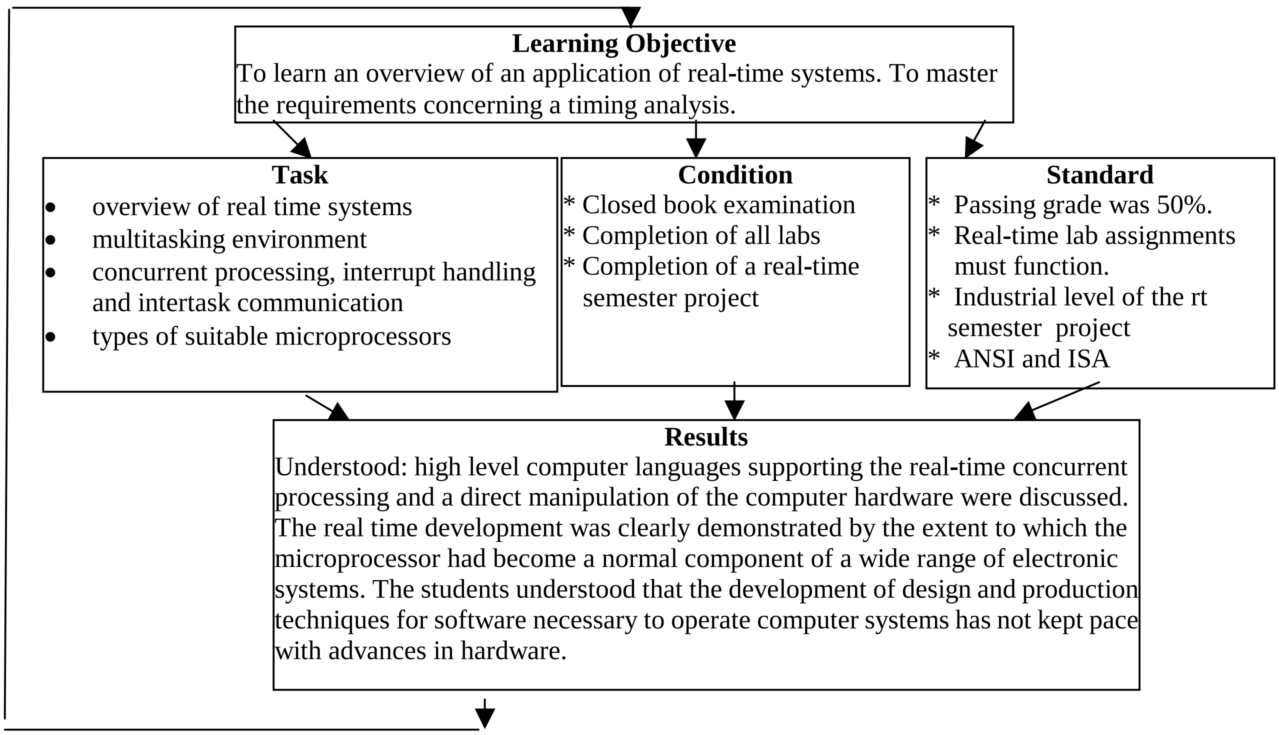

Figure 1: Learning Assessment of Real Time Simulation (BEE 5243)

IIIc. Laboratory Curriculum

The Feedback and Control Laboratory was equipped with the Modulator Servo System MS 150[26] and the PLC system.[30] The lab equipment utilized standard electronics components, frequency generators and oscilloscopes. The following examples of laboratory measurements were investigated:

- Frequency response of electronics filters
- Velocity feedback of non-compensated and compensated system
- State variables
- Deadband, step response, and velocity feedback.
- Basic operation of a PLC - writing a simple ladder diagram

In the Microprocessor Laboratory, the Microprocessor Development System (MDS) used the most advanced equipment in real time. The laboratory assignments implemented a basic operation of the real-time debugger. First, the "dummy target board" was used familiarize students with the debugger operation. There were the following topics investigated by students:

- Familiarization with operation of the real-time C debugger for the 68000 microprocessor.
- Locating the instruction codes, understand the trace window of the real-time C debugger for 68000.
- Operating a demonstrations temperature control program used in the real-time debugger for 68000.

The skill session was conducted in the Machine Lab of the Institute of Technology Tunn Hussein Onn (ITTHO) during the summer of 1996. The development of the curriculum was completed in May, when students ran machines and experimentally verified that laboratory exercises were feasible. The student skill training lasted four weeks. The group of forty students was split into two subgroups. The students obtained basic knowledge about three-phase synchronous generators, dc motors, connecting an ac generator to the utility system, etc. The daily student assignments consisted of two parts per group. The first part was an independent library search for related references. Relevant references were read and understood. The students maintained a logbook with date and time entries (morning or afternoon) mandatory. Each student made notes into his logbook about his library search. Measurements were made in the second half of the day. The second part included the actual laboratory measurement (the skill assignment) implementing the data from the student's search. If necessary, a student could remeasure data at a later date when he/she better understood the system operation.

IV. Conclusions

Electronics classes with comprehensive laboratories were developed at the newly established University at Batu Pahat in Malaysia. This paper describes the development and coordination of an educational assistance program for that institution. A successful teaching model was implemented that engaged the students in industrial projects while interfacing faculty expertise and industrial needs. The students retained lecture materials for their own teaching assignments at institutions being built in Malaysia's rural areas. They also developed a program of internship and placements that both complemented their field of study and assisted in solving industrial problems. The curriculum development included process/computer control and real-time simulation using the latest microprocessor technology. The laboratory exercises comprised feedback and control systems, computer control in process and real-time simulation. Research activities outside the classroom included computer-based training and power engineering library research. The use of existing resources (electronics hardware and software) to a direct transfer of previously developed technologies at a new university appeared as the most efficient approach for developing new academic programs.

V. Acknowledgment

The consultant's work was accomplished during his assignment with the Purdue University program. The author appreciates the help of the colleagues from this university in the development of curricula and experience.

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