On the Strategic Importance of University versus Industrial Lead for Engineering Programmes at the University of Technology, Jamaica

Rae A. Davis (PhD)
President
University of Technology, Jamaica
237 Old Hope Road
Kingston 6
Jamaica W.I.
rdavis@utech.edu.jm

Gossett D. Oliver (PhD)
Dean
Faculty of Engineering & Computing
University of Technology, Jamaica
237 Old Hope Road
Kingston 6
Jamaica W.I.
goliver@utech.edu.jm

Abstract
In this paper the authors address issues related to the demand driven model in curriculum development and evaluation for academic engineering programmes in the context of a third world economy.

Two issues arising from the "Global Engineering Accreditation Bodies"– eg. ABET, US EC^{UK} UK, etc are; employees are looking for knowledge skills in addition to engineering knowledge and professional development so that they will be consistent with the knowledge of the end users.

Further, examples are given as to how the University of Technology, Jamaica addressed these issues.

1. Introduction

In this paper we shall be concerned with 'learning' – namely, to refer to the acquisition of additional technical skills and knowledge by individuals and, through them, by organisations. More generally, then, the term will be used to refer to the acquisition of increased 'technological capacity'.

It is often used to refer to a process of acquiring skills and knowledge that depends largely or entirely on experience: learning-by-doing. The execution of production tasks in one period generates a flow of information and understanding which allows execution to be improved in a subsequent period. This flow of 'learning' is therefore seen as a feedback process which operates within production activity. It also seems to involve two distinguishable components. One is a flow of information which stimulates search for improvement. This is usually information about system performance; it consists of information about problems encountered or opportunities perceived. The second is a flow of understanding and knowledge about how change might be made. The execution of production activities generates a flow of knowledge

about how the particular system 'works'. The increments of knowledge enable better methods to be defined. In trying out such methods, further flows of stimuli and understanding may be generated to allow the change to be perfected – or at least made profitable.

"Doing based" learning has three remarkable properties. First, it arises quite *passively*. Little or no explicit action is required to capture the increased knowledge/skill and whatever benefits flow from that acquisition. Second, the learning process is virtually *automatic*. Given the period of 'doing', some quantum of learning will take place. Third, it is *costless*.

Learning is acquired simply as a free by-product from carrying on with production. No expenditure beyond that needed for production is required to generate the increased knowledge and skills.

This 'something-for-nothing' model of the learning process leads inevitably towards certain kinds of policy prescription. Increased 'learning' requires increased 'doing', and hence various forms of protection for doing are seen as appropriate means of enhancing learning – the benefits of the learning gained will offset the inevitable costs of protection. Beyond that, the role of policy intervention is limited. Since experience accumulation is simply a function of time or of cumulated total output, questions about policy intervention designed to raise the rate of learning derived from a given stream of production activity are largely irrelevant.

This perspective has long characterized the engineering curriculum design at the University of Technology, Jamaica (UTech); particularly in the context of a small developing economy where the industrial landscape is primarily Small and Medium Enterprises (SMEs).

Also driving the process for linkages between industry and academia is the intervention of engineering accreditation bodies such as the Accreditation Board for Engineering and Technology (ABET) of the United States of America and Licensed Members of the Engineering Council, United Kingdom (EC^{UK}).

1.1 The Jamaican Situation

The Government of Jamaica (GOJ) policy framework (Planning Institute of Jamaica, 1997) recognizes that the development process of growth in Jamaica is significantly influenced by the activities of micro and small businesses, but there are special problems which limit the extent to which the sector can contribute to this development. These problems arise from constraints imposed by, among other things, the small scale of operations, limited capital and limited skill of participants in the sector.

In many instances the state of the art engineering equipment and qualified professional engineers are to be found at UTech – the only institution of its kind on the island. Given this scenario, the type of engineering curriculum design for Industry/Academia partnership must be structured differently to that of a developed economy. Where it is proposed that the engineering curriculum should be demand driven (Burns and Chisholm, 2005), Lee addressed this concept, albeit from a different discipline focus in an article published in the TIMES Educational Supplement (Lee). The article states that teachers should adopt the methods of the medical profession to raise the quality of school-based training: - sending trainee to any school that would have them should stop. The article continues, by stating that instead, the Government should set up dedicated university practice schools along the lines of teaching hospitals. There should be expert staff in the school so trainers could refresh their teaching skills. If you're in teacher training and not teaching regularly, you shouldn't be doing the job", the article states.

The parallel discussion is pertinent to the design of the engineering curriculum at UTech.

1.2 The UTech Model for Industry/Academia Links

The Industrial Cell concept at the University of Technology, Jamaica is a scheme by which industrial companies are involved directly in the education of undergraduate engineering students during the academic parts of their degree course by using a Problem Based Learning (PBL) approach. The benefits of the scheme areas follows:

(a) **To students**

1. opportunities to relate academic work to industrial needs
2. exposure to industrial constraints
3. close working contact with young professional engineers
4. an increased awareness of different types of Industries, requiring Engineering inputs

(b) **To academic staff**

1. increased opportunities for industrially related research
2. increased exposure to new technologies in industry
3. increased opportunities to equip laboratories/workshops with industrial type equipment

(c**)** **To industrial staff**

1. reduced R & D cost
2. close working contact with University staff with consequential opportunities for co-operative research
3. training for young company engineers
4. opportunities for assessing students for employment
5. reduced response time to changes in technology

This paper, as well as providing background information on the proposed organization and structure of the Industrial Cell, is intended to be a useful source of information for participating companies. This would however, be supplied by additional information to guide Company Engineers and Industrial Tutors when projects are being chosen.

1.3 The Foundations

The School of Engineering at UTech considered that the implementation of the recommendations of the various accreditation bodies would represent a significant paradigm shift in the education of its full-time undergraduates. In the context of downsizing of many companies in an environment where the economy has experienced continued yearly 1-2% growth, there are a number of well known barriers that have the effect of discouraging companies (those who, have survived.) from participating in training opportunities. From the outset, it was obvious that operating the type of scheme, which requires large elements of managerial, commercial information and industrial as well as professional skills, would involve a high level of expenditure, which could not be met entirely out of the school's funds. The training partnership, therefore, must seek innovative approaches to develop organizational and delivery strategies specifically designed to overcome these barriers.

In Spring of 2000, a consortium was established on the basis that, as well as, providing the necessary input via projects and industrial tutors the companies would also contribute cash and kind towards the cost of running the Industrial Cells, by way of a formalized contract.

The extent of Industry "pump priming" took many forms such as;

a. Developing contracts, which are formalized agreements, between UTech and Companies;
b. Forming Industrial Advisory Panels, on which member companies would be represented, to coordinate Contract functions. The Panel meets formally twice each year, and is an essential forum for the development of Contracts. Panel meetings are also attended by academic staff from the School of Engineering.

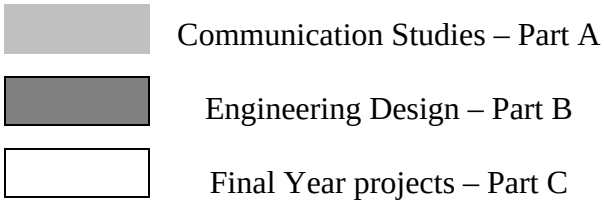
1.4 Structure

The Contract's activities span the last three years of the engineering programme. In line with the Contract's objectives, the activities relating to it are devised to establish a high level of interaction, between students, academic staff and industrial engineers. This is achieved through student project work, secondment of staff to companies, and co-operative research.

It is important to note that the development of the Contract's activities is carried out within an existing course structure. An important feature of this approach is that additional loads on academic staff would be kept to a minimum.

Second Year – In the second year, the Contract project will be part of the Communication Studies course. The objective of this subject is to develop the students' ability to communicate with others through the most appropriate media. Students should be given practice in communicating their views on engineering topics by means of written reports and oral presentations. The Contract projects form the basis for this work, which commence in January of the 2nd semester – see **Table 1**.

Table 1: Course Structure



SEMESTER 1				SEMESTER 2				SEMESTER 3			
Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
				Part A				SECOND YEAR			
Part B								THIRD YEAR			
Part C				Part C				FOURTH YEAR			

Discussions between the Communication Studies Subject Tutor and company engineers are held towards the end of the 1st semester to establish suitable material for the projects. The company engineers who act as Industrial Tutors to the students are usually professional engineers.

About four (4) companies are involved with project work in Communication Studies from the 2nd year. With the 2nd year student numbers pertinent at the sixty mark, this means that each company provides five projects to enable the students to work in groups of three.

The structure of the UTech Engineering programme requires all first year students to pursue common courses, for this reason, the industrial cells start in the second year where project selection draws upon a substantial demand upon the students' knowledge of engineering science. Projects are therefore based

upon Problem – Based Learning in which students are required to research and review a topic or area of current technological interest.

In this context, Problem Based Learning (PBL) is a real thing or task, which is used to reinforce material that has already been taught.

Problems are usually "real". An example is given in **Table 2**.

Table 2: Example of a Problem

University of Technology, Jamaica
School of Engineering
Problem Based Learning: Communication 2nd year

Problem 1

A number of Cable & Wireless (C&W) consumers were rather irate to learn that Cable and Wireless had communicated to them through Voice Mail message on their telephone, imposing a voice mail service upon them, albeit free of charge for a predetermined time.

The Office of Utility Regulation (OUR) on behalf of the consumers took Cable & Wireless to Court, where Cable & Wireless were found guilty of this act and was ordered to withdraw this imposition.

Some Issues to be Addressed

(These are to be determined by cell number 1)

1. How was Cable & Wireless so certain that this was an appropriate form of communication?
2. Why were the consumers so irate, given that there were no cost to them?
3. Is it that the Jamaican Consumers are so technophobic that they were put off by this means of communication?
4. Calculations are needed to establish why Cable & Wireless found this method cost effective by offering the service free for a given period.
5. Consider the damage done to the company's image.
6. What would be (in your opinion) an appropriate method for introducing this to consumers? Narrate your opinion.

The construct of such a project is done between the academic tutor and the industrial tutor. This type of Problem-Based Learning is a learning experience in which the amount of formal teaching is reduced to a minimum. Students, working in small groups work out what knowledge they need to solve the problem, then set about acquiring that knowledge. This approach relies on the appropriate resources being available for the students, such as: computers, library and laboratories.

Students are presented with their project briefs at the start of the 2nd semester. This is followed within the first four (4) weeks of the semester by a visit to the participating company when students can meet their Industrial Tutor and discuss the brief with him. The students are accompanied on the visit by a member of the academic staff whose role is to liaise with the Industrial Tutor, during the projects, to handle the passing of information to the students, and help with visits by the Industrial Tutor to the University. The structured visit has two purposes. Firstly, it allows the student to examine the environment in which his

topic exists, and secondly, it extends his awareness of industry. This second aspect is important, and care is to be taken to maximize the benefits by ensuring that students will be associated with the types of industries, which will be different to their previous experience. Hence, a student will not be assigned to a company, which "deals" with the same type of product as the Company in previous projects.

Third Year – In the third academic year, the Teaching Contract project is part of the Engineering Design course. At this stage, students are in their advanced course of study, and will be able to cope with the greater engineering science content involved in these problems.

Third year teaching Contract projects are chosen to be open-ended in nature. Students are expected to assess the problem as presented to them by their Industrial Tutors, and write a detailed specification. Alternative design proposals must then be presented from which a preferred idea is selected for development to the advanced concept stage.

The structure has a provision where students take part in a visit to industrial companies, where tutorials are held with Academic and Industrial Tutors, after which they are assessed by means of a written report and a seminar performance. However, an additional assessment is included in the form of a Preliminary Report, which is submitted the week following the industrial visit. This report must contain an evaluation of the problem by each group and include detailed specification. The main benefit from this requirement is to make students concentrate their attention on the project quickly so that the benefits of the visit are not lost.

A typical structured visit will take three (3) hours. The first hour usually includes a general item and introduction as product range, market forces, turnover etc., and enables the student to place his topic in the same overall framework as his Industrial Tutor. The second hour should generally involve splitting the students into groups and taking them around the facility.

Particular attention is paid to those areas, which are associated with a group's project, and gives the students the opportunity to ask questions. The third hour should see the groups reunited for discussion on the projects with their Tutors.

In the weeks following the industrial visits, the students devote their time to informarion gathering and generally planning how best to handle the presentation of the project topic. The Communication Studies lecture programme should help them to do this. At the end of the Spring term, the Industrial Tutors visit the University to hold tutorials with the students to ensure that the aims of the projects are being met and to assess the progress made with the technical content of their project.

Assessments are done by progress tutorial, a joint written report submitted by each group and by performance in an oral presentation given during the Summer term to academic staff and Industrial Tutors.

Final year projects supplied by teaching Contract companies offer the student the opportunity to work on problems closely related to industrial needs.

Conclusion

A key factor in this approach; is to guide appropriate learning outcomes, given the shortcomings of engineering training in companies. Another key factor in PBL is that knowledge gained through learning is maximized and that obtained by tuition minimized.

This carefully crafted programme has taken three courses – Communication, Engineering Design and Projects and has woven them in a college based curriculum so as to enable the engineering graduates to Hit-The-Ground running in the areas of:

1. Problem Solving Skills
2. Computer Literacy
3. Interpersonal Skills
4. Group Working Skills
5. Numeracy Skills
6. Written Communication Skills
7. Time Management Skills

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