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Development of Flexible Education Systems for Technology Students

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Abstract

The pressures on educational institutions to keep pace with the changes in educational theory and technology are growing rapidly. There is now more competition between education providers, especially in the tertiary and career training sectors, this has meant that students and industry is demanding more input into the education process. As a result a more flexible approach is being taken to the delivery of courses. This thesis describes the development and implementation of a flexible learning approach applied to technology related subjects. It addresses the work carried out in relation to a specific aspect of the Bachelor of Technology degree as taught at Massey University, Palmerston North, New Zealand. Issues have been addressed in educational programme design, material presentation, and a major focus for implementation has been computer mediated assessment mechanisms. A guide has been developed to assist the educator in increasingly applying flexibility to subjects undertaken within the Bachelor of Technology degree reflecting the specific needs of the New Zealand industrial and educational sectors.

Key words: Flexible education, flexible learning, computer mediated education, computer assisted learning, computer simulation is assessment, computerised marking, computer mediated assessment.

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“Learning is more effective when it’s fun”

Peter Klein

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1 Introduction and Overview

1.1 Introduction

This thesis addresses the issue of flexible education as applied to technology related subjects. Specific attention is given to the development of a flexible course structure and the implementation of assessment units.

In the face of a changing educational environment a more flexible approach is increasingly being adopted. Flexible learning seeks to enable students to learn at their own pace, in a preferred location, the topics of interest within a given qualification structure, and at a time more convenient to themselves and in a manner that maximises their learning. The provision of such programmes frees both the student and educational institution to focus on the material being taught, and to assist students to understand and implement what they are learning.

The introduction of flexible programmes of study is being enabled in part by the development of computer and communication technologies. No longer is distance a limiting factor in the delivery of education. With the use of conferencing technologies the interaction between students, and between student and tutor is maintained independent of location. Of special significance is the developments in computer technologies, both in terms of available hardware and software. It is increasingly possible to view live video images of people and machinery in real time. The computer control of such machinery has enabled the complete remote operation. Thus enabling a student, or worker, to control the actions of a machine, be it an experimental apparatus or a production model, from any location and see the response to commands issued with a minimal delay.

Where a computer forms the central delivery or communication passing agent in a flexible learning environment this can be termed Computer Mediated Education. The ability of a computer to perform repeated tasks and its relation to the drill and practice exercises of many existing educational systems has long been established. A number of systems are available that use this method to instruct the user. Some subjects relate specifically to this type of learning and they should continue to be used. The subject areas addressed in this thesis are those that primarily do not fall into this category. A matching of subject matter and ways available to assist in its teaching was made, and where possible implemented. Some of the possible solutions fell well beyond the limitations of time and financial availability for both the work contained in this thesis and that of most educational institutions. It is acknowledged that the reality of life is that the available level of finance and other resources is not infinite. A perfect solution may be implemented with unlimited resources, yet here we have sought to work within strict limitations to establish a good and valid solution that is both sustainable and adoptable.

Amongst the increasing pace of change in technologies available has been changes in the focus and requirements of education. The requirements of tertiary level education especially as it relates to professional training, for example doctors, engineers, veterinarians, technologists, is constantly on the move as the professions themselves adapt the changes in society and technological developments. Tertiary institutions are under pressure to keep up with these changes, with the pressure coming from the industry for which students are being prepared and from the

students wishing to equip themselves for future careers. Flexibility within a course of study is one way to address both of these issues. It enables the establishment of modularised subjects which can be updated faster and with greater accuracy than before, and to establish greater links with those in industry resulting in a shorter gap between the subject studied at university and that which is later applied.

The rate of change now being experienced is reflected in the need to acquire life long learning skills and attitudes. No longer is it possible to remain in the same job or forty years without the job changing dramatically. Graduates now face the prospect of re-education and re-training at least three to four times in their working lives. The implementation of a flexible learning programme enables the student to discover and use the ways in which they learn best. The knowledge of how they learn best, and what support activities are of benefit, is applicable to any training or education undertaken. Education is coming to be viewed as a partnership between the institution represented by its various tutors and the student. No programme is fully successful unless both parties actively engage in the learning exercise to establish, measure and achieve the desired goals.

The joint meeting of educational goals and the utilisation of appropriate technologies has been a major focus of the work carried out within this thesis. The thesis itself presents both sides in order to demonstrate that the purposes of education, the needs of industry for trained graduates, and the preparation of students for life long learning, as especially applied to technology subjects, can be achieved.

1.2 Outline of the chapters

Chapters 2 and 3 focus on existing research and system implementations. Chapter 2 from an educational perspective and Chapter 3 from a technological and systems perspective. Current practices and why they are in place is discussed in Chapter 2, along with proposes ways to implement new systems form the existing educational theories. The resistance to any change is presented along with issues specific to the education of technologists and engineers, and the impact of changes in available technologies is having upon the their professional career development. Chapter 3 addresses the available technologies and the systems within which they operate in a more detailed manner. The focus changes in this chapter to reflect a more technology orientation and thus more technical detail is presented than that found in Chapter 2. Various mechanisms and environments useful within an educational setting are discussed along with the technical issues of delivering the material in the various formats to a distributed audience.

Chapters 4 and 5 deal with the development of strategies for flexible learning and their implementation as it relates to material presentation and assessment of learning. Chapter 4 outlines the development of a flexible learning approach in relation to the Bachelor of Technology degree and the subjects undertaken within it. It discusses aspects of course design relevant to any subject and the selection of appropriate presentation mechanisms. How the material is to be delivered and presented has its' own effects upon the choices made and the number of different implementations required to accommodate the various learning styles of students. The way a course is assessed is determined in the most part by what mechanisms of delivery and presentation have been used. Options available and the related security factors are also discussed. Chapter 5 presents the implementation of several experimental

systems, two relating to material presentation, and four relating to the assessment of learning. The methods used or material presentation is dependent upon the needs of the audience and the desired use of the material. Two of the available methods are presented in relation to computer based systems for material delivery, they are instructions and interactive learning. As stated earlier assessment units were a specific focus for the experimental work carried out within the scope of this thesis. There is a large section in this chapter presenting the development over time of assignments that have been implemented in a computer mediated fashion. From each implementation improvements were noted and incorporated into the next implementation. As the assessment of assignment work has become increasingly available by these mechanisms so attention is drawn to the more formal aspects of the evaluation of student learning, the final examination. To conclude this chapter the development of the simulation systems behind the assignments is presented with the full programme details contained in the associated appendices. Formal conclusions can be made at this point as to the effectiveness of such implementations which lead to the identification of good systems components and guidelines for further implementations.

Chapter 6 outlines the impact of the experimental work carried out to date, and the implications for further development of a flexible learning approach to technology related subjects, and beyond. It reflects the lessons learnt over the entire period of experimental work and the implications these have for increasing the levels of flexibility within the Bachelor of Technology degree.