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Using the internet to support education: Implications for life – long learning and self assessments

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ABSTRACT
Included in the New Zealand Government's green paper 'A Future Tertiary Education Policy for New Zealand' is the intention to put in place common quality standards, standard methods for reporting programmes of study, and a national system to record all students registered in any paper at any tertiary institution. Through the National Qualifications Framework (NQF) the government asserts the right to ensure there is one coordinated qualifications system that is easy for the consumer to understand and use. Since this plan is being phased in over a four to five year period there remains much to be done. Independently of the NQF, many tertiary institutions have initiated their own quality assurance processes as well as projects to assist students in evaluating study options and accessing learning resources via the internet. One such project is an internet, browser-based, computer-supported learning (CSL) system designed and built by The University of Auckland's MSIS Department to serve primarily business students. Now completing its second year of operation it has moved to a more powerful computer platform and been completely redesigned to become a university resource. Several thousand students use CSL daily. This paper will outline the development of CSL and, in particular, discuss our work in connecting a taxonomy of knowledge with the multimedia assets needed for learning and assessment. The implications for self-directed study and our university's goal to provide life-long learning will be presented. In the process we believe CSL also complements NQF objectives.

Introduction

In addition to well-established tertiary institutions, New Zealand has experienced a rapid growth in occupational training standards and the necessary infrastructure of training organisations and establishments to support them. The public and private sector are committed to meeting the occupational needs of New Zealanders for the next decade and beyond.

There were 1,200 post compulsory education institutions in 1995 with an enrolment of 244 336. Of these institutions there were 7 universities with an enrolment of 104,525 and 25 polytechnics with an enrolment of 94,389. The majority of the institutions listed were 'other' private training establishments (NZ Official Yearbook, 1996).

In the green paper, 'A Future Tertiary Education Policy for New Zealand' (Ministry of Education, 1997) we are informed that the consumer has difficulty purchasing an education given the proliferation of programmes of study across many institutions, private or public. Through a standard

reporting system and quality assessments the consumer is expected to be better able to compare 'apples with apples'. The government is also expected to achieve inner peace based upon the assumption that government funds are purchasing what is intended. A complex data base system is planned that would register each paper taken by a student, and the student's intended programme of studies within an institution. In addition, through public access computer stations, the planned system is to provide the consumer with a means to examine the programmes of study for all tertiary institutions and thereby to make career decisions based upon the information provided. There is considerable apprehension in educational circles regarding the costs and benefits of this system, particularly, if the costs are to be borne by institutions through new, complex reporting systems and a pro-rata charge for the data base administration. The move toward quality assurance practices, on the other hand, has been strongly supported by the New Zealand Vice-Chancellor's Committee (NZVCC, 1997).

At the macro level, the implementation of a National Qualifications Framework (NQF) will give students the freedom to work towards national qualifications by 'continuing their studies, and adding to their credits, wherever they wish - at school, university, polytechnic, a private training organisation or even in the workplace' (NZ Official Yearbook 1996, 1997). At The University of Auckland, with an enrolment of approximately 25,000 students, there are approximately 3,000 papers taught per semester. Students within existing programmes of study are free to mix and match papers with the result that there are apparently 20,000 unique profiles. How a national system will grant the consumer freedom to shop across the 1,200 tertiary institutions while gaining a national qualification will be a wonder to behold. To many it appears to be a bureaucratic nightmare in the making.

On the positive side, the call for greater visibility for programmes of study comes at a time when institutions are recognising they have competition not just down the street but often overseas as well. Programmes of study and even advanced degrees are being offered over the internet by internationally accredited organisations. New Zealanders, often early adopters of new technology, have not been slow to appreciate the usefulness of the internet.

In a country with a population of 3.6M, there are approximately one million computers that use or could be upgraded to use the internet. An additional 200K are purchased each year. The number of internet accounts in New Zealand is 105K, with 32.5K business and 72.5K personal accounts (IDG, 1997). The total number of individual New Zealanders with access to the internet maybe as high as 590K (AGB-McNair, 1997). The percentage of computer users joining the internet is exciting and carries with it the usual significant commercial possibilities. But we are not the only country coming to terms with the implications of technology. In fact we may, as individuals, clearly understand the implications of high technology but as a nation we may be too slow.

Singapore plans to have 84% of its residents on a broadband network by the year 2000 as part of the country's vision to be a hub of excellence in telecommunications. Malaysia will be investing NZ $5B to enter the e-commerce, telemedicine, and distance learning arena (Cayford, 1997). Countries with the best electronic infrastructure will attract the information work and knowledge workers. For NZ to capture the market or even get a significant piece of it government and business must establish a stable, open, level playing field.

Progress is being made. New Zealand has a fully digital telephone system and competition is increasing for the consumer's business. Moves by the major telephone company to place free internet service points in every school and access points in every community lead one to ... believe that internet services will rapidly increase in functionality and bandwidth - while remaining well within the budget of many families. Kiwi consumers now are able to shop for virtually anything, including an education, on the world wide web.

At the academic level, a substantial majority of first year students at The University of Auckland's School of Business own multimedia computers and more than thirty percent used the internet frequently from their homes before enrolling at the institution. The University recently

signed a strategic agreement with a major internet service provider to gain access and bandwidth well beyond what it could have arranged using internal university resources. With an enrolment of approximately 25,000 students we now have the capacity to handle more than 6,000 simultaneous users through internet communications. The university is uniquely positioned to serve the nation with its knowledge resources. The challenge is to reengineer these educational resources to suit the new medium.

As one answer to this challenge, a computer-supported learning (CSL) environment has been developed in the past two years by the Management Science and Information Systems (MSIS) Department of the University. CSL was built around the popular internet browsers and was designed to support administrative, communication, instructional, resource management, and assessment modules. This internet based resource has become a platform for disseminating our knowledge resources using multimedia technology.

What is CSL?

Computer supported learning (CSL) is a comprehensive structure for the organisation of the curriculum and the provision of individual learning programmes, on-line access to instructional materials, electronic mail, resource booking, on/off line assessment, while providing the academics with audit trails and competency records. CSL was initially built on a Microsoft NT server using SQL 6.0. with Delphi and Java modules. It has since migrated to a Sequent NumaQ and uses a software architecture that delivers active pages generated by MS ASP+ COM objects. The CSL data model includes more than 200 tables and 1000 attributes and is managed using an industry standard CASE toolset. Aspects of CSL's data model replicate those of the Registry with the result that the university's administrative systems can update enrolments in CSL as well as up-load marks from CSL. Naturally, CSL is platform independent since the browsers mounted on Macintosh or Windows systems worked equally well. In addition with the new software architecture CSL is database independent. Figure 1 illustrates the CSL model.

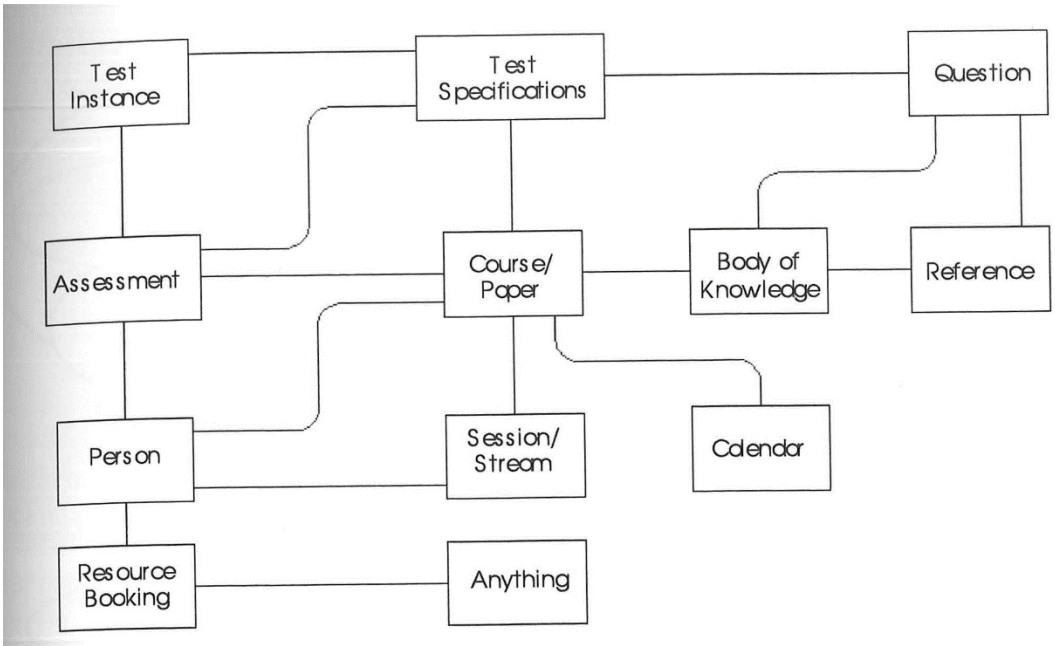

Figure 1 CSL Model

In this paper we will focus on two CSL features as they address the issue of life-long learning: the representation of knowledge and the provision of on-line assessments.

Bodies of knowledge

In the CSL data model all learning is related to what might be called a career, discipline or a body of knowledge (BoK). Many professions such as medicine, accounting, mathematics and information systems have well articulated taxonomies. The New Zealand Qualifications Authority has technical training standards that also form BoKs since they provide a framework for learning and assessment. This is portrayed in Figure 2.

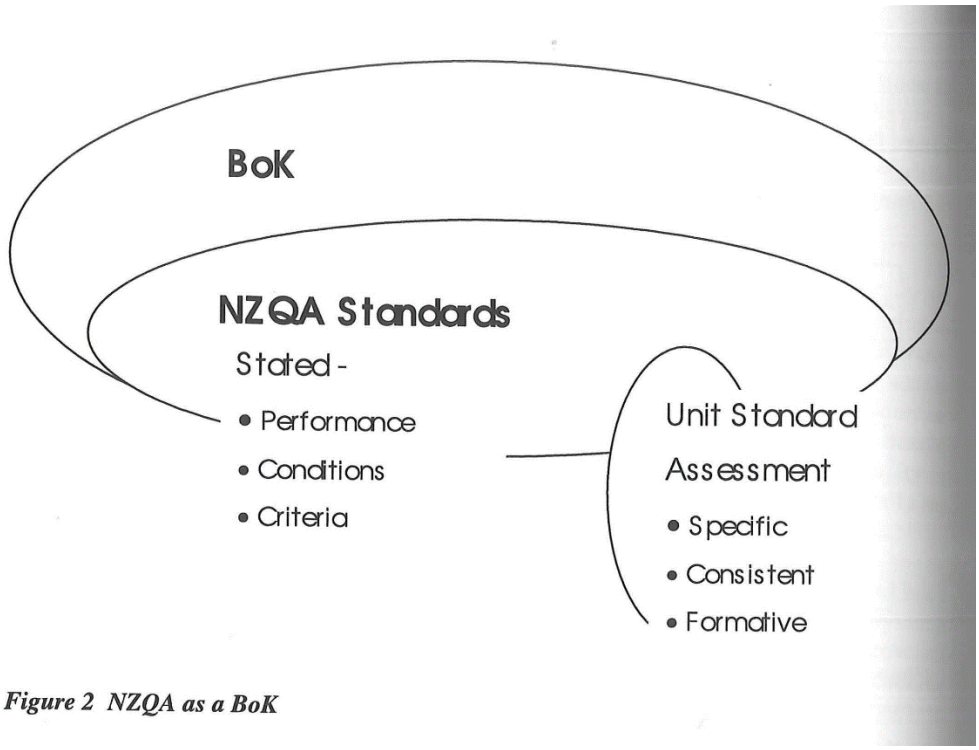

Figure 2 NZQA as a BoK

The body of knowledge (BoK) for information systems (IS) has been developed over more than twenty years and based upon numerous studies by individuals and professional organisations (Couger, 1973; DPMA, 1986; ACM, 1983; IEEE, 1980; Longnecker et al., 1995; IRMA, 1996; Davis et al., 1997). One such body of knowledge (IS'97) is accepted by AIS, ACM and DPMA as a model curriculum (Davis et al., 1997). In it are detailed hundreds of knowledge elements classified in a variety of ways that includes the use of Bloom's Taxonomy of Educational Objectives (Bloom, 1956). Combinations of the knowledge elements form learning units that in turn form the basis of courses of study in IS. Figure 3 depicts the IS' 97 framework.

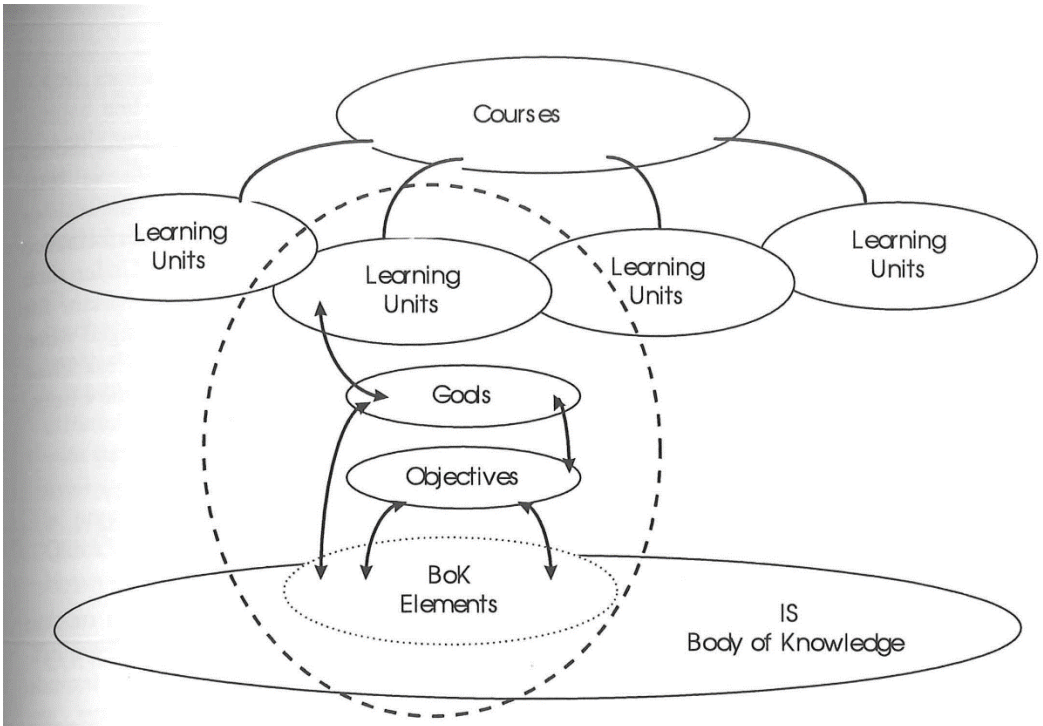

Figure 3 IS '97

Using CSL our MSIS department has proposed to make a formal link between professional requirements (the body of knowledge for Information Systems), our courses of study, individual papers, and our assessments.

Building a link between assessments and knowledge elements has many benefits; one is the student's ability to plot their progress in their studies over weeks, months, or years. In our design we retain students' achievement data with the result that we can provide a report on what parts of the body of knowledge the students have learned, what remains to be learned for a qualification, and what changes have occurred in the body of knowledge that were not available when they were taking their training. This latter feature should be useful for planning post-graduate sessions.

If post-graduate training or continued education is necessary then the differences between a student's personal accomplishments and their desired goal can be readily provided. In the case of obsolescent knowledge then the new knowledge elements are provided as links from the knowledge elements the student mastered earlier.

Under CSL students may wish to have their academic record stored at their former institution or at a central site and choose to query the system over the internet. If privacy is an issue, an individual may store their academic record on their personal computer and then use the internet to compare their accomplishments with the current standards.

Learning through self-assessment

A dedication to life-long learning assumes the individual will be committed to continuous self-assessment. Many students have been put-off by their experience with 'academic' tests and subsequent personal failure. Often failure was as much the failure to 'read' the teacher as to read the book. Linking assessment with standards brings into the open the performance criteria expected and the conditions under which the assessment will be given. Under such systems students who

often thought of themselves as failures find a new enthusiasm for learning. Learning can often be at the student's pace and assessments can be arranged when the student has practised enough to feel confident of success[1, 2]. The student feels less stress when the nature of the assessment, its conditions and timing can be controlled to some extent.

> Assessment should not dictate curriculum or be unmanageable. It must be fit for the purpose. It should be a process linked to learning, not a separate entity. Its impact should have positive, not negative consequences for learning (NZQA, 1996).

CSL has been designed to support all known types of assessment ranging from on-line assessments involving multiple-choice, text, numeric, or pointing questions to data from offline assessments such as 'hands-on' evaluations. On-line assessment items may include multimedia such as graphics, still or moving video, and audio messages. Thus, the multimedia contribution could be anything from heart sounds to a short compressed video. CSL has been designed to make use of existing and future multimedia options on the internet or the client's system.

Results

In its first year CSL provided 6000 on-line quizzes, and marked 1800 off-line tests for approximately 1200 students. It also supported browser-based grade book and resource booking systems the students could access remotely. In the second academic year enrolment increased to approximately 2600 students and more than 40K on-line assessments were conducted. Off-line tests were also scored using a combination of an optical mark reader (OMR) and test specifications set-up in CSL. More than 30K OMR sheets have been read in the past two years. Whether the assessments are formative or summative, diagnostic feedback by email to each student is normally produced. On occasion we have issued approximately 1K email messages in ten minutes. CSL has processed more than 350 transactions per second and has not maximised its capacity.

During a typical on-line assessment a student is presented with a unique set of questions selected from an item bank and matched the requirements set by the instructor. During the assessment students can review all of the questions, answer them in any order, change their minds, check the answers to be submitted and finally exit the assessment. Immediate feedback normally includes the total assessment score and is followed by a detailed diagnostic message sent to the student by email. CSL is able to generate very detailed feedback messages, for example, each answer option of a multiple-choice question could have a separate message. Precise remedial recommendations could be given if the author had the energy to write them.

CSL captures every action the student performed on-line - including ifs/he changed his/her mind and when it happened The diagnostic feedback for both on-line (weekly) quizzes and term's tests is generated through the data model that links course references and assessment items. The system has a high level of security, passwords can be provided that have a life span of less than a minute. If there is any technical failure during an assessment, CSL has always stored the student's last response.

CSL is a sophisticated environment. Many forms of course management, assessment and feedback can be provided by the computer system (server). However, the end-user's experience will be governed by the strengths and limitations of HTML and the bandwidth available. Our preferred solutions, including JAVA, have provided quite a challenge due to differences among the browsers for the various platforms. These problems will be overcome with time. In the meanwhile much useful material can be presented using the authoring tools available in such products as Office 97 and Netscape Gold. Media from a variety of sources is prepared using Adobe Photoshop and Premier. Audio and video are presented in QuickTime and Real Audio / Video formats. The IS'97 taxonomy is being prototyped in Hyperwave, Apple's Project X (HotSauce), a VRML, and our own database solution.

Conclusion

We believe computer supported learning, easily accessed through the internet, can provide useful assistance to our academic community. CSL may become one of the means by which the university reaches out to its constituency to fulfil its mission. In addition to teaching, universities create, organise, store, disseminate, and assess knowledge. Our computer systems can be designed to intelligently deliver many of our traditional services; and, if permitted, to acquire, analyse and model groups or individual's learning achievements. Academics will not be replaced but their role as a guide and a resource will be emphasised.

Institutions that place their bodies of knowledge, curriculum and their assessments in the public domain will persuade New Zealanders that they are progressive, goal-oriented and successful - a necessity to maintain the competitive-edge in the global marketplace?

Notes

1. In a Michigan study of 203 middle school (adolescent) it was found that students who need the most help are the least likely to ask for it. Peer pressure appears the major factor in preventing students from asking for assistance. The motivation for help is off-set by the fear of looking ignorant.

   Ryan and Pintrich (1997), Allison M. Ryan and Paul R. Pintrich 'Should I Ask for Help?' The Role of Motivation and Attitudes in Adolescents' Help Seeking in Math Class. *Journal of Educational Psychology* 89(2) pp. 1-13

   CSL provides ample opportunities for practice with diagnostic feedback.

2. 'Modern theories of cognitive and constructive learning portray students as agents who set and pursue goals. More effective students select among cognitive tactics they use to approach goals and learn from false starts and setbacks. These students self-regulate not merely performance but also how they learn. How do students develop forms for self-regulating learning? The author suggests they experiment thereby bootstrapping newer forms of self-regulated learning from prior forms. Experimenting is an arduous way to build knowledge and it is subject to at least 3 obstacles that may be especially troublesome for young students: obtaining sufficient practice with appropriate feedback remembering how learning was enacted, and reasoning about factors that affeci learning.'

   Winne (1997) Winne Philip H. Experimenting to Bootstrap Self-Regulated Learning. *Journal of Educational Psychology,* 1997,89(3), pp. 397-410.

   CSL can complement conventional instruction by providing an organisational structure for self-regulated learning.

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