

Enhancing Learning Through Technology

Research on Emerging Technologies and Pedagogies

Reggie Kwan • Robert Fox

F T Chan • Philip Tsang

editors

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ENHANCING LEARNING THROUGH TECHNOLOGY

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PREFACE

The marriage between technology and education is as old as, perhaps, the invention of paper. As Business Week predicted in 1995, “*The Web Changes Everything*.” Traditional forms of teaching and learning are being transformed in a very short period of time. The use of ICT in education continues to grow in its popularity as well as its usefulness. New models, platforms, applications, etc. pop up everyday. Some helped at-risk students, some are used to gauge the progress of students, while others tackle legal issues; and many are discussed in this book. The Web has significantly helped increase access to education opportunities. Our ability to harness all the new technologies and apply them appropriately is and will remain a key element in education. This paves the way for new pedagogies to emerge.

This book is a collection of research work done in different parts of the world with one common goal – to enhance teaching and learning through technology. Content interaction and learning support are some of the key issues in the book. Many of the contributors worked together, so to speak, in cyber space as a result of technological advances. Many got to know one another through conferences we attended since the late 90’s. Many of the ideas in the book were presented at ICT2006 and ICT2007. The conference attracted about 300 researchers and practitioners around the world annually. One of the authors of Chapter One was indeed a keynote speaker from the conference.

We would like to take this opportunity to thank all contributors for their insightful work in the area. We would also like to extend our gratitude to organizations for which we worked. Last but not least, much credit should also go to the army of reviewers associated with, in particular, the International Conference on ICT in Teaching and Learning and the Hong Kong Web Symposium.

July 2008

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ENHANCING LEARNING THROUGH TECHNOLOGY: CHALLENGES AND RESPONSES

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Abstract

This opening chapter provides an overview of the challenges currently facing educational institutions, particularly universities, with respect to both learners and the array of new and emerging technologies confronting tertiary educators. In addressing these challenges, the perspective taken is an institutional one, illustrating how institutions can act strategically to both encourage innovation and, at the same time, ensure that the technological underpinnings of the learning and teaching environment are stable and supportive. A particular example is used, showing how the development of strategic planning and documentation can guide the three key aspects of governance, policy and process with respect to the use of educational technology.

Introduction

We live in a world of constantly emerging new technologies that challenge the field of education while at the same time present exciting opportunities. Strategic use of new educational technologies can enhance learning and teaching. However, to be effective, new educational technologies need to be supported by innovative pedagogical approaches which in turn enable collaboration, communication and mobility. Such emerging educational technologies include virtual worlds, wireless technology and the spiralling use of mobile devices.

In responding to the challenges, how do educational institutions, in particular universities, investigate and assess the options with respect to creative and innovative use of new technologies in teaching and learning. Typically, universities, though finally recognizing that there is no ‘magic bullet’ that will answer all challenges (Schramm, 1977), still lack a structured approach to collaborative innovation, development and implementation of educational

technologies. This chapter will attempt to discuss and illustrate how institutions can develop a whole-of-university strategy for effective utilization of new technologies to enable an enhancement of learning and teaching, recognizing and reflecting both internal and external contextual factors.

Challenges

Opportunities presented via new educational technologies are inevitably coupled with challenges. Laurillard (2007) points out a range socio-political challenges facing educational endeavours in higher and further education, such as higher standards of attainment, wider participation and lifelong learning.

Apart from the wider socio-political challenges, there are also the more technical challenges related to the introduction and use of new educational technologies. For instance, the sheer range of new technologies presents challenges in making correct selection decisions for specific learning tasks. This is further complicated by the existence of a wide range of software and limitations in infrastructure and resources available to higher education institutions. More specifically, the challenges to learning with technology include being in an information rich age, with the associated open source software developments, social networking tools, mobile devices and increasingly large and complex management systems. Achieving a balance between these and other factors presents a challenge to all educators.

At present, we are in an era where vast amounts of information are being accessed and transmitted electronically. This applies to all aspects of modern life, education (including higher education) and work. Specifically focusing on higher education, the question that may be asked here is: How can learners manage, survive and thrive in an information era? For example, how can teachers present complex concepts more holistically, displaying complex inter-relationships? The movement towards more visual representation of these complexities challenges the traditional textual presentation of information.

Currently, there is a growing trend towards the use of open source software in higher education, but its spread so far has been uneven. This software provides educators with opportunities to adapt and innovate. The leading areas where open source software is applied are, for instance, with respect to university portals, course management systems and student portfolios. Abel (2006) highlights several significant advantages in using open source software, such as the relatively low cost of ownership, integration with the campus infrastructure and security. Abel also points out the main reasons why some higher education institutions have not seriously considered open source

approaches, including a lack of resources for implementation, an unclear future for open source in higher education, satisfaction with current non-open source software (therefore no reason to change), and lack of clarity of associated costs (Abel, 2006).

Further, there is rapidly increasing use of social networking tools, such as blogs, Facebook, myspace among learners. Often these are employed as a form of social support networking. However, the question is to what extent and how students learn through them and thus to what extent these tools should be formally encouraged and used in learning across higher education (Coutts *et al.*, 2007).

Mobile learning devices such as PDAs, the iPhone or wifi are increasingly being implemented for learning and teaching purposes. The question in this context is not what to present in a digital form but how to develop the conventions for serious communication and use in the context of the desired learning environment (Liestol, 2007).

Finally, a contradictory phenomenon is starting to develop in the use of new technologies in higher education. On the one hand, there is a tendency towards standardization – the use of common technologies, whilst at the same time, there is a need for diversification to accommodate the requirements of a widening and diversified range and requirements of the student population (Pincas, 2001). This phenomenon may, for instance, be illustrated by an ongoing discussion concerning the Personal Learning Environments (PLEs) as opposed to the currently used Learning Management Systems (LMSs). Unlike LMSs, which take course-centric view of learning, PLEs are learner-centred. The idea behind PLEs is to enable students to gain a greater control over their own learning. This raises many questions for higher education institutions and how they support learning using technologies (ASCILITE, online source).

These examples illustrate but do not cover all of the extensive number of challenges related to new learning technologies presently facing those involved in higher education. Rather than provide a more comprehensive list, it is more productive to discuss just how to formulate appropriate responses.

Responses

Due to the constantly changing and increasing demands of current modern ways of work, life and also education on teaching and learning, there is a greater need for a progressive change and redesign of teaching and learning environments and spaces. While innovative use of new educational technologies suited for particular purposes can help to fulfil this need, there is an associated imperative

to view the new technologies in light of “proven practices and models of teaching”, the resilient pedagogies, such as feedback and authentic assessment rather than radically claiming to reinvent pedagogy. At the same time, new technology will inevitably impact on the ways in which people learn (Beetham, Sharpe, 2007).

In higher education, the issue of large amounts of data is dealt with through the use of electronic and digital teaching and learning systems and tools. In particular, increasingly visual ways of mapping and navigating information and complex concepts are employed. For instance, portals, as an example of a personal information management (PMI) system, are increasingly seen as one approach to assist learners in navigating information relevant to their enrolment and studies, including the development of personal digital libraries and e-research tools. Such portals have a number of benefits, including:

- Enabling learners to keep personal information and to access it through the Web at any time and any place;
- Improving personal information management; and
- Users can adapt the libraries and tools to suit a variety of activities and purposes, according to their needs and preferences (He & Lu , 2004).

The current use of LMSs in many higher education institutions might need to be supplemented with more personal learning systems, such as through new tools becoming available through open source software such as Sakai and Moodle, to incorporate the needs of the widening and diversified student populations. Part of the emergence of open source solutions is the emerging resistance to the perceived domination, even constraining influence of large-scale learning management systems. Institutions in higher education are opting for the adoption of a network of learning management systems, often purchasing these on the assumptions of supportability, perceived efficiencies and market penetration. However, a subtle but powerful risk is inherent in this decision making. One of those risks is that their use necessitates that teachers adapt their teaching to the features and assumptions of the system, in turn ‘shaping’ the very learning environment. In so doing they may then contradict a basic tenet of educational thought – that educational approaches should arise from an analysis of the learning need and a corresponding matching of an appropriate solution. It is critical to the enjoyment of students and teachers that we encourage the creative development of solutions to specific learning needs, allowing the learning need to shape the learning environment and not vice versa. There remains a creative movement by teachers in higher education to develop

innovative learning environments. These approaches are responsive to specific learning situations, addressing the inherent issues and problems through informed integration of pedagogies and technology. One manifestation of this is the open source movement.

Mobile learning devices, including wireless networking, may also further enhance aspects of higher education teaching and learning experience. Casey (2006) points out that the advent of networked mobile devices makes mobile learning environments a real possibility (also identified more broadly as ubiquitous learning or u-learning to include a range of devices including desktop computers). Increasingly it is achievable to deliver e-learning environments to a range of mobile devices including tablets, PDAs, Pocket PCs and WAP 2 phones. There are many examples of the successful use of mobile devices already including the provision of university results, timetables and reminders by SMS to students. Murphy et al. (2006) described student feedback on a flexible learning initiative that provided course materials and activities for a subject within a Faculty of Information Technology via mobile devices including smart phones. Open source learning management systems (such as Sakai) are also designing for mobile technologies as they continue to refine and develop 'PDA portals', essentially removing iFrames (which are not very accessible/mobility-friendly) and providing functional but simplified views of web pages and navigation menus. There is little doubt that in the near future there will be increasingly powerful, handheld and networked devices that will provide many new and exciting possibilities to educators.

Social networking tools may also contribute to the enhancement of student experience, but they may be best suited as individual/personal tools that students own and use as they need. There is no obligation to see these as enterprise (institutional wide) supported tools, but rather as an increasing suite of personal tools that are used to facilitate learning. This will call for dialogue and discussion between teachers and learners. Do students want to interact with their teachers on Facebook, for example? Do they consider it as 'their space', where teachers should not dare to enter, or will teachers be welcomed by some, if not all, as the relationships between learners and teachers evolve into more collaborative forms?

An essential part of any educational practice is innovation; it can enhance the way in which teachers engage with students. This applies to all modes of learning and teaching, including technology-assisted learning and teaching. Innovation is itself challenging but it may also bring solutions to the range of challenges related to the usage of new educational technology in higher

education. But then the technological innovations, when successful, in turn raise fresh challenges from an institutional perspective. Questions which arise include how is success measured, will it translate across disciplines, how will it impact on existing technological use, and how can it be implemented across the university in a manner that enhances and increases efficiency and effectiveness, rather than just adding another burden to busy teaching staff.

The next section outlines how one particular institution, Monash University in Australia (<http://www.monash.edu/>), is responding to the challenges at an institutional level, in an effort to ensure that the most appropriate technologies are adopted.

The Monash Response

Recognising that the university had let developments in educational technology drift without clear policy and strategic direction, in 2006 Monash established an Educational Technology Committee, and charged it with responsibility for aligning the considerable forces and innovative practices into a cohesive plan. To ensure input from all relevant stakeholders (including technology 'champions'), committee membership included all faculties, service divisions, the library and student groups, making a total of 25 persons.

At the time, the university had been developing a series of frameworks, the name used for the means of addressing issues and areas of activity which are:

- Complex;
- Cross-portfolio;
- Require conceptualisation and infrastructure support;
- Bring together existing activities; and
- Add new activities to the mix.

One of the first decisions of the Committee was thus to prepare the *Educational Technology Framework*.

By way of background, Monash University, Australia's largest university, is a significant player in international research and education. New educational technologies may play a pivotal role in enhancing the University's multiple campuses and international perspectives enabling communication across boundaries. New educational technologies can also complement mobility experiences through seamless platforms for communication and learning (*Educational Technology Framework*, 2007).

Monash is unique among Australia's research-intensive universities in having multiple campuses, which include one regional, two outer suburban,

three metropolitan and two overseas locations (<http://www.monash.edu/campuses/>). Off-campus learning is also an important mode of education provided by Monash University. New educational technologies may assist and enhance learning and teaching provided across the Monash University campuses, including the off-campus mode of education.

The relevant technologies employed to assist and enhance the needs of the international, multi-campus and off-campus aspects of learning and teaching include learning management systems (LMSs), learning object repositories, collaboration tools (such as desktop and group video and voice conferencing tools), media supporting recording and playback of classes, document-sharing tools, instant messaging etc (*Educational Technology Framework*, 2007).

A particularly successful technological application that Monash has introduced in response to its challenges and context is the Monash Portal. Established as one of the first of its kind in Australia, the my.monash Portal has proved to be extremely popular with students, providing an integrated messaging, academic, administrative and cultural environment for Monash students and staff. It has become the focal point of online access to university services and web resources for practically all Monash students.

Another example of a generic use of new technologies aimed at enhancing teaching and learning developed for teaching and learning needs is Monash University Studies Online (MUSO) system. This is an internet-based teaching and communications platform based on Blackboard Vista. The system was piloted in 2004, and put in service in 2005. MUSO is a web-based course management system that allows students to access information and assessment tasks related to units that they are studying at Monash University. While not all units at Monash offer a MUSO component, it is becoming increasingly popular due to its ease of delivery and accessibility to students (*Educational Technology Framework*, 2007). MUSO is being supplemented in 2007 and 2008 with a suite of other applications, including a number of Monash developed tools and a range of open source systems such as Sakai and Moodle.

One other example of innovative use of new technologies is the application of videoconferencing at Monash University. Videoconferencing is utilised for a wide range of educational, research, administrative and other purposes at Monash University, such as tutorials, lectures, cross-campus committee meetings, collaborative research groups, staff meetings, recruitment interviews, conference participation, and training sessions (Monash University website).

The above examples exemplify large-scale applications that have been introduced across the university. It needs to be emphasised that there is a large

range of small-scale innovative activity with respect to technology, teaching and learning that introduces fresh challenges and opportunities. Examples can be viewed at <http://calt.monash.edu.au/Quality/ETC/project/projectgateway.html>, and include a leading teaching laboratory of the future and a simulated treasury dealing room.

However, there are limitations to innovation. Whilst innovation in the use of new educational technologies is a positive thing, innovative activities need to be monitored as issues of compatibility, access, security and training have an impact on what individuals can achieve using new technologies. These issues are complicated by the broad range of data sources that individuals within the higher education context require access to.

So, within this context, work began on the The Educational Technology Framework, and after a few iterations and presentations to various associated groups and committees, the following structure emerged (see Figure 1).

Overall, the aims of the Framework are to:

- Encourage the creative interest and enthusiasm of staff in exploring rapidly developing educational technologies within the context of Monash University;
- Provide a list of recommendations to guide governance, policy and implementation in educational technology development for Monash University;
- Identify current and emerging requirements for educational technology within the network of Monash campuses;
- Outline how innovation in teaching and learning using educational technology can be encouraged; and
- Inform an implementation plan for the deployment of technologies through the faculties and campuses of Monash.

Its purpose is thus to ensure that the development of technology to advance learning and teaching, and to position Monash as a leader in this field. The aim is for development to be of high quality and to be aligned with the needs of Monash as a research-led, international and multi-campus university, and to establish Monash as a leader in the innovation and application of educational technology in the higher education sector. Innovation and development at Monash will encompass both educational technologies, with emphasis on their role in collaboration, communication and mobility, and innovation in pedagogical approaches to the use of these educational technologies.

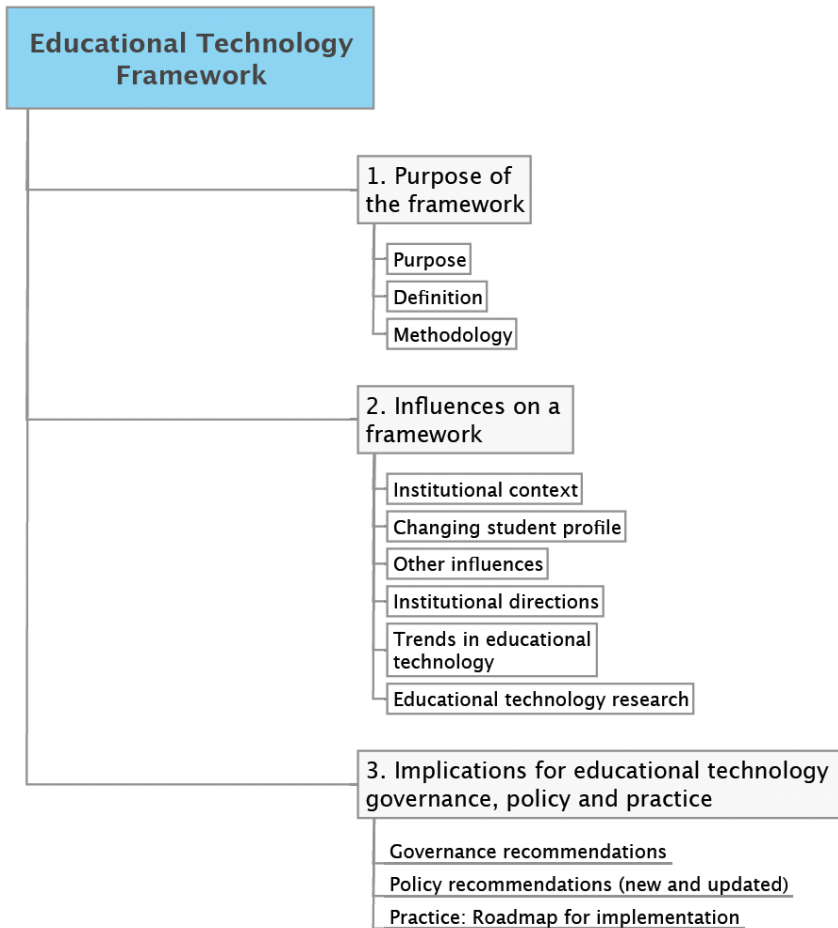


Figure 1. Outline of educational technology framework.

New educational technologies are constantly emerging, and they present unique research opportunities for their application to teaching and learning. Examples of currently emerging educational technologies are virtual worlds, wireless technology and mobile devices. Many small groups and individual Monash staff are researching such technologies in creative and innovative ways. The Framework will provide a vision of this complex interconnected mix of educational concerns, acknowledging that ultimately the success of any educational technology rationale for teaching and learning will rely on creative and collaborative problem solving. The Framework provides a structure through

which planning and goal-setting will underlie future development; that is, it aims to provide a more determined pathway for development to follow (*Educational Technology Framework*, 2007, pp. 2, 3).

A four-stage process was used to develop the framework, incorporating conceptualisation, scoping, consultation and collaboration.

The process incorporated feedback from a diverse range of stakeholders, including:

- Students: undergraduate and graduate student representatives;
- Senior management and staff: the Vice-Chancellor, Deputy Vice-Chancellors and PVCs;
- Faculty representatives: Associate Deans (Teaching) and other faculty stakeholders;
- Campus representatives: PVCs and Academic Directors; and
- Service divisions: Centre for the Advancement of Learning and Teaching, IT Services and the Library.

Feedback was gathered via a variety of mechanisms, including personal interviews, collaborative workshops and submissions from key stakeholders. The end result is a collaboratively drafted document that endeavours to incorporate a broad university view and provides recommendations for governance, policy and practice.

Research

One of the key influences addressed in the Framework is research. Educators draw upon diverse educational theories to enhance their students' learning experiences supported by new technologies. These educational theories range from behaviourism, constructivism, situated learning, conversation theory, activity theory or critical theory. Different forms of technology are suited to the enhancement of different aspects of student learning experiences. Educational technology researchers commonly adopt a range of experimental and qualitative research methods, such as developmental or conversational research approaches. There is no single learning theory, educational technology or research method that is best suited for all learning situations (Jonassen, 2004).

Educational technologies are changing so rapidly that frequently researchers have difficulty to develop pedagogies that would most effectively utilize latest technologies (Laurillard, 2006). However, there are four widely recognized, resilient and well researched and accepted pedagogies for learner-centred technology-supported environments: convenience and flexibility, contextual-

ization, collaboration and communication and constructive feedback. These may form the basis for examining future technologies, an evaluation approach for judging the value of new technologies for a learning and teaching application, particularly for an enterprise wide application,

Convenience and flexibility

Educational technologies have become invaluable in Australian as well as many other universities around the world in providing flexible modes of learning demanded by contemporary students. Most students appreciate the convenience and flexibility provided by new educational technologies, providing ease of learning irrespective of the place or time (Bird, Morgan, O'Reilly, 2007).

Contextualisation

Interactive and adaptive educational technologies enable individual students to contextualize the learning activities to suit their current levels of understanding and personal circumstances, as well as professional aspirations. Contextualising learning activities may enhance student creativity, critical thinking, problem-solving skills and perseverance (Muirhead, 2007).

Collaboration and communication

Educational technologies can be effectively used to promote reciprocity, cooperation and collaboration. Well-structured, skillfully moderated collaborative environments, which value multiple points of view, may foster deep learning (Resta, Laferriere, 2007). Extending communications beyond the classroom boundaries may equip students with strategies for lifelong learning (McConnell, 2006).

Constructive feedback

The importance of appropriate and timely feedback to facilitate learning is consistently recognized across all educational theories. Students often appreciate the immediacy of feedback and information flow from their lecturers and peers provided by educational technologies. Educational technologies (such as online grade books or technology generated class announcements and result notification) facilitate diverse forms of ongoing and constructive, formative and summative feedback to individuals or groups of students (Mory, 2004).

Generally, new educational technologies may create new pedagogies, and these need to be balanced with the existing resilient pedagogies. The balance in

the use of new pedagogies in combination with the existing pedagogies may be informed by research (Educational Technology Framework, 2007).

The Monash *Educational Technology Framework* (2007) made two recommendations concerning innovative and creative approaches in utilizing new educational technologies:

- a) the need to develop a university policy and procedures in supporting staff to develop and trial new technologies; and
- b) the need to develop a university policy and procedures to ensure effective evaluations of innovations and new developments in educational technology.

As the Framework explains, Monash does not currently provide any co-ordination for innovation, research and development in ET. Innovations tend to be conducted in isolation, with little shared learning and significant possibility of duplication in researching the same or very similar products.

The proposed 'Innovation Support Model' (see Figure 2) aims to provide a more structured approach to supporting the various levels of innovation. At the initial level, isolated individuals are developing innovations or using a service provided from an external vendor (either over the internet or through a temporary licence). Status and results would be recorded in a co-ordinated database/knowledgebase of ETs and their use or potential at the university. Integrated into a web-based teacher support site, it would highlight current activity/practice with links to communities of practice, interest groups or key experts.

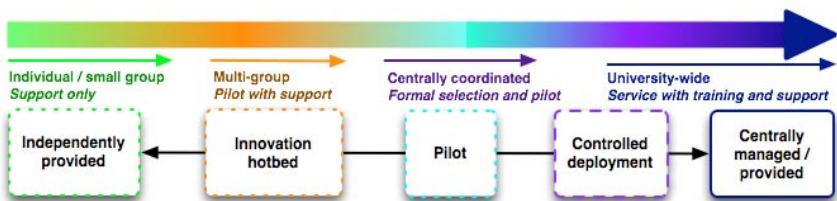


Figure 2. Innovation support model.

Once an activity gains a sufficient level of interest (e.g. across multiple disciplines or faculty boundaries), the activity would be incorporated into the 'innovation hotbed'. The hotbed would provide a common technology environment for innovation activity, allowing teaching staff to focus on their educational innovations while the underlying environment is managed and supported centrally.

In order to provide an efficient, agile environment, the hotbed would still have some limitations (e.g. no integration, formal training, decentralised support, etc.). Evolution from pilot, to controlled deployment and then to a centrally managed/provided service would require a formal, university-level project (with capital funding and change management) to address these limitations. A suitable enterprise-class product would be competitively selected, and a more formal pilot conducted. The pilot would investigate the above factors and other technical issues to provide a recommendation on an appropriate solution for the university.

Evaluation and Quality Assurance

Monash University carries out regular evaluations of quality of teaching and learning and other university services. The approach to quality is based on a 'fitness for purpose' definition of quality and the Monash Quality Cycle: plan, act, evaluate (monitor and review) and improve.

Monash uses a wide range of monitoring mechanisms to assess the effectiveness of its education activities. These include unit evaluations, the Monash Experience Questionnaire (MEQ) and the Course Experience Questionnaire (CEQ). The results of these surveys are increasingly important as many are linked to government funding, such as the Learning and Teaching Performance Fund (LTPF) and more recently awards and grants from the Carrick Institute. These surveys should inform the evaluation of educational technologies in Monash University. For instance, where unit evaluations reveal challenges in providing relevant and timely feedback, that challenge should be considered in the selection and evaluation of new educational technologies. The new technologies have a potential of improving such an aspect.

Further, the Monash Quality Cycle includes an improvement phase. Educational technologies may provide opportunities for faculties to improve results in areas of concern through interventions applying educational technology.

To comply with the Monash Quality Cycle, data needs to be collected and interpreted on an ongoing basis. Such data will provide information for the purposes of program development. In case of gathering information on educational technologies, the collected data may include:

- Surveying students and staff about the use of ICT and educational technologies. Such survey data would provide a valuable measure to assist the evaluation and improvement of programs;

- Benchmarking against the Group of Eight (Go8) and other institutions with exceptional achievements in the area of educational technology.

The Monash Quality Cycle needs to be applied throughout planning, development and implementation of educational technologies (*Educational Technology Framework*, 2007).

Outcomes

As indicated in Figure 1, the Monash University *Educational Technology Framework* (2007) includes a series of recommendations with respect to the governance, policy and practice in the use of educational technology to support the learning and teaching environment. These are not discussed in detail here, as they are peculiar to the Monash context. However, it is worth mentioning that the first recommendation ensures that educational technology governance is firmly placed within the education portfolio.

Given the time, effort and extent of collaboration in the development of the Framework, it is perhaps not surprising that it passed quite quickly and smoothly through the required committee structures at the University. Further, the attention that the creation of the Framework has brought to the proper application of educational technology has been at least partly responsible for increased resources being made available to support its recommendations. Priority areas, such as the development of technologically supported learning spaces, the use of online collaborative tools and the development of e-portfolios have all received strategic initiative funding for at least the next year.

Conclusion

This chapter has provided an overview of the challenges currently facing educational institutions, particularly universities, with respect to both learners and the array of new and emerging technologies confronting tertiary educators. In addressing these challenges, the perspective taken has been an institutional one, illustrating how universities can act strategically to both encourage innovation and, at the same time, ensure that the technological underpinnings of the learning and teaching environment are stable and supportive. A particular example, Monash University, has been used to show how the development of strategic planning and documentation can guide the use of educational technology. At Monash, the *Educational Technology Framework* (2007) has been instrumental in ensuring that the three key aspects of governance, policy

and process with respect to educational technology are properly and usefully addressed.

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DEVELOPMENT OF AN E-LEARNING SYSTEM FOR AUTOMATION TECHNOLOGY EDUCATION

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Abstract

Traditionally, automation engineering education is one of the hardest education program to teach online because of the need for providing practice & hands-on experiences at a distance. Currently, practical training is still applied on the shop floor to discipline students to empower them with practical experience. How to build up students' practice ability through an e-learning system is an important research issue. To address such issue, this study developed an interactive semantic web based Virtual Reality (VR) system to enhance students' practice abilities. Four kinds of manufacturing technology are established in this system: turning, milling, spraying, and laser marking. This system allows students to select different process parameters to view entire manufacturing processes in real time. This study reports the development such VR e-learning system in teaching automation technology courses. It also discusses how the e-learning system enhances the quality, scale, and breadth of technological education. This study has opened up an opportunity of change to the traditional practical training method. It demonstrates a great enhancement in teaching effectiveness through the use of ICT technologies.

Introduction

Since the early 1980s, computers have entered the manufacturing arena as an educational aid. Increasingly, general purpose tools, such as computer-aided drawing and design packages, computer-aided manufacturing and simulation packages, and computer-aided analysis packages, were developed as valuable computer environments for improving manufacturing productivity (see ElMaraphy, 1982 & Khoshnevis, 1986). The emerging technologies require new knowledge and skills. This places a serious responsibility on engineering educators to provide students with the scientific principles of new technologies, and familiarize them with their impact on the modern manufacturing processes. Manufacturing science includes these technical areas: manufacturing technique, manufacturing systems, design and analysis of manufacturing process planning, material handling, monitoring and control, automated inspection, sensors and interfaces, and management. The manufacturing technique covers: turning,

milling, drilling, holing ... etc. Much time and cost are used to teach these techniques. Particularly, computerized machines are continuously increasing in use. The development of educating engineers on computerized machines becomes much more difficult than with traditional machines. This is because of the limitation of the extremely expensive cost of teaching. The quality and quantity of teaching cannot always be promoted in this respect. The traditional teaching methods do not respond well to the needs of the present, let alone the future.

The evolution of computer and Internet technologies has made it easy to access learning contents from almost anywhere, anytime, and at user pace (Wald, 1992 & Sutherland, 2000). Bengu (1994 & 1995) developed a suite to provide comprehensive engineering education for freshmen in manufacturing processes and systems, and in concurrent engineering. The focus was to develop a support mechanism to deliver the courseware of manufacturing through the web. Since manufacturing education is so vital to the education of the engineers, Bengu (1996) & Swart (1996) created a learning process based on total quality management (TQM) and critical thinking (CT) concepts. Their study takes advantage of computer and information technology to enhance the delivery of education through computer-aided teaching and learning tools. A basic proposed framework for the course brings together assembled subject material using various media. In order to achieve the effective use of this new teaching and learning methods, the course proposed includes: on-line lectures, audio-video education tools, interactive computer software, on-line assignments and exams, information about faculty, on-line evaluation tools to obtain student feedback, and to improve teaching quality. The advance in the optical-fiber network makes real-time transmission of a large amount of data, such as three-dimensional models or video images, possible between remote places. In particular, by connecting virtual environments through the broadband network (Paquette, 1996), a three-dimensional virtual world can be shared between remote places.

The field of virtual reality (VR) initially focused on immersive viewing via expensive equipment, is rapidly expanding and includes a growing variety of systems for interacting with 3D computer models in real-time (Sung, 2003). Various applications in fields including education, training, entertainment, medicine and industry have been developing, and more and more areas will gain benefits from using VR (Craig, 2003). In the past few years, a number of interactive VR systems have been developed. An educational virtual environment (Bouras, 2001) is a special case of a VR system where the emphasis is more on education and collaboration than on simulation.

Development Approaches

The goal of this study is to analyze the main aspects of automation technologies through the Web and to develop a semantic web based e-learning system to improve students' application ability. In order to provide students with as realistic an e-learning system as possible, and one expandable to the entire system, the developed system is based on N-tier architecture. The application tier side consists of a web server and a Java application server. A presentation tier is a client-side that comprises HTML, XML, and a 3D Web player plug-in. The client, which runs in a Web browser, provides a student interface that handles input (allowing students to enter data, access course materials, make decisions, and interact with a 3D virtual laboratory), and output (displaying results or simulations). The web server performs actions and computations based on student input using XML and JSP languages. The application server reads and writes to the databases using JavaBean, and interfaces with external software packages (CAD/CAM and CAE). The content of the course is primarily presented using Web pages written in HTML. In order to move courses from one system to another, and extract and/or perform automated processing on the documents, standardized definitions for course structures are necessary. To meet the requirements, Extensible Markup Language (XML) is used to develop course structures. In order to attain cross-platform application, JAVA language is used to develop an interactive Web site.

One of the challenges for learning machining techniques through Internet, is how to present spatial information to students to promote student practice ability? In this research, virtual reality (VR) techniques are adopted to describe various activities of machining in terms of translation, rotation, combination, and decomposition of geometric objects. The course model developed in this research is based on two methodologies: manufacturing feature and group technology. Manufacturing features are those which are meaningful to the manufacturing. Some manufacturing features are hole, groove, countersink, counter bore, pocket, hole, tip, chamfer, fillet, etc. Usually, the geometry of desired parts is not simple and can be machined by turning or milling process only. Complex parts contain various manufacturing features. Therefore, a systematic way to identify manufacturing features from mechanical graphics is needed. In this system, group technology is used to develop a coding method for mechanical parts. The geometry of mechanical parts is represented by ten digit codes. The machining method and manufacturing process can be generated according to the GT code. The approach of coding method employed in this research not only enables the learning contents of manufacturing to be

standardized, but also lets students learn the machining method of manufacturing features and processes.

Implementation and Results

This system provides students with a systematic way to learn manufacturing technology, via the client-side graphical user interface. Students study the overall shape of the part, and specify geometric information of the desired parts, designed as 2D or 3D graphics. The system will automatically analyze the manufacturing features, and generate its GT code, according to the geometric information specified by students. The learning content of the manufacturing processes will be extracted from the database based on the generated GT code. The purpose of this module is to let students learn the basic concept of manufacturing features, and improve machining skill. In order to let students learn the machining methods for basic manufacturing features, a module called “Basic Machining Skill” was developed. This module provides course material that allows students to study the basic skills (Turning, Milling, and Drilling) of machining basic manufacturing features. Students can learn the machining method for basic manufacturing features from this system. The selection of process parameters, such as cutting tools, cutting speed, feed rate, etc., is one of the key issues in machining processes. Therefore, a mechanism is designed in this system to assist students in learning the process parameters. Once the student inputs incorrect values of process parameters, it will be triggered automatically, and reference information is given to guide the student to input the correct values (Fig. 1). A virtual machining laboratory was developed to

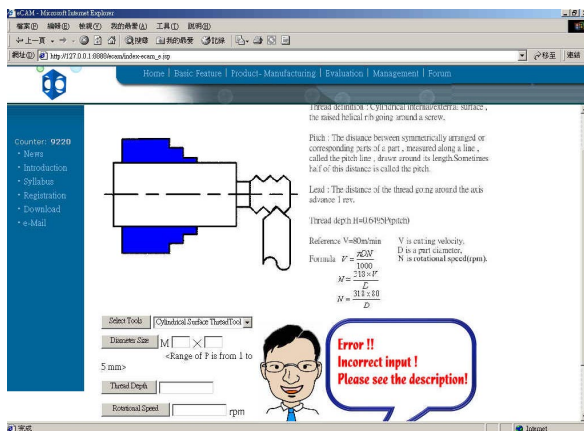


Figure 1. Guidelines for learning machining parameters.

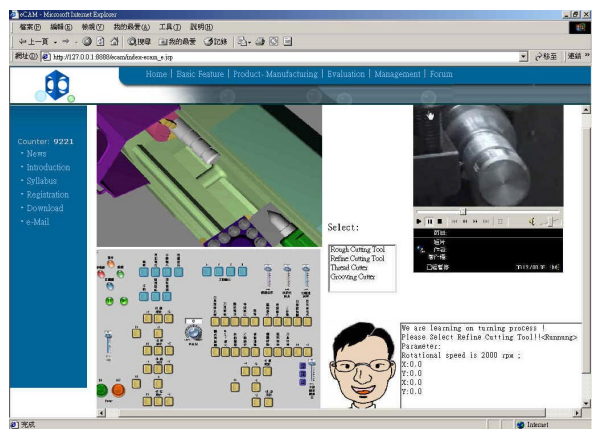


Figure 2. Virtual laboratory of turning process.

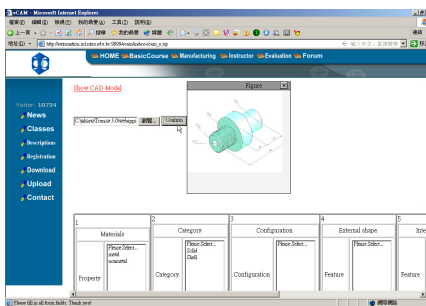


Figure 3. Import CAD model.

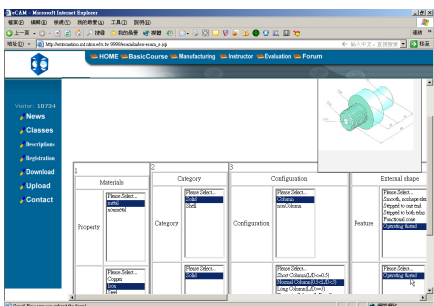


Figure 4. Specify part geometry & material.

bring the machining practical training to web-based learning system. This will allow students to familiarize machining skills before real practice in the laboratory. The virtual laboratory of turning, drilling, and milling is built (Fig. 2) to simulate, as real as possible, the skill of machining. In order to facilitate the effectiveness of education by the developed e-learning system, multi-media and virtual laboratory are integrated to demonstrate the machining skill.

Students can go further to learn machining process planning, once they have the capability of machining basic manufacturing features. An interface has been developed to allow students to import the part geometric from a standard CAD model like AUTOCAD (described in dialogue as Fig. 3) and to specify the part geometric information (Fig. 4). The system will automatically analyze the manufacturing features, and generate its GT code, according to the geometric

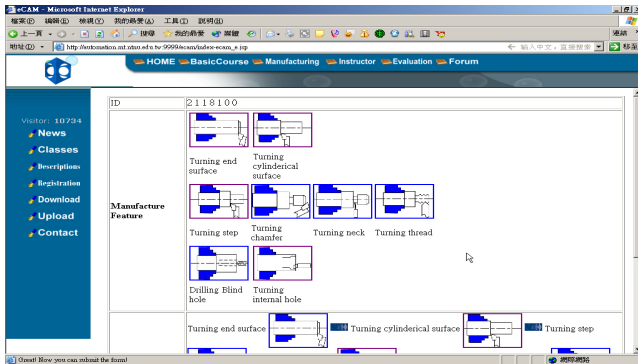


Figure 5. Manufacturing features for complex part.

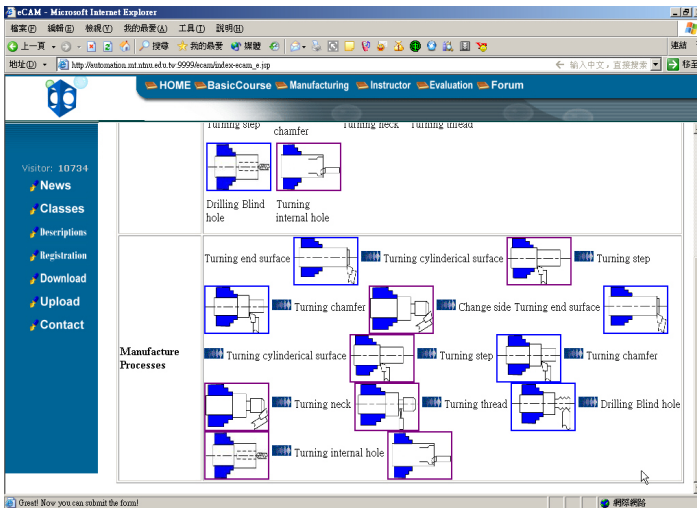


Figure 6. Machining procedures for complex part.

information specified by students. The learning content of the manufacturing processes will be extracted from the database based on the generated GT code. This system will create a GT code based on the geometric information specified, and generate the manufacturing features required to fabricate the desired part, as shown in Fig. 5. The possible machining procedures are displayed for students to learn the principle of manufacturing process planning (Fig. 6). The system will present the appropriate procedure and give the reasons for decision making. The machining methods for each manufacturing features are delivered to

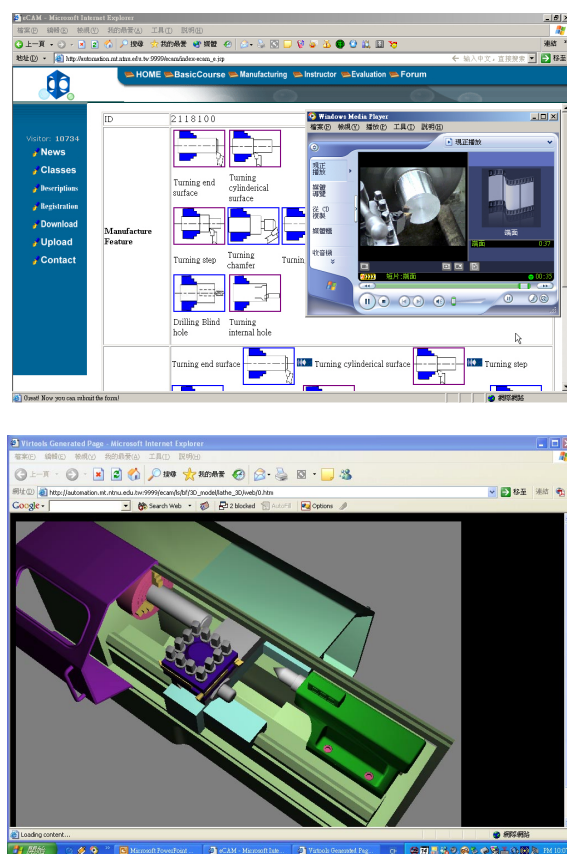


Figure 7. Multi-media and virtual laboratory for turning manufacturing features of end surface.

students by multi-media and virtual laboratory (Figs. 7–9) once the students click the features. In this phase, the objective is to discipline students the ability to extract the manufacturing features for a complex part, from a mechanical drawing in either 2D or 3D. Besides, the students have a chance to accept the cultivation of the concept of manufacturing process planning in this stage.

The computerized machines are continuously increasing in use. The development of educating engineers on computerized machines becomes much more important than ever. Therefore, learning contents of CNC coding method was established in this system and simulation of CNC cutting path is delivered to students using multi media (Fig. 10). In order to provide media contents for multi-users, eliminate the delay of casting processes, and increase cast quality,

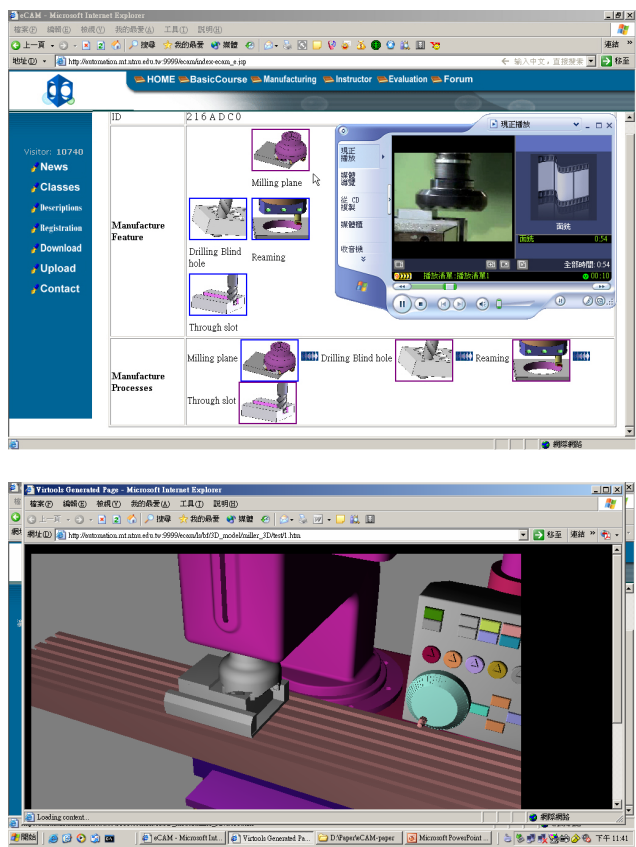


Figure 8. Multi-media and virtual laboratory for milling manufacturing features of flat surface.

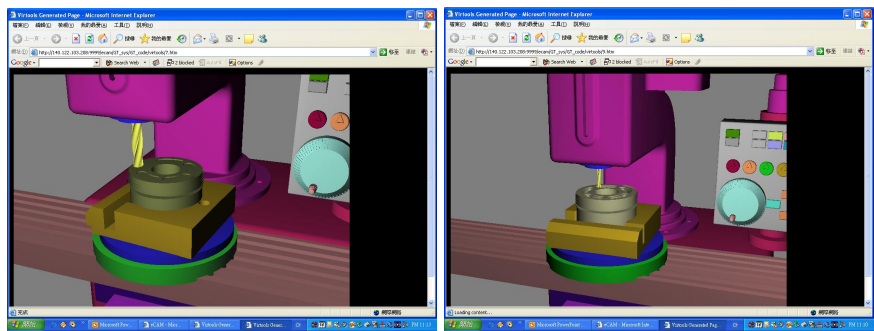


Figure 9. Virtual laboratory for milling manufacturing features of slot & hole.

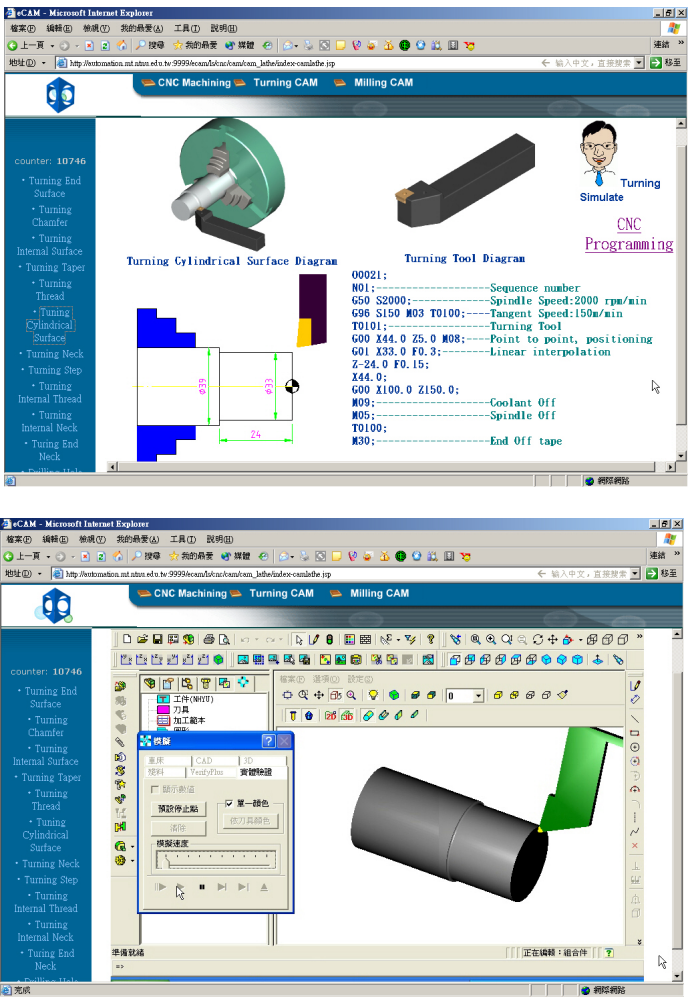


Figure 10. CNC programming and simulation.

the SureStream technique is employed to manipulate stream files for casting. The stream media contents are controlled and cast by the Pear-to-Pear casting method to meet the multi-cast purpose.

Coating technologies are widely used in manufacturing processes to prevent products from deterioration due to water, air, or an acid, and to improve the artistic functions of product. Interactive interfaces for this process are designed



Figure 11. Virtual laboratory of spraying process.

to allow students to select process parameters as shown in Figure 11. Various process parameters such as air/coating pressure, color, voltage, speed, range, distance, and coating thickness can be changed by students. Marking is a process to make a mark on a product for the purpose of product identification. There are many advantages in laser marking as compared with conventional marking methods, such as no wear on tools, a high degree of automation, free programming and the choice of characters. The mark qualities, especially mark clearance, are most important in the marking process. In order to obtain a clear mark, suitable processing parameters must be selected. The interactive virtual laboratory is developed for students to learn the operation techniques and the effects of the process parameters as shown in Figure 12. Process parameters such as material, power and speed can be selected by students. Further, the marking path can be designed through this interface. The entire marking process is simulated in real time and displayed using different view angles.

Conclusions

The developed interactive manufacturing virtual laboratory has been implemented in a number of manufacturing related courses. The impacts of

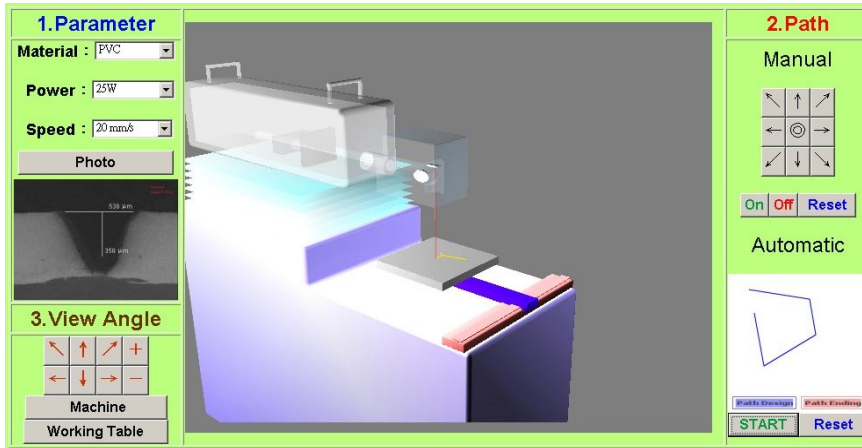


Figure 12. Interactive laser marking.

the system on manufacturing education are as follows:

- (1) This system can enhance students' ability to extract the manufacturing features from a mechanical drawing in either 2D or 3D. Besides, the cultivation of the concept of manufacturing process planning can be carried out in this system.
- (2) This system can carry out part of the practice through the virtual laboratory. This will advance teaching speed and the quality of practical training in the machining shop. Also, part of the homework assignment and evaluation can be issued and executed through the network.
- (3) The developed learning contents control mechanism can deliver CNC programming and CNC machining techniques to students with good cast quality through Internet.
- (4) The developed Web-based learning system improves the safety and efficiency of hands-on machining practice. Students can learn basic machining and experience machining technology through the virtual laboratory before any real practice. In the conventional teaching method, the instructor has to explain all the details of machining operation, including the safety rules. The teaching assistant has to demonstrate the machining operation step by step. The conventional teaching method takes much teaching time. The developed Web-based learning system can allow students to learn the lecture material, and experience the machining

operation through the network. This will save the instructor teaching time, and make the teaching of the machining practice go through quicker than ever.

- (5) The developed interactive Web-based learning system allows students to learn and practice the machining techniques repeatedly, and much easier than with conventional teaching ways. In the traditional teaching method, it is difficult to re-practice the machining technology in the machine shop – due to the limitations of machinery and tooling supply, material preparation, practice time schedule, cost... and so on.
- (6) The learning activities are free from time and location. The expensive learning resource of machining techniques can be circulated through the web for the purpose of sharing resources and the diffusion of education.
- (7) Student's feedback indicates the developed Web-based manufacturing learning system can reduce their trepidation of the machining operation at an early stage of their hands-on practice.

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USING YOUTUBE: STRATEGIES FOR USING NEW MEDIA IN TEACHING AND LEARNING

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Abstract

Educators regularly use media to engage and enhance the learning experience for students. Suggested is that the evolving ubiquitous nature of New Media websites such as YouTube provides possibilities for engaging students within a new “Learning Ecology”. A landscape whereby collaborative and (co)creative spaces are emerging for engaging students in the creation, critical assessment and personalization of “New Media” that can be used within teaching and learning.

YouTube, an example of New Media, is a free video-sharing website that has rapidly become a popular way to upload, share, view, and comment on video clips. With more than 100 million people visiting the site per day and more than 65,000 videos uploaded daily, it provides educators with a rich visual resource to engage the net generation student.

However in order for a new learning tool, be it print, multimedia or video to be adopted, educators must be able to conceptualize the possibilities for use within a sound framework. This paper will focus on the educational possibilities of incorporating New Media websites such as YouTube (as an illustrative example of New Media) within a pragmatic framework. Suggestions for the effective incorporation of New Media into the student learning experience will be explored.

Introduction

Why should the notion of incorporating New Media and interacting with for example socially distributed and user-created videos (e.g. from www.youtube.com) be important within education? In what ways has the rapid development of digital technologies associated with the terms New Media and Web 2.0 and their use in education enabled individuals to interact differently within existing and new ecologies of learning? How can we as educators engage with New Media possibilities presented by websites such as YouTube within sound educational practices?

In his article, *Growing Up Digital: How the Web Changes Work, Education, and the Ways People Learn*, John Seely Brown (2002) uses ecology as a metaphor to describe an environment for learning. Brown says, “an ecology is basically an open, complex adaptive system comprising elements that are

dynamic and interdependent. One of the things that makes an ecology so powerful and adaptable to new contexts is its diversity.” Brown further describes a learning ecology as, “a collection of overlapping communities of interest (virtual), cross-pollinating with each other, constantly evolving, and largely self-organizing.”

Brown’s ecology concept requires the creation and delivery of a learning environment that presents a diversity of learning options to the student. This environment must offer students’ opportunities to receive learning through methods and models that best support their needs, interests, and personal situations. But who are our students? An essential component of education involves understanding learners. Students today have grown up within a world of pervasive technology including mobile phones, digital cameras and the omnipresent internet. Described as, “Gen-X, Millennial’s, the Nintendo and Net Generation” (Oblinger, 2003; Olsen, 2005), these students blog, play games in immersive 3-D worlds, listen to podcasts, instant message friends, listen to music, author their own video for www.youtube.com and collaborate on the creation of ‘digital stories’ for their ePortfolio. Their default reference library for research has become ‘Google’ and ‘book learnin’ is referred to as “so BG” or “before Google” (Miessler, 2007). These experiences are the ecological learning landscape that frame our interactions as educators with students and must prompt us to consider different way of interacting and engaging.

New Media websites, such as a YouTube, make new demands on learning equally as they provide new supports to learning, even as they also dismantle some of the learning supports upon which education has depended in the past. If we agree that there are changes occurring across the learning ecology and, that new conceptualizations are required to use these emerging technologies, then some care should be taken to think deeply about the impacts of New Media on the processes and practices of pedagogy and our student context.

A Student Context

As previously mentioned, why would the notion of incorporating New Media and watching user-created videos (e.g. from www.youtube.com) be important within education? From a student perspective we must reflect on the changing nature of our students as key stakeholders in the educational process. Sometimes called “digital natives” or the “Nintendo Generation”, these new millennial’s approach work, recreation and certainly education in new ways. (Tapscott, 1997) They absorb information quickly, in images and video as well as text, from multiple sources simultaneously. They operate at what Prensky (2004)

describes as, “twitch speed”, expecting instant responses and feedback. Technologically savvy, they prefer random “on-demand” access to online media; expect to be in constant communication with their friends and an ease of access in the creation of their own New Media.

However, there is some debate about students’ ability to transfer these technological “real world” skills to an academic context (refer for example to The ECAR Study of Undergraduate Students and Information Technology, released in December 2006). But certainly not debated is the dominance and pervasive use of the technology by students. According to an American study on teen content creators and consumers, (Lenhard & Madden, 2005), 57% of online teens create content for the Internet. That amounts to half of all teens ages 12–17, or about 12 million youth. The study referred to students being involved in the following activities: create a blog; create or work on a personal web-page; create or work on a webpage for school, a friend, or an organization; share original content such as artwork, photos, stories, or videos online; or remix content found online into a new creation. In learning, these trends are manifest in what is sometimes called “learner-centered” or “student-centered” design (Marzano, 2006). This is however, more than an adaptation to accommodate different learning styles or allowing the user to change the display of a website; it is the placing of the control of learning experience itself into the hands of the learner. The areas of New Media and Web 2.0 provide for students an unprecedented way to access, socialize and co-create.

New Media

New Media is a buzz word that refers broadly to an emerging convergence of digital communications technologies within co-creative online social spaces. A consideration of the term ‘New Media’ can also be framed within a contrast to “old media”. Old media defined as incorporating forms of communication prior to the digital world such as radio, television and printed material and being predominantly linear in nature.

The term New Media has also become to a degree a catch-all phrase and as such is defined within the context of this paper to be inclusive of two consistent characteristics. Uniquely individualized information that can simultaneously be delivered or displayed to a potentially infinite number of people, and, all authors involved (e.g. publishers, broadcasters, students, educators, consumers) share equal or reciprocal control over content (http://en.wikipedia.org/wiki/New_media). Also noted as central to a

consideration of the term New Media is that it is often associated with and considered to be a superset of emerging technologies relating to Web 2.0.

Web 2.0

“Web 2.0”, a phrase coined by O'Reilly Media in 2003, refers to a perceived second generation of web-based interactions, applications and communities. It is considered to be inclusive of a shift from a World Wide Web that is “read only” to a Web that is being described as the “Read Write Web” (Gillmor, 2007). Instead of content that was for the most part static, we are now seeing the ability by users to remix content in different ways, in order to suit contextual needs. The Web is evolving to become more like an area for social and idea networking. Students negotiate meanings and connections within Web 2.0 social spaces or idea networks, exchanges bits of content (media), creating new content, and collaborating in new ways in the individual and authentic creation of New Media.

Similarly to the term New Media the term Web 2.0 has been applied to a heterogeneous mix of the familiar with the innovative and emergent and as such can be considered problematic in a definitional sense. What must be considered here though is not the shifting ground in relation to definitional aspects of Web 2.0 but how the term is defined for the purposes of this exploration of its use within education and pedagogic possibilities? As Alexander, (2006, p. 32) states, “Ultimately, the label “Web 2.0” is far less important than the concepts, projects, and practices included in its scope”.

Presented here are some broad characteristics of a Web 2.0 website in order to further delimit the term for the reader.

- “Network as platform”, delivering (and allowing users to use) applications entirely through an internet browser.
- Users own the content on a site and exercise control over it.
- An architecture of participation that encourages users to contribute.
- A rich, interactive, user-friendly interface.
- Social-networking functions.

In summary, O'Reilly (2005) states that, “Web 2.0” stands for the idea that the Internet is evolving from a collection of static pages into a vehicle for software services, especially those that foster self-publishing, participation, and collaboration”.

User-centered Web 2.0 phenomena such as blogging, community photo-sharing (exemplified by Flickr), video sharing (exemplified by YouTube),

collective editing (Wikipedia), and social bookmarking (Delicious) are disrupting traditional ideas about how students interact online and how content/media is generated, shared, and distributed. (Adapted from http://tallskinnykiwi.typepad.com/tallskinnykiwi/web_20/index.html). Further light can also be shed on the terms New Media and Web 2.0 through a comparison of various examples.

Examples of Web 2.0

Tim O’Rielly (2005) provides a comparison between websites and functions that typically illustrate Web 1.0 and 2.0. In his initial brainstorming, he formulated the following examples and this initial list has been adapted to include some previous terms such as read-write web to provide further insight and a context for the reader in relation to these terms.

Table 1. Comparison of Web 1.0 and Web 2.0 sites.

Web 1.0		Web 2.0
DoubleClick	→	Google AdSense
Ofoto	→	Flickr
Akamai	→	BitTorrent
mp3.com	→	Napster / Podcasting
Britannica Online	→	Wikipedia
personal websites	→	blogging
evite	→	upcoming.org and EVDB
domain name speculation	→	search engine optimization
page views	→	cost per click
screen scraping	→	web services
publishing	→	participation
content management systems	→	wikis
directories (taxonomy)	→	tagging ("folksonomy")
stickiness	→	RSS - syndication
Read Web	→	Read-Write Web
Linear	→	Non-Linear
Daily ME	→	Daily WE
Old Media	→	New Media / or Social Media

(This table has been adapted from <http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html>)

Some of the terms above may be problematic for the novice Web 2.0 reader and so a brief description of some of the more common terms is provided. Blogs provide a personal commentary or news on a particular subject and many function as a personal online diary. A typical blog combines text, images, and links to other blogs and web media. The ability for readers to leave comments in

an interactive format is an important part of many blogs. Blogging is content created from a personal point of view, in a personal voice.

A wiki is a web application designed to allow multiple authors to add, remove, and edit content. (Cunningham, 2007) The multiple author capability of wikis makes them effective tools for mass collaborative authoring. Wikipedia, is one of the best known wikis.

RSS, folksonomies and tagging are often part of the transformation to the “Read Write Web.” The term folksonomy (derived from “folk” and taxonomy”) was coined by Thomas Vanderwal (Vanderwal, 2006) and refers to a form of organic categorization that comes from internet users as they encounter new information.

Podcasting, is the creation and distribution of an audio or more recently a video recording online. It is distributed over the internet using RSS or syndication feeds and is often suitable for playback on portable players such as an iPod.

Various “social” New Media sharing websites have become associated with the term Web 2.0 as well. Photo-sharing websites such as Flickr, (www.flickr.com) are becoming hubs for students sharing photos. In addition to being a popular website for users to share personal photographs, the service is widely used by bloggers as a photo repository. Its popularity has been fueled by its innovative online community tools that allow photos to be tagged and browsed by folksonomic means. Video-sharing websites continue to proliferate on the internet, for example, the article “The Ultimate Online Video List”, indicates 210 different online video sites. (refer to <http://www.everybodygoto.com/2007/05/21/the-ultimate-online-video-list/>). At present the website with the largest market share is www.youtube.com and it is this site that is the focus here in relation to New Media and an exploration of specific strategies to use YouTube in teaching and learning.

What is YouTube?

YouTube is a popular video sharing website where users can upload, view, and share video clips. Videos can be rated, and the average rating and the number of times a video has been watched are both displayed. YouTube has become an enormously popular form of web 2.0 New Media. A recent article in *Wired* cites an average of 65,000 uploads and 100 million videos viewed per day on YouTube (Godwin-Jones, 2007). The article explores some examples of the wide variety of video content available on the site and searching through the site will provide ample examples of that diversity.

Using YouTube

Video can be a powerful educational and motivational tool. However, a great deal of the medium's power lies not in itself but in how it is used. Video is not an end in itself but a means toward achieving learning goals and objectives. Effective instructional video is not television-to-student instruction but rather teacher-to-student instruction, with video as a vehicle for discovery.

YouTube is increasingly being used by educators as a pedagogic resource for everything from newsworthy events from around the world to “slice-of-life” videos used to teach students within an ESL (English as a Second Language) course. From instructional videos to an online space to share student authored New Media.

Some general guidelines recommended by Clark and Mayer (2002) in relation to considering the appropriate use of any media to improve learning suggest that media must:

- be aligned with expected learning or performance outcome;
- reduce cognitive load;
- exclude superficial text or graphics; and
- be appropriate for target learner's learning literacy's.

Video learning shouldn't be passive. These are some guidelines relating to the specific use of video to promote active viewing and maximize learning:

SEGMENT – allow your students to watch the video in short segments and encourage them to comment on the video segments, exploring inter-relationships and also read comments from others.

NOTES – videos are ideal for developing note-taking skills. Take notes on the first viewing, then rewind, replay and check them. This can be done individually or collectively as a class discussion / brainstorming session.

PAUSE – use the “pause” feature to temporarily stop the video and allow your students to try to predict/recall what will happen next. This can also be incorporated within a task whereby students then create a series of shared iterations of the predicted story.

AUDIO OFF – for video sequences that rely on visuals, turn the sound off and narrate. This technique works especially well for listing the steps of a process. It is also useful in exploring cultural semiotic reading of various everyday images.

IMAGE OFF – use the audio clues to describe what is on screen. Compare and contrast the predictions with the actual video.

PREVIEW – each video carefully to determine its suitability for the lesson's objectives and student's learning outcomes, also to ensure the technical aspects of bandwidth and time for downloading have been considered.

INTEGRATE – the video into the overall learning experience by adding an experimental component to the lesson. Activities can be done prior to viewing; to set the stage, review, provide background information, identify new vocabulary words, or approaches to introduce the topic. The activity can be done after viewing to reinforce, apply, or extend the information conveyed by the video. Often the video can serve as an introduction or motivator for the activity to come.

CUT – use online video editors like www.cuts.com or www.eyespot.com to capture the concepts that are most relevant for your lesson topic. It is often unnecessary and time-consuming to screen a program in its entirety. When previewing a program, look for segments particularly relevant or useful to the lesson or activity planned.

FOCUS – give students a specific responsibility while viewing. Introduce the video with a question, things to look for, unfamiliar vocabulary, or an activity that will make the program's content more clear or meaningful. By charging students with specific viewing responsibilities, teachers can keep students “on task” and direct the learning experience to the lesson's objectives. Be sure and follow-up during and after viewing the video.

COLLABORATE – Ask your students to produce a short video relating to a specific content area and then upload to a social video viewing site (aka YouTube). Explore then reactions to the content and opportunities to virally market the educational material.

POST – when students have viewed the video consider; what interested them? What didn't they understand? How can you relate the program to their experiences and feelings? Ask the students to add comments / blog on the video. How can you validate and appreciate diverse reactions to the material?

Teachers and students alike will find that video is an effective catalyst and facilitator for classroom discourse and analysis. Coupled with hands-on learning, a New Media, video-enhanced curriculum can be invaluable for expanding the learning experience and by incorporating a medium that is

as popular, forceful and familiar; educators can tap into the existing enthusiasm towards this form of New Media. (The above strategies were adapted from <http://www.idahoptv.org/ntti/strategies.html> and <http://www.edb.utexas.edu/fieldexp/SampleSeminars/SampleSeminar11.php>)

Below are some specific examples of approaches to incorporating YouTube into the learning experience.

YouTube can be used to create a learning community. It can be incorporated into tasks whereby you can include the formation of an online social space where everyone has a voice, anyone can contribute, and the value lies equally within the creation of the content and the networks of learners that form around content created, discovered and shared (adapted from Educause Learning Initiative, 2006).

Allow your students to create a short video as part of an assessment item instead of the traditional essay. Becoming involved in the creation of a video, “heightens a student's visual literacy, an important skill in today's electronic culture” (Educause Learning Initiative, 2006). YouTube allows the learner to experiment in New Media to convey information and knowledge. “Many educators believe that the act of creating content, in virtually any form, is a valuable learning exercise” (Educause Learning Initiative, 2006).

Record a video of a guest presenter relevant to your content and use the YouTube comments feature to generate some discussion that can be further explored within class.

Pose a question at the end of class that can be considered from distinct viewpoints and ask your students to search for 2-3 New Media video references relating to the different perspectives. The use of video as a part of an anticipatory set to promote discussion can be useful tool to engage with an audience already enamored with the YouTube phenomenon.

The use of video also has several advantages over graphic and textual media: “portrayal of concepts involving motion, the alteration of space and time; the observation of dangerous processes in a safe environment; dramatization of historical and complex events; demonstration of sequential processes the viewer can review and the promotion of affective, social, and cultural ideas with powerful visual treatments” (Misanchuk, Schwier & Boling, 1996) are all examples of the use of video.

To support language learning, at the end of one of your classes, decide on a particular topic and ask your students to, before the next lesson begins, go to YouTube and search for short videos on this topic. Once the student has decided on an appropriate video resource ask them to watch it and create a difficult

vocabulary guide. This can also then be shared with the rest of the class, course or learning community. The vast majority of clips in YouTube are in English, and a number of ESL/EFL teachers have begun tapping into this source. While some provide sample lessons for students to view and discuss, others have uploaded videos of their own, with the specific goal of language learning in mind. Instructors of other languages, including Spanish, French, Japanese and Indonesian, have also found YouTube to be useful in language learning (Refer here for various examples <http://llet.msu.edu/vol11num1/emerging/default.html>).

Ask students to capture a series of video vignettes related to their work placement or on-the-job training experiences. This will provide a rich authentic resource both for current students and future use. One example of this use are the video vignettes that are captured and described for the real-world context within Health Care as evidenced within Diane Skiba's (2007) article, "Nursing Education 2.0 via YouTube."

YouTube can be used as a virtual library to support classroom lectures by providing students with access to historical, contextual and sometimes obscure video clips. This "archival" function of YouTube is valuable from the importance of the video sharing service and equally for the tools and discourses that frame that content (Conway, 2006).

The evolving Learning Ecology

Like the early days of the Internet, there is an optimism driving experimentation and exploration across the learning ecology associated with terms like, "New Media", and "Web 2.0". New Media presents educators with shifting frames of reference to consider in relation to teaching and learning. Students and educators now have access to a ubiquitous learning environment where it's possible to search for, locate, and quickly access elements of learning that address immediate needs. It is possible to use the New Media to construct and organize personalized, unique interactions with an educational context.

The instructional design and content elements that form a learning ecology must ideally be dynamic and interdependent. The learning environment should enable instructional elements designed as small, highly relevant content objects to be dynamically reorganized into a variety of pedagogical models. This dynamic reorganization of content into different pedagogical models creates a learning system adaptive and personalized to varying student needs.

Imagine for example, what could happen if our education curriculum operated more like Web 2.0, YouTube and Wikipedia, allowing for the rapid deployment of scattered expertise and the dynamic reconfiguration of content

across contexts. Shifting conceptions of participation and connection for students could be explored and the contrast between 'Push' and 'Pull' Education (Richardson, 2005) can be mapped across this new learning ecology.

Richardson suggests that 'Push' models indicate students as passive whose needs can be anticipated and shaped by centralized decision-makers. 'Pull' models treat students as networked co-creators of media and are designed to accelerate capability building, helping students learn as well as innovate, by pursuing trajectories of learning that are tailored to their specific needs.

In part this shift can be seen to relate to George Siemens's (2005) notion of Connectivism. Paraphrasing he indicates that, we derive our competence from forming connections.... unlike constructivism, which states that learners attempt to foster understanding by meaning-making tasks, this theory indicates that the meaning exists and the learner's challenge is to recognize the patterns which appear to be hidden. Meaning-making is seen to involve forming connections between specialized communities. Within higher education Jenkins, (2007) describes the 'YouNiversity' and suggests an intellectual network where students interact not only with professors, but with industry and the community thus encompassing a change in the traditional classroom learning ecology and inclusive of collaborative broader perspectives usually described within a blending of online with face-to-face learning experiences.

YouTube is not necessary for good teaching, in the same way that wheeling a VCR into the classroom is not necessary. Within an examination of New Media sites such as YouTube and the discourses that frame their use educators should consider: how do we engage with these technologies, and, how do we teach students to think critically about their potential uses? How do video sharing sites such as YouTube reshape our participation in and out of the classroom? Such questions, of course, do not have simple answers. Suggested is that educators need to go beyond treating video sharing sites as only virtual libraries and instead emphasize the features more aligned with social interactivity and participation irrespective of place or time. To advocate sharing and discussion of comments, video responses to existing content, flexible possibilities for collaborative assessment and other possibilities of media sharing collaboration.

Challenged must be the ways in which our educational system is designed to "push" the limited resources it which it has access. Explored should be ecologies of access to the plethora of knowledge and resources, and a rethink and expansion of the choices for our students to find those resources most relevant and effective. We need to teach them to take ownership of their own learning

and it is this close examination of New Media technologies and the discourses that frame their use that attracts the interest of many educators. The challenge for building effective learning ecologies that encompass the possibilities of New Media is the creation of enhanced information and navigation models that simplify and facilitate learners locating and accessing contextually relevant educational content. John Seely Brown (2002) states, “The new literacy, the one beyond just text and image, is one of information navigation. I believe that the real literacy of tomorrow will have more to do with being able to be your own private, personal reference librarian, one that knows how to navigate through the incredible, confusing, complex information spaces and feel comfortable and located in doing that.” Similarly, Koper (2001) says the promise of eLearning (and suggested here is also New Media) is, “to make learning experiences in all types of settings more effective, efficient, attractive, and accessible to learners”.

Lastly we must concentrate on the quality of the pedagogical design and its relationships to online learning spaces if we want to accomplish the promises of New Media and Web 2.0 technologies. This paper has suggested some educational possibilities for incorporating the Web 2.0 website YouTube within a pragmatic framework and suggestions for the effective incorporation of New Media into the student learning experience have been presented in order to provide a “stepping stone” for educators within this evolving educational landscape.

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ENHANCING LEARNING THROUGH INNOVATIVE TECHNOLOGY: EDUCATION IN ‘SURF EQUIPMENT, DESIGN, MATERIALS AND CONSTRUCTION’ COURSE

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Abstract

This chapter deals with results obtained through active research conducted between 2004 and 2007 in the ‘Surf Equipment, Design Materials and Construction’ course unit. This 2nd year unit is offered at Edith Cowan (ECU) University (South West Campus) in Bunbury (W.A., Australia) as part of the Surf Science and Technology (SST) course. It aims to engage students in research and technological activities related to design modelling, materials’ selection, optimisation procedures, and performance testing when working on their individualised fins and surfboards. So far, only little has been published about the effects of surfboard/fin design and materials on performance and durability, and from this, it is clear that the opinion of various users and designers on the importance of surfboard design features with respect to performance is in conflict. Consequently, the driving force and rationale for this study is associated with four principal issues. The first one looks at the need for technology education to respond in a quicker and more flexible way in order to keep up to date with advances in scientific, technological and industrial fields. The second one deals with the necessity to gain a deeper understanding of Australia’s industry needs in order to stay competitive in the worldwide market and prepare a universal ‘generic’ teaching module for teaching, learning and training purposes to address such issues. The third one considers the need to eliminate the use of expensive testing equipment that is not always available in remote campuses, and to devise the test and facilities for carrying out experiments and training exercises from available resources in order to get both reliable and accurate results from a practical point of view. Finally, the fourth one deals with the necessity to better understand the students’ diversity and technical decision-making ability and to reflect on it properly in practice in order to make technology education more attractive to a wider student audience. In this study, over the course of several units the students were taught to understand materials, art and design-related features, quality management, standards and safety engineering. After acquiring the necessary skills, they were encouraged to design, produce and test their own fins and surfboards. In an open learning environment they felt free to combine research science with hands-on skills to develop their ideas. The teaching mode involved lecturer’s assistance (by face-to-face and/or via websites), including videos and the additional presence of professional shapers. On completion, each student was required to submit an individual project report and prepare materials for a 15 minute debate for sharing ideas, results and achievements with group members. To assist in the analysis of the sample results, and to provide a quantitative comparison of relative importance of each qualitative criterion with respect to other criteria associated with surfboard design features and performance, a statistical method was established. This allowed the results to be discussed from both qualitative and quantitative points of view and to

create a mutually involving and stimulating topic for the students and the lecturer. This information assisted in the optimisation of fins and surfboards. The students' attitudes to project-related issues and effectiveness of teaching initiatives were evaluated from pre-tests and post-tests – group design – experiments and surveys. It was found that those students who worked closely with experienced supervisors believed that they were better prepared for solving technically-oriented problems in design and production, and reported more satisfaction with their individually designed surfboards and fins than those relying on web-sites and video links.

Introduction

The Surf Science and Technology (SST) course was established at Edith Cowan University (ECU) – South West Bunbury – in 2002. This unique course is a one of only two such courses in the world – with another one being available at Plymouth in England. Consequently, both degree courses are involved in extensive collaboration and activities that include teaching, research, as well as exchange of students. Since its establishment, the SST -ECU SW- course is constantly attracting international students from UK, Germany, France, USA and Japan, and their enrolment contributes up to about 20% of that at SST. Moreover, in this male-dominating field the current females' enrolment is about 40% which is an interestingly high number (Aprhys 2006). The SST study content includes materials and technology, as well as studies on ocean sciences, business, human biology and contemporary issues in surfing. Among these subjects the unit entitled “Surf Equipment, Design, Materials and Construction” is a particularly popular one because its structure offers to study, explore and research the scientific and technological aspects associated with the production and performance of surfboards. To date, little work has been done on investigating the effects of surfboard design and materials on performance and durability as a whole system, and for this reason, this unit is very important. Recent literature search (Warshaw, 2004; Wang & Crosky, 1996; Manning *et al*, 1993; Orbelian, 1987; Young & McGregor, 1983) and videos (for example, “That’s surfing; and Walking on water *etc.*”, 1995) has revealed that a small number of investigations were focussed on studying the effect of individual features in design or material on performance, durability, cost and appearance. However, these features were treated in isolation from other features in the system. Consequently, such studies were not able to provide numerical data for quantitative comparison of individual features against others that would allow for an assessment of the mutual inter-relationship between these features. Moreover, from the published information it becomes clear that the opinion of various surfboard users and designers on the importance of surfboard design features with respect to performance is in conflict. A DVD video (“Biggest Wednesday *etc.*”, 2001) for example, indicated that “*The surfers of the same*

ability use a wide variety of equipment while competing in similar conditions in effort to impress the same judging system". Other sources, namely, two videos ("That's surfing *etc.*"; and Walking on Water *etc.*", 1995) and the papers by Warshaw (2004) have shown that it is the weight and height of a surfer combined with the level of his/her surfing skill and wave conditions that affects the choice of surfboard(s). From the above literature survey it appears that surfboard manufacturers and users did not reach the final agreement on how a particular design feature and material affects performance. This results in a variety of combinations in design features, different materials and finishing for satisfying diverse surfers' requirements. So far it appears that 'the best' surfboard is the one that responds to the type of performance required by its surfer. Consequently, the following contribution is focused on open learning in qualitative education and research associated with surf science and technology. It aims to address the complex ideas about surfboard design, materials and performance using the following objectives:

- To show and analyse various students' work relevant to the fin and surfboard production activities carried out within SST 2119 and SST 2219 courses, namely, "Surf Equipment Design and Manufacturing, 1 & 2" (ECU Undergraduate Handbook, 2007).
- To present the most relevant qualitative and quantitative information from a survey about criteria defining the surfboard as a whole complex system in terms of craft weight, craft cost, craft design/shape, fin design(s), number of fins, craft durability, craft appearance, craft shaper and the surfboard/fin materials.
- To analyse the survey sample results from qualitative and quantitative points of view and to determine the relative importance of each qualitative criterion with respect to other criteria associated with surfboard design features, materials and performance.
- To analyse the efficiency of this course unit from both the students' and teachers' perspectives.

Teaching and Learning Approaches

The "Surf Equipment Design Materials and Construction 1 and 2" courses are taught at ECU within the second study year. In the first semester, the unit is structured to introduce the SST students to composite mechanics and fibre-reinforcement technologies. Students are trained to get hands-on experience in a range of fabrication technologies. The course follows on from other pre-requisite material-based units and provides a comprehensive grounding in

composite materials theory and practice. It needs to be noted that before designing their own surfboards the SST students are asked to conduct a number of destruction tests on laminated specimens, Figure 1. This helps them to understand in more detail the flexural and impact behaviour of commercial surfboards as a whole, with respect to geometrical features, material composition and structure as well as testing conditions. The first semester culminates with the calculation of fin design features according to theory of wing section (Abbot & Doenhoff) and fluid motion (Dyke, 1997), creation of pattern(s) and mould(s), and production of various fin designs by laminating techniques.



Figure 1. The 1st year class of SST students involved in fatigue testing of real surfboards; 2007.

The following photographs show the second year students involved in optimising their fin design features via computer-assisted modelling (Figure 2), and an example of a prototype-like fin produced by hand laminating and casting (Figure 3).

Some ECU findings have already been presented at worldwide conferences (Audy *et al*, 2005 and Audy, 2007) and published in peer-reviewed journals (Audy 2007). This resulted in a collaborative grant being established between ECU SW Bunbury and domestic companies. It involves academics, company researchers and students working on computer simulations to optimise fin design

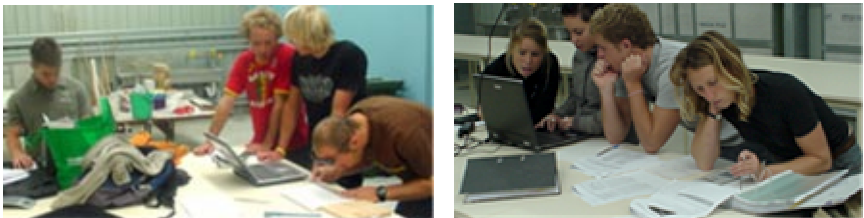


Figure 2. The second year class of SST students designing their fins at ECU; 2005.



Figure 3. An example of fin prototyping work; 2004.

features for improved performance. In addition, it looks at options that would allow manufacturing sustainable fins from recycled plastic materials.

In the second semester the unit draws upon the knowledge and understanding of design and materials technology developed in the prerequisite units *"Introduction to Design Materials and Manufacturing 1 and 2"* and *"Surf Equipment Design Materials and Construction 1"* and applies these in the context of the design and manufacture of surfing equipment, accessories and clothing. Students are trained to get hands-on experience in a range of fabrication technologies used in the surf industry. The 2nd semester culminates with the calculation of design features for various Type surfboards, preparation of templates and construction of surfboard(s). Students are encouraged to accumulate, evaluate and use data from different sources, either literature or directly from shapers. Probably the most comprehensive information about surfboard production is in the literature (Orbelian, 1987). Students work individually on their own design. Their knowledge is extended via industrial visits and professional surfboard shapers' assistance. An example of the 2nd year students' work associated with surfboard production is shown in Figure 4.

All SST students are dedicated surfers who enjoy the great quality waves at Margaret River in Western Australia. Consequently they often search for improvements in their surf-craft and surfing performance. Over five years a wide variety of different fins and surfboards were produced at ECU. The most popular appeared to be the thruster *i.e.* three fin design. Majority of these surfboards bore features similar to both a Type "Short", 4' 0" to 6' 3", and a Type "Fish", 4' 0" to 6' 3", surfboards. Very few students designed a Type "Malibu", 8' 6" to 12', and/or a Type "Minimal", 7' 0" to 8' 6", surfboard(s). Moreover, the students showed a high level of artistic skill which is evident from the appearance of their surfboards. Therefore aesthetically-pleasing surfboards seem to be of some interest.

In order to find out which criteria are important for our students when buying or making a surfboard, the first, second and third year ECU students



Figure 4. ECU students, and Dr. Audy (front) with their surfboards made in 2007.

involved in the SST programme were surveyed. The results were quantitatively analysed in order to conduct a comparison of relative importance of various qualitative criteria with respect to each other. The results are presented and discussed from both qualitative and quantitative points of view in the following section.

Students' Responses to Survey of Surfing Activity and Surfboard Features

This survey was conducted in March 2004. Forty-nine students were surveyed: 16 of them were first-year students (Group 1), 15 were second-year students (Group 2), and 18 were third-year students (Group 3). The most important results are tabulated in Table 1.

Of the total survey sample of respondents, 52% were males and 48% females. The age range included 52% of respondents younger than 20 years, 37% of respondents between 20 and 25 years, and the remaining 11% of respondents were older than 25 years. This indicated that mostly young people were interested in studying surf science and technology. The average height values for males appeared to be similar in mean values but differed in variation, $177^{\pm 10}$ cm for Group 1, $175^{\pm 5}$ cm for Group 2 and $179^{\pm 6.5}$ cm from Group 3. The average weight values for males appeared to be similar in mean values but

differed in variation, $73^{+12.5}$ kg for Group 1, $75^{+12.5}$ kg for Group 2 and 75^{+15} kg from Group 3. A similar situation was found in the case of females (see data in Table 1). This indicated that the surfboards produced or purchased by individuals in these three groups would vary in length, width and thickness depending on the level of buoyancy needed by the surfer. Of the total survey sample, 48% of respondents indicated that they surf more than twice a week, 22% surf around twice a week, and one person has never been surfing. This shows that our students like surfing. It is expected that they must also have some surfing skills and experience. This would be useful for judging surfboard performance from an empirical point of view. When surveyed about surfboard ownership the average number of surfboards owned so far were 4 with the range of 10 for the 1st year students, 4 with the range of 9 for the 2nd year students, and 14 with the range of 48 for the 3rd year students. This indicates an increased trend in surfboard ownership. This trend is plotted in Figure 5 by histograms showing the distribution of surfboards owned by the ECU students involved in the SST programme.

Table 1. Survey results of ECU SST students, 2004.

PARTICIPANTS PERSONAL DETAILS				SURF-BOARD(S) OWNERSHIP			
Male	10	7	7	Do not have a surfboard	1	0	0
Female	6	8	8	Own 1 surfboard	2	6	2
Under 20 years old	6	9	9	Have more than one and less than 3 surfboards	8	4	8
Between 20 and 25 years old	9	4	4	Own more than 3 surfboards	5	2	9
Over 20 years old	1	2	2	Average number of surfboards owned so far	min 0 max 10 (range 10)	min 1 max 10 (range 9)	min 2 max 50 (range 48)
Average height of males [cm]	177 ± 10	175 ± 5.5	175 ± 5.5	Do not remember how many surfboards owned	6	2	2
Average weight of males [kg]	73 ± 12.5	75 ± 12.5	75 ± 12.5				
Average height of females [cm]	167 ± 5.5	163 ± 9.5	163 ± 9.5				
Average weight of females [kg]	63 ± 6.5	57 ± 8	57 ± 8				

MOST IMPORTANT CRITERIA WHEN BUYING A SURF-BOARD			
the craft weight	13	8	7
the craft cost	11	13	16
the craft design/shape	15	14	16
the fin design	7	6	4
the number of fins	9	5	7
the craft durability	9	3	6
the craft appearance	NA	2	2
the shaper	3	1	NA
the surfboard / fin material	2	1	NA

SURFING ACTIVITY			
Never been surfing	1	0	0
Surfing once a week	0	4	8
Surfing twice a week	3	4	4
Surfing more than twice a week	10	6	6

COST OF THE SURF-BOARD PURCHASED			
around \$600	12	13	13
between \$600 and \$1000	3	2	3
more than \$1000	0	0	2

CHANGING THE SURF-BOARD			
every six months	2	1	3
once a year	4	1	6
when its old or damaged	10	13	9

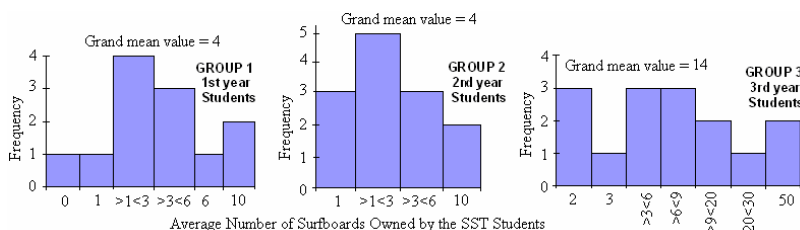


Figure 5. Histograms showing the distribution of surfboards owned by the SST students.

Of the total survey sample, 37 students owned together 378 surfboards. The survey further indicated that 77.5% of students spend around \$600 per surfboard, while 16% spend more than \$660 and less than \$1000 per surfboard, and two more than \$1000 per surfboard. If considering the lowest level of \$600 spent for a surfboard, the group of 37 students spent around \$232 200 for their 378 surfboards. This indicated that the students opted to have more surfboards for less cost. 66% of respondents indicated that they change their surfboard when damaged or old, 20% said that they change their surfboards once a year, and 12% said that they change their surfboards every six months. It appears that the majority of surfers ride their surfboards until destruction, while some of them are keen to experiment with new designs and materials, or exchange their board when worn. The last part of this survey focussed on the 'most important' criteria when purchasing a surf-board. From Table 1 it is evident that when surveyed, the surf science students responded to nine important criteria associated with purchasing a surfboard. These criteria were: craft cost, craft weight, craft shape, fin design, number of fins, craft durability, craft appearance, craft shaper, and fin/craft material. To assist in the analysis of this survey sample results, and to provide a quantitative comparison of relative importance of each qualitative criterion with respect to other criteria describing the surfboard(s) in terms of design features, material, performance and durability, a comparative method has been established. The accuracy of this method is dependent on the number of qualitative features examined, and both quantity and quality of the information gained about the whole system involved in the evaluation process. Statistical significance of each criterion against others from the same sample group was determined from the percentage difference between the two criteria that was calculated using Equation (1).

$$\%difference = \frac{100.(Criterion1 - Criterion2,3,4,...9)}{Criterion1} \quad (1)$$

$$\text{Continue } \%difference = \frac{100.(Criterion2 - Criterion1,3,4,...9)}{Criterion2} \text{ etc}$$

eg (Group 1, 1st year)

$$\%difference = \frac{100.(CraftCost - CraftWeight)}{CraftCost} = \frac{100.(11 - 13)}{11} = -18 \%$$

Whenever the percentage difference between two mutually compared variables was less than plus and/or minus 25% both criteria were considered to have the same level of statistical significance which was marked as 1. For

percentage differences higher than positive 25% the first variable was more significant than the second variable. In such cases the statistical significance numbers were 2 and 0 for the first and second criterion, respectively. When percentage differences were more negative than negative 25% then the first variable was less significant than the second variable. In such cases the statistical significance numbers were 0 and 2 for the first and second criterion, respectively. An example of determining statistical significance of the craft cost criterion against the other eight criteria, namely craft weight, craft shape, fin design ... craft/fin material, is shown in the following Table 2 for the group 2 and the 2nd year students.

Table 2. A key to determine statistical significance of one criterion against other criteria.

Craft Cost versus	Craft Weight	Craft Shape	Fin Design	Number of Fins	Craft Durability	Craft Appearance	Craft Shaper	Craft/Fin Material
13 (Group 2, 2 nd year)	8	14	6	5	3	2	1	1
% difference	38	-8	54	62	77	85	92	92
Significance of Craft Cost versus	2	1	2	2	2	2	2	2

The same approach was used to calculate the percentage difference(s) and statistical significance coefficient(s) for all possible, 170 in total, criterion to criterion combinations. The qualitative criteria and their corresponding significance coefficients are tabulated individually for each group and different year students in Table 3, including the statistical results showing the perceived relative importance, q_i , for variety of qualitative criteria, calculated from the students' responses. For each criterion, in Table 3 (A, B and C), the relative quantitative importance (q_i) was calculated using Equation (2).

$$q_i = \frac{D_i}{\sum D_i} = \frac{D_i}{D} \quad (2)$$

In Equation (2), the D_i represents the individual quantitative pointer for each qualitative criterion, and it was calculated as a sum of statistical significance numbers in a row *e.g.* for Group 1 and 1st year students the craft weight criterion had $D_i = 12$ *i.e.* (1 + 1 + 2 + 2 + 2 + 2 + 2). The D represents the statistical sum quantitative pointer of all D_i values for the whole sample set. The sum of relative quantitative importance (q_i) values should be equal to 1 for overriding importance/significance.

The data from Table 3 was used to make a plot, and to study the relationship, between the quantitative weight values and qualitative criteria for the three sample groups. This plot is shown in the following Figure 6. From this figure it

Table 3. Statistical results of q_i calculated from responses of 1st year (A), 2nd year (B) and 3rd year (C), SST students. The symbols in Table 3 are as follows: CW – Craft Weight; CC – Craft Cost; CS – Craft Shape; CD – Craft Durability; CA – Craft Appearance; S – Craft Shaper; FD – Fin Design; NF – Number of Fins; CFM – Craft / Fin Material.

(A)	CW	CC	CS	CD	CA	S	FD	NF	CFM	D_i	q_i
CW	--	1	1	2	NA	2	2	2	2	12	0.214
CC	1	--	0	1	NA	2	2	1	2	9	0.161
CS	1	2	--	2	NA	2	2	2	2	13	0.232
CD	0	1	0	--	NA	2	2	1	2	8	0.143
CA	NA	NA	NA	NA	--	NA	NA	NA	NA	NA	NA
S	0	0	0	0	NA	--	0	0	1	2	0.036
FD	0	0	0	0	NA	2	--	0	2	4	0.071
NF	0	1	0	1	NA	2	2	--	2	8	0.143
CFM	0	0	0	0	NA	0	0	0	--	0	0
sum										56	0.998

(B)	CW	CC	CS	CD	CA	S	FD	NF	CFM	D_i	q_i
CW	--	0	0	2	2	2	1	2	2	11	0.152
CC	2	--	1	2	2	2	2	2	2	15	0.208
CS	2	1	--	2	2	2	2	2	2	13	0.232
CD	0	0	0	--	2	2	0	0	2	6	0.083
CA	0	0	0	0	--	2	0	0	2	4	0.055
S	0	0	0	0	0	--	0	0	1	1	0.014
FD	1	0	0	2	2	2	--	1	2	10	0.138
NF	0	0	0	2	2	2	1	--	2	9	0.125
CFM	0	0	0	0	0	1	0	0	--	1	0.014
sum										72	0.997

(C)	CW	CC	CS	CD	CA	S	FD	NF	CFM	D_i	q_i
CW	--	0	0	2	2	NA	2	1	NA	7	0.166
CC	2	--	1	2	2	NA	2	2	NA	11	0.262
CS	2	1	--	2	2	NA	2	2	NA	11	0.262
CD	0	0	0	--	2	NA	2	1	NA	5	0.119
CA	0	0	0	0	--	NA	0	0	NA	0	0
S	NA	NA	NA	NA	NA	--	NA	NA	NA	NA	NA
FD	0	0	0	0	2	NA	--	0	NA	2	0.048
NF	1	0	0	1	2	NA	2	--	NA	6	0.143
CFM	NA	NA	NA	NA	NA	NA	NA	NA	--	NA	NA
sum										42	1

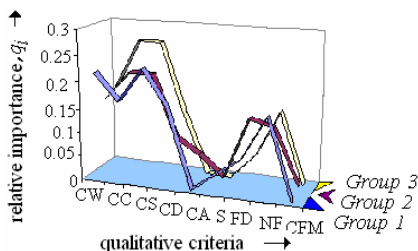


Figure 6. The relative importance of various criteria considered when purchasing a surfboard by ECU SST students.

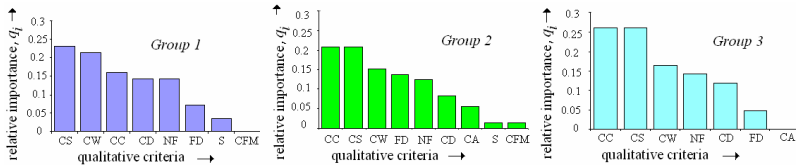
Figure 7. Histograms showing plots of q_i against each qualitative criterion for groups 1 to 3.

Table 4. Final order in the qualitative statements associated with surfboard criteria.

GROUP ORDER	Group 1 (1 st Year Students)	Group 2 (2 nd Year Students)	Group 3 (3 rd Year Students)	FINAL ORDER
1	Craft Shape	Craft Cost Craft Shape	Craft Cost Craft Shape	Craft Shape
2	Craft Weight	Craft Cost Craft Shape	Craft Cost Craft Shape	Craft Cost
3	Craft Cost	Craft Weight	Craft Weight	Craft Weight
4	Craft Durability	Fin Design	Number of Fins	Number of Fins
5	Number of Fins	Number of Fins	Craft Durability	Craft Durability
6	Fin Design	Craft Durability	Fin Design	Fin Design
7	Craft Shaper	Craft Appearance	Craft Appearance	Craft Appearance
8	Craft/Fin Material	Craft Shaper	NA	Craft/Fin Material
9	NA	Craft/Fin Material	NA	Craft Shaper

is evident that the trends in all nine qualitative criteria and the three sample groups are qualitatively similar but quantitatively different. To determine the quantitative importance of each qualitative criterion in the sample group the qualitative criteria were rearranged in order from highest to lowest relative quantitative importance according to their q_i values, see Figure 7.

From the graphs in Figure 7 it is evident that there is some disagreement in order of qualitative criteria between the three student sample groups. Because of this, the qualitative criteria were tabulated into one group order for all the three student sample groups, see Table 4. The final order of qualitative criteria for all three groups was determined from the majority of same qualitative criteria for each group order number *eg* for Group Order 1 it was Craft Shape because three Craft Shape Criteria were in a row 1; for Group Order 2 it was Craft Cost because Craft Cost was the second criterion mostly presented in row 1 (Group Order 1) and row 2 (Group Order 2). In Group Order 3 Craft Weight was represented two times by Group 2 and Group 3, while Group 1 preferred Craft Cost. Statements in Group Order 4 were not consistent. Consequently they were compared with those in Group Order 5. For Group Orders 4 and 5 there were three Number of Fins criteria, two Craft Durability Criteria and one

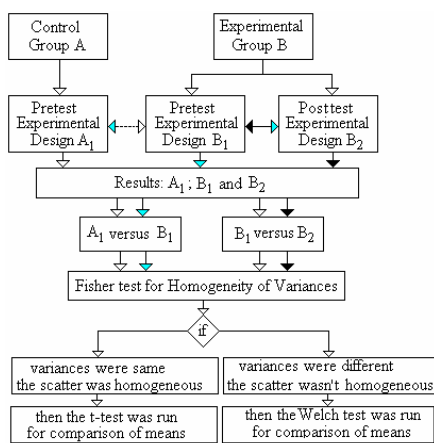
Fin Design Criterion. Consequently, the final order was Number of Fins for Group Order 4 and Craft Durability for Group Order 5. For Group Order 6 there was Fin Design supported with statements by 1st and 3rd year students. For Group Order 7 it was Craft Appearance represented by the 2nd and 3rd year students' statements. Statements in the last two Group Orders 8 and 9 were not consistent. When treated all together, there were two Craft/Fin Material Criteria against one Craft Shaper Criterion, while the rest of the three statements were not available. Consequently, the Craft Fin Material criterion took up the position of eight in the total group order, while the Craft Shaper Criterion was the last in the final order.

From Table 4 it is evident that surfers and surfboard users appreciate most of all the features in craft shape as functional ones that influence the performance of the surfboards. The craft cost is the second most appreciated variable. Its economical importance became more evident when 78% of respondents indicated that they were willing to spend around \$600 or less on the surfboard(s), and that 86% of them would change their surfboard(s) only when old or damaged (see data in Table 1). This shows that all improvements in surfboard construction that are currently sought through the changes in design and materials should not exceed the \$600 retail value of the surfboards, and hence be able to compete, successfully in the open market. The next most highly expressed feature was the craft weight supported by 57% of respondents. The current trend in surfboard production is to reduce the craft weight as much as possible. However, this feature is not isolated from others, as it affects the mechanical properties of surfboards; boards break where they should not, mostly because of their inability to deal with wave impact forces due to reduced strength, stiffness and toughness. Generally, reductions in the weight are sought via reductions in surfboard thickness features. This approach however, reduces both strength and durability. There are some possibilities to reduce the craft weight by reducing the number of fibreglass layers and squeezing resin off the cloth when embalming the foam core, but the downfall is that it reduces board stiffness. Stiffness can be improved by replacing the common E-fibre glass with carbon fibres but this increases production cost. It is therefore evident that the choice of correct material(s) is critical and requires a full understanding of all the interactive factors. It is recognized from experience that the qualitative level of the whole surfboard is ultimately dependent upon the level of the weakest – most inadequate – part of the total product which can be any variable in material and design features. To maximize quality the whole quantities have to be lifted to a similar level. This level, however, has to be economically sound. In

contrast, the recent survey has shown that our students have a tendency to underestimate the role of materials in surf production since the craft/fin material criterion was ranked at the tail of the group order *i.e.* the second from last. Surprisingly, the craft shaper criterion was the least important factor which indicates that it does not matter how sharp the board is unless the craft has the right shape and appearance. Finally, the survey results showed that the number of fins was a highly sought surfboard feature, supported by 47% of respondents. These respondents probably prefer the three fin design (known as the 'thruster') invented by Simon Anderson in the early 1980's. According to our results the number of fins is more important than fin design (see group order numbers 4 and 6, in Table 4). However, the increase in fin numbers would result in the increase of the craft weight, unless other improvements are done via fin design and fin materials. Thus, it is apparent that a surfboard has to be treated as a complex system with mutual interrelationships between its various qualitative and quantitative measures. Consequently, there is a need to gain a deeper understanding on the potential of various manufacturing procedures and materials in order to see what further improvements can be made to the design and performance of surfboards.

Teaching and Learning Efficiency

Lecturer: In this study the learning styles were independent variables and both achievement scores and attitude scores were dependent variables. Achievement scores were marks based on the results obtained by the students from their individually designed and manufactured surfboards including marks for their final reports. The main measures in assessment were: product quality (both intended and final), with links to, and critical comments on, reported data on surfboard design and procedures and data analysis. Fifty percent was the highest possible mark to be achieved by a student for his/her surfboard and report. The other 50% was allocated for the exam. The following Figure 8 shows a key to experimental design, data analyses and results. The results showed that the variances of the 'score' data between the two groups in both cases (A_1 and B_1) and (B_1 and B_2) were not equal or homogeneous. In contrast, differences in mean values of scores *i.e.* 37.4 for A_1 and 38.3 for B_1 were found to not be significant at a 95 percent confidence level. This suggested that one common grand mean of 37.85 will apply for the two groups from the pre-test experiments. The relatively small (but statistically significant) differences in variances, 65.2 and 53.3, and the same grand mean value of 37.85 for both



Results from descriptive statistics for equity of variances and equity of mean values on the results from pre-test and post-test experimental designs

Results	Variances	St. dev.	Mean
A ₁ (dof=14)	65.2	8.1	37.4
B ₁ (dof=12)	53.3	7.3	38.3
B ₂ (dof=10)	19.9	4.4	44.8

A ₁ & B ₁	B ₁ & B ₂
$F=0.81, F_{critical}=0.37$	$F=0.36, F_{critical}=0.34$
Scatter different	Scatter different
$t=0.28, t_{critical}=1.7$	$t=2.7, t_{critical}=1.7$
Means similar, 37.85	Means different

Figure 8. A key to experimental design and subsequent data analyses.

Types A₁ (dof=14) and B₁ (dof=12) from pre-test indicated that students had diverse skills but the same background.

The post-test experiments (video assistance and lecturer’s interactions) appeared to be very successful in improving students’ achievements. Students’ scores improved (increased) by about 18 percent (from 37.85 in A₁ and B₁, to 44.8 in B₂). In addition, the standard deviation in mean score was reduced from 8.1 for the pre-test A₁ and 7.3 for the pre-test B₁ to 4.4 for the post-test B₂. This improvement was found to be statistically significant at a 95 percent confidence level.

Finally, it deserves to be noted that the total production time spent on shaping and laminating ECU surfboards varied from three weeks to nine weeks. There was no big difference in the total average production time 27.7^{±6} hours and 24.9^{±6} hours between the two –A₁ and B₁– pre-test groups. However, the significant drop in production time (to 16.4^{±5} hours) was observed in the pre-test group B₂. This trend was evident in all three individual surfboard-making activities that included *firstly* shaping, *secondly* laminating, and *thirdly* fin setting and finishing. The individual time factor for A₁ and B₁ (pre-test) designs was greater than that for B₂ (post-test) design.

Students: At the end of each semester the SST students are asked to complete a UTEI (University Teaching Evaluation Instrument) based on a 5-point Likert-type scale (strongly agree, agree, not sure, disagree and strongly disagree) and to respond to questions on Unit Organisation (UO), learning scope (LS), evaluation of learning (EL), resources and context (RC), and overall satisfaction (OS).

Several students indicated that the blackboard method (web-assisted sites) does not enhance learning, and stated that they preferred face-to-face communication with the lecturer. The students' satisfaction with the unit was extremely high. The mean scores, based on the UTEI survey were 100% for UO, EL, RC as well as OS; and 93% for LS.

Conclusions

The main conclusions to be drawn from this study may be summarised as follows:

There are various important criteria, namely craft weight, craft cost, craft design/shape, fin design, number of fins, craft durability, craft appearance, shaper, surfboard/fin material(s), to be considered when purchasing or designing a surfboard. These criteria are mutually linked to each other and cannot be treated independently if the surfboard is to be evaluated as a whole system. However, a variety of literature sources refer to the above criteria in rather descriptive and qualitative ways, and provide very limited or no quantities for a quantitative comparison.

This being the case, a survey on surfing activity and surfboard criteria was carried out between a large number of ECU students involved in surf science and technology. Initial analysis of survey data showed that our students are dedicated surfers and owners of a number of surfboards. This indicated that the results would provide valuable information from both a surfboards' design and performance point of view.

A comparative method was developed to determine the quantitative importance of each qualitative criterion to other criteria with respect to various design and performance measures. When ranking these qualitative criteria according to their relative quantitative importance values for three group sample students, the pattern(s) in statements were qualitatively similar and quantitatively different. This means that the 1st, 2nd and 3rd year students put different importance to criteria.

Analysing importance values from a quantitative point of view for each criterion in terms of three sample groups allowed for the finding of a final order in importance of criteria for purchasing or building a 'best-fit' surfboard. This order, from best to worst, was: Craft Shape, 1, Craft Cost, 2, Craft Weight, 3, Number of Fins, 4, Craft Durability, 5, Fin Design, 6, Craft Appearance, 7, Craft/Fin Material, 8, Craft Shaper, 9. This indicated some underestimation of effects of materials against other, higher ranked criteria, namely cost, weight, durability, and appearance.

More work is needed to study the potential of various manufacturing procedures, materials and design features that may improve the performance of surfboards and contribute to teaching and learning modules at the SST programme.

Students' opinions, as indicated by quantitative ratings and comments on UTEI questionnaires, on the quality of teaching and learning were very positive *ie* reaching almost 100% level of satisfaction. Students enjoyed working on their boards. In addition, they found the lecture material very helpful and seemed to appreciate the more 'traditional' face-to-face teaching, as opposed to the blackboard – web assisted – alternative.

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A STUDY ON TAG CLOUD QUALITY IN E-LEARNING 2.0

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Abstract

This chapter investigates tag visualization for tag-enabled web applications. We propose an approach which allows users to adjust different settings, such as formulae, number of font sizes and number of tags, so as to improve the tag cloud quality. A series of experiments about the visualization effects are conducted. Based on the experimental results, some recommendations on choosing the formulae, number of font sizes and number of tags are made.

Introduction

The nature of the Internet has been changing since its commercial realization in the mid-nineties. One of the latest developments that have captured the attention of Internet researchers is the way people use the Internet. This new trend, often summarily referred as Web 2.0 (O'Reilly, 2005), refers to creating and distributing Web contents such as in blog, wiki and podcast. Collaborative tagging is also a notable example of this new development, characterized with individual tags for each user. More specifically, Web 2.0 shows less emphasis on hit-rate-driven popularity, but emphasizes more on open communication, freedom to share and re-use, decentralization of authority, the market as a conversation, and a sense of civic responsibility. Internet social network, or online communities, is considered a vital aspect of Web 2.0 concepts, because it depends upon social interaction and exchange among users. They inevitably encourage the exponential growth in these online communities. This chapter focus on the tagging feature of Web 2.0.

The e-Learning 2.0 is an online learning environment soon evolved from Web 2.0 development. The three main features of Web 2.0 linking to e-learning 2.0 are user-centric, content creation and content access. In the following, we

draw upon a tagging lecture slides application (Chow *et al.*, 2006a; Chow *et al.*, 2006b) to illustrate e-learning 2.0 concepts and substantiate the issues of tag cloud quality in e-learning 2.0.

The user-centric characteristic of Web 2.0 correlates closely with the student-centered learning. e-Learning 2.0 is a form of social networking. Each student plays the role of nodes in a social network and interacts with others through adding tags. Other students react with enquiring tag clouds and taking the additional tags. There exists shared learning among students. Students are free to share their tags with others as well as reuse tags of others. Hence, in the tagging process, students themselves naturally become the actors in learning. In conformance with Web 2.0, students are the focus and source of learning materials. Students will soon realize that a sense of responsibility as the number of tags is directly proportional to their active participation. Overall this approach is learner-centered, self-paced, personalized and shifting responsibility from instructors to learners.

Adding tags is a form of content creation. Tag is any word that student uses to establish association to a slide. A slide tag is interpreted in a similar way as the tag used in web. Each tag has properties like tag name, creator name and created date. This tagging effect is different from the traditional web-based learning where students are more often passive viewers of lecture slide contents. The frequency of students accessing the course web site is secondary to how well they learn in cross-referencing the slide contents and in sharing peer remarks, i.e. collective intelligence. Reflecting its usefulness, tagging has been applied to different academic discipline, application system and problem domain. These include, for examples, image retrieval (Aurnhammer, 2006), Foragr system (Dennis, 2006), art museum (Trant and Wyman, 2006).

The primary purpose of a tag cloud is for content access. Being an important part in the tagging area, a tag cloud allows access of tag contents by linearly displaying the collected tags in a multi-line graph according to certain order such as alphabet, size or time. With more and more user participation for adding tags, such as in some famous social networking sites (Del.icio.us, flickr, etc.), it becomes difficult to visualize tags in an easy way, particularly within a limited output framework such as on the browser screen. Such difficulty in visualization becomes one of the tag cloud weaknesses, and becomes more obvious as the number of tags progresses from large to huge. This new research in tag cloud improvement is also an area of active research for researchers, such as proposing algorithms for cloud visualization (Kaser and Lemire, 2007) and making improvement through visual interfaces (Hassan-Montero and Herrero-Solana,

2006) and clustering technique (Bengelman *et al.*, 2006). The issue of tag cloud quality is our main concern. Consequently, this chapter tackles the tag cloud visualization and quality issue and aims for an effective access of tag contents through improving tag cloud quality.

Tag Cloud Quality

In this section, we investigate tag and tag cloud, and derive a list of dimensions and quality attributes that contribute to improving tag cloud visualization.

Tag and tag cloud

A tag is a user-defined open-ended label associated to a piece of information or object such as bookmark, photo, audio and video. This label is chosen freely by user and is not taken from any controlled set of words. Selecting a single tag leads to a collection of objects associated with that tag. Tags help individuals to organize contents and obtain information about social network, as confirmed by their early results (Farrell and Lau, 2006). It is inevitable that, among the tags, some are more popular than others. There are highly popular tags as well as rarely used tags. This varied frequency of tags is usually shown in different fonts. There are different types of tags, such as from the 7-type (Golder & Huberman, 2006) to 5-type (Xu *et al.*, 2006). Tags are not pre-categorized in users' mind. A collection of tags is a folk taxonomy or folksonomy, and is different from the taxonomy of classification which is hierarchical. As for examples, "Del.icio.us" (Figure 1) is a social bookmarking site that allows users to bookmark web sites and then tag them with descriptive words, so as to make it available for others to search for interesting pages; "Flickr" is a service that allows users to tag images with specific nouns, verbs and adjectives describing pictures, facilitating photo search and filtering within the site; "Gmail" is a web mail site that was one of the first to allow grouping of objects with tags, known as "labels" on e-mails.

It is important for tags to be displayed, in order for tagging to be useful. A tag cloud is commonly used as a visual representation of tags. Tag cloud is a non-hierarchical pictorial listing of tags. It is rendered by inline HTML elements such as <a>, ,
, <div>, , <i> and . Tags are displayed in various font sizes so that tag popularity can be represented visually. Higher popularity tags are depicted in larger font size whereas lower popularity tags are depicted in smaller font size. In most tag clouds, tags are displayed in either alphabetical order or font size. Currently, most web sites allow limited settings

in tag cloud display. Some web sites allow users to view a tag cloud with selected tags and most recent tags. However, users cannot change the settings such as formula, number of font sizes and number of tags.



Figure 1. Tag cloud from del.icio.us (Source <http://del.icio.us/>).

Visual effectiveness

Regarding the visual effectiveness of tags, three questions on tagging are posed : How to properly reflect the tag collection? How to distinguish tags. How to select tags into the tag cloud? The effectiveness of a tag cloud depends on factors such as the font size of the tags, number of tags, timeliness of the tags and most importantly, its underlying formula in the calculating tag distribution. The quality of tags is a question of concern in the research community. To improve tag quality, Xu *et al.* (2006) list five criteria for good tag combination. They are high coverage and popularity, least-effort, uniformity and exclusion of undesirable tags. Fokker *et al.* (2006) also aim to improve tag quality. Begelman *et al.* (2006) believe that other techniques can be used with tagging to improve tagging experience. They proposed to use clustering to establish strong relations among tags in tag space. This is attained by counting co-occurrences of tag pairs within the same web page.

Formulaes are essentially used in calculating tag distribution. Jeffery Zeldman uses pure count to divide tags into groups (Zeldman 2006) while Kentbye uses logarithm count (Kentbye 2006). Tag clouds can be very different based on different formula. In general, a tag cloud formulae makes use of the number of tags counted, find out the maximum and minimum counts for arriving

a range, determine the number of tag groups, and use different font sizes to show the distribution of tags.

Tag cloud dimension

To properly reflect the tag collection and to obtain an effective visualization of tag cloud, essential tag cloud elements need to be extracted. Table 1 lists these elements that would affect tag cloud visual effectiveness. They are summarily called the dimensions of a tag cloud.

Table 1. Tag cloud dimensions.

Dimension	Description
No. of Font Sizes	Different font sizes are used, from smaller to larger. They show the differences in tags distribution clearly.
No. of Tags	It is important to display a suitable number of tags on screen. Displaying too many tags may overwhelm users.
Formula	It forms the tags distribution. If the tags are distributed in group evenly according to their relative group count, users will see the differences of tags in groups.
Time	Most tag clouds do not use time to measure the importance of tag. However, time dimension may provide useful information to users.
No. of Groups	Some webmasters choose a number of tag groups and they rarely change this number. It should be fine in most situation but some extreme cases such as very high or low tag count may confuse group distribution.
Relatedness	Related tags and user feedback about tags help users to share their concepts and ideas about tags in Folksonomy.

Quality attribute

In a good tag cloud, the tag cloud size should fit into the browser screen so as to reduce scrolling. Designer may use inline HTML elements to properly eliminate scrolling of the tag cloud. It can be applied in any tag cloud easily. The listing of tags should be able to show the tags effectively with varied font sizes. The differences within the tag distribution should be displayed clearly. The numbers of tags in each group should be proportional. The font sizes of tags must be different in each group, but the change of font sizes should be gradual. Given a fixed number of tags within a tag cloud, the larger font size tags, which provide more information of tags, should be maximized. It would be better to remove the low popularity tags from the tag cloud as too many tags may overwhelm the users. A tag cloud may attempt to display as many tags as possible to maximize users' choices of tags, but not overwhelming users.

In our view, the website del.icio.us (<http://del.icio.us/>) is a good example that provides a quality tag cloud (Figure 1). The tag distribution among groups is displayed clearly. The font sizes of tags are well distinguished. The number of tags is optimal that all tags are shown in one page without the need of scrolling.

A list of tag cloud quality attributes that summarizes the visual effectiveness of a tag cloud is shown as follows:

- Maximizing larger font size tags in a tag cloud, and excluding low popularity tags in a tag cloud
- Providing sufficient contrast among tag groups in a tag cloud, such as different font sizes and gradual change in font sizes
- Applying optimal number of tags in a tag cloud to maximize the number of tags, while not overwhelming users

Research Approach and Tool

This section explains the research approach taken in the chapter and conducts a series of experiments on tag cloud generation.

Research approach

We launch a series of experiments for generating tag clouds based on different number of font sizes, number of tags and formulae. As mentioned before, a tag cloud consists of 6 dimensions, namely, number of font sizes, number of tags, formulae, time, number of groups and relatedness. Number of font sizes, number of tags and formulae will make the most significant impact on the tag cloud, so they are studied in our experiments. The experiments involve : (i) generating tag clouds with 5 and 8 font sizes, (ii) generating tag clouds with different formulae, and (iii) generating tag clouds with different number of tags in tag cloud. The results are then compared and analyzed.

In our experiments, the tag clouds display 200 tags in most cases, in 5 or 8 font sizes. We will adopt three formulas, namely, Jeffery Zeldman's (Formula A), our proposed formula that sorts all tag count and divides tag count into groups (Formula B) and Kentbye's formula (Formula C). Formula A is the simplest formula and it uses pure count to divide tags into groups. We propose a Formula B that sorts all tag count and divides tag count into groups. It is more complex but gives a better tag cloud than Formula A. In Formula C, logarithm count is used to divide tags into groups. Formula C is simpler than Formula B, but also gives a good tag cloud.

Tag cloud generator tool

For a good visual appearance of tag clouds, a Tag Cloud generator (Figure 2) is used. It produces customized tag clouds, based on different settings, such as number of font sizes, number of tags and formulae.

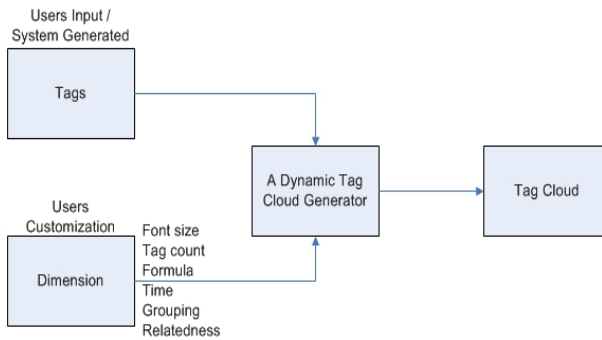


Figure 2. A Tag cloud generator.

Experimental Results

Our experiments are conducted on an e-Commerce Technology course. Tags are regarded as pieces of information related to the course lecture slides. Each slide is associated with tags. A tag may relate to different slides so cross-reference is possible. Students are enabled with functions to assign tags to slides, and every student may have a customized tag cloud for the course. Individual tag clouds are generated accordingly.

We study the use of different number of font sizes, number of tags and formulae. In the following, we presents the experiment results which show tag clouds generated from different number of font sizes, number of tags and formulae.

Using 5 font sizes, 200 tags and different formulae

As shown in Table 2, the first group of tag cloud settings (1.1, 1.2 and 1.3) is aimed for investigating the impact of using different formulae (5 font sizes and 200 tags). Figures 3, 4 and 5 show the tag clouds generated.

Table 2. The first group of tag cloud settings 1.1, 1.2 and 1.3.

Dimension	Maximum value	Setting 1.1	Setting 1.2	Setting 1.3
No. of font sizes	10 font sizes	5 font sizes	5 font sizes	5 font sizes
No. of tags	200 tags	200 tags	200 tags	200 tags
Time	10	5	5	5
No. of groups	10	5	5	5
Relatedness	10	5	5	5
Formula	Nil	Formula A	Formula B	Formula C

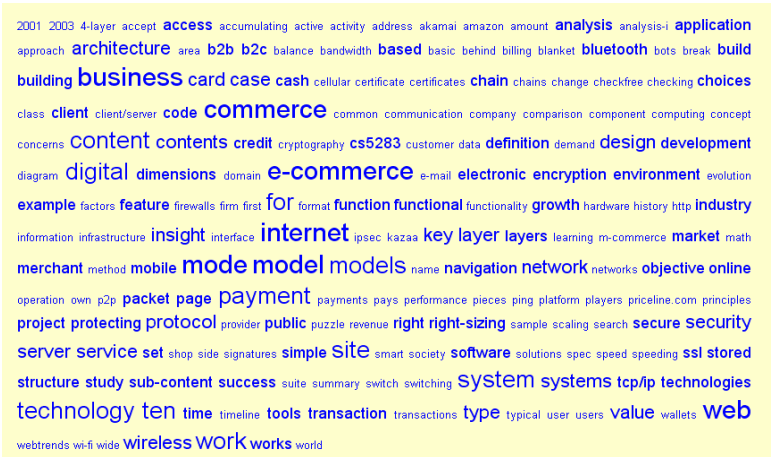


Figure 3. Tag cloud generated, based on setting 1.1 (5 font sizes, 200 tags, Formula A).



Figure 4. Tag cloud generated, based on setting 1.2 (5 font sizes, 200 tags, Formula B)

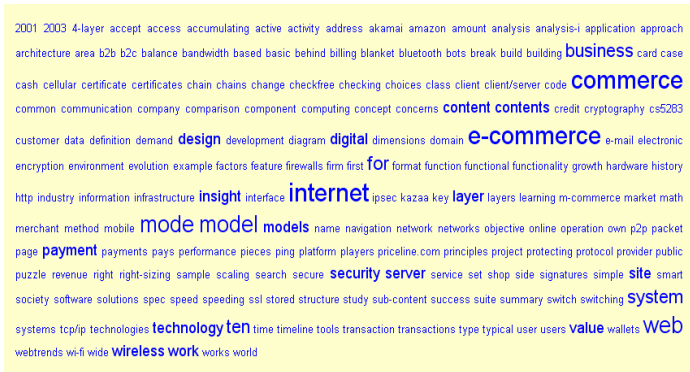


Figure 5. Tag cloud generated, based on setting 1.3 (5 font sizes, 200 tags, Formula C).

Using 8 font sizes, 200 tags and different formulae

As shown in Table 3, the second group of tag cloud settings (2.1, 2.2 and 2.3) is aimed for investigating the impact of using different formulae (8 font sizes and 200 tags). Figures 6, 7 and 8 show the tag clouds generated.

Table 3. The second group of tag cloud settings 2.1, 2.2 and 2.3.

Dimension	Maximum value	Setting 2.1	Setting 2.2	Setting 2.3
No. of font sizes	10 font sizes	8 font sizes	8 font sizes	8 font sizes
No. of tags	200 tags	200 tags	200 tags	200 tags
Time	10	5	5	5
No. of groups	10	5	5	5
Relatedness	10	5	5	5
Formula	Nil	Formula A	Formula B	Formula C



Figure 6. Tag cloud generated, based on setting 2.1 (8 font sizes, 200 tags, Formula A).

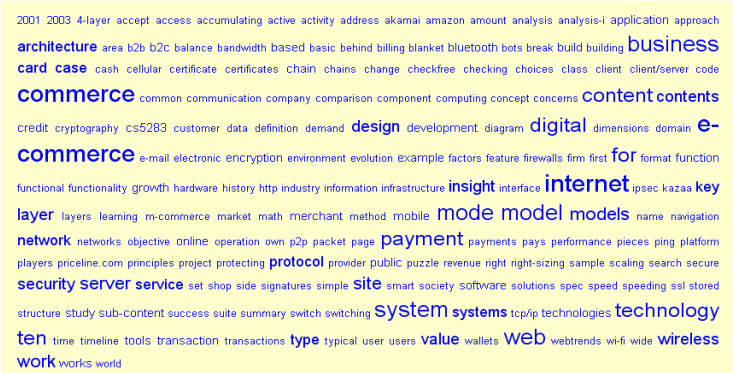


Figure 7. Tag cloud generated, based on setting 2.2 (8 font sizes, 200 tags, Formula B).

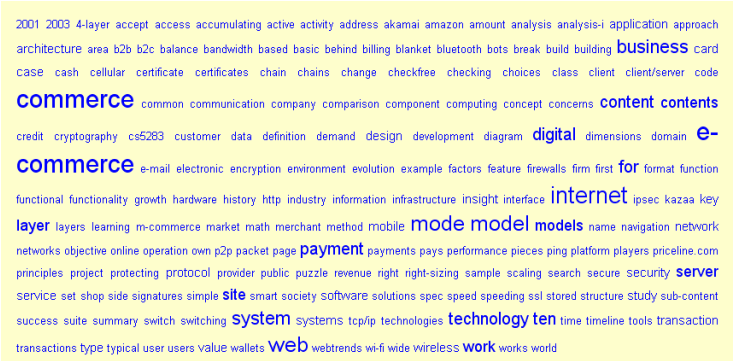


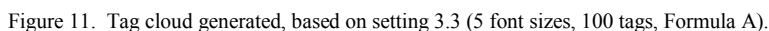
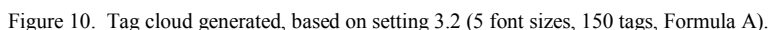
Figure 8. Tag cloud generated, based on setting 2.3 (8 font sizes, 200 tags, Formula C).

Using 5 font sizes, formula a and different numbers of tags

As shown in Table 4, the third group of tag cloud settings (3.1, 3.2 and 3.3) is aimed for investigating the impact of different number of tags (5 font sizes and Formula A). Figures 9, 10 and 11 show the tag clouds generated.

Table 4. The third group of tag cloud settings 3.1, 3.2 and 3.3.

Dimension	Maximum value	Setting 3.1	Setting 3.2	Setting 3.3
No. of font sizes	10 font sizes	5 font sizes	5 font sizes	5 font sizes
No. of tags	200 tags	200 tags	150 tags	100 tags
Time	10	5	5	5
No. of groups	10	5	5	5
Relatedness	10	5	5	5
Formula	Nil	Formula A	Formula A	Formula A



Result Analysis

We analyze the impacts on the tag clouds generated, when using different formulae, number of font sizes and number of tags.

Impacts of using different formulae

Tables 5 and 6 show the tags distribution using different formulae on 8 font sizes and 200 tags, and on 5 font sizes and 200 tags, respectively. Tag clouds using formula C with 8 font sizes and 5 font sizes are undesirable because 90% of tags are small tags. Tag clouds using formula A with 8 font sizes and 5 font sizes are better than tag clouds using formula B as the number of large tags is higher (formula A: 46% and 29% vs. formula B: 29% and 17%). Therefore, formula A gives the best tag cloud.

Table 5. Tags distribution of tag cloud using different formulae (8 font sizes and 200 tags).

Tag Cloud	Formula A	Formula B	Formula C
Font Size 1 (Largest)	3	3	2
Font Size 2	5	5	1
Font Size 3	9	6	3
Font Size 4	8	4	2
Font Size 5	14	7	6
Font Size 6	19	9	6
Font Size 7	70	24	19
Font Size 8 (Smallest)	72	142	161
Large (Font Size 1-6)	58 (29%)	34 (17%)	20 (10%)
Small (Font Size 7-8)	142 (71%)	166 (83%)	180 (90%)

Table 6. Tags distribution of tag cloud using different formulae (5 font sizes and 200 tags).

Tag Cloud	Formula A	Formula B	Formula C
Font Size 1 (Largest)	7	18	3
Font Size 2	10	7	3
Font Size 3	17	9	4
Font Size 4	58	24	15
Font Size 5 (Smallest)	108	142	175
Large (Font Size 1-4)	92 (46%)	58 (29%)	25 (12.5%)
Small (Font Size 5)	108 (54%)	142 (71%)	175 (87.5%)

Impacts of using different number of fonts

The percentages of large tags with 5 font sizes are larger than that with 8 font sizes. For formulae A, B and C, the percentages of large tags increase from 29% to 46%, 17% to 29% and 10% to 12.5% respectively. It can be concluded that dividing tags into 5 font sizes may increase the percentage of small font size tags and reduce the percentage of small font size tags.

Impacts of using different number of tags

Tables 7 and 8 show the tags distribution in 5 font sizes using different number of tags. When the number of tags is reduced from 200 to 150 or 150 to 100, most of the tags in font sizes 4 and 5 decrease significantly. Only small change exists for font sizes 1 to 3. Therefore, less popular tags will be discarded in the tag cloud. On the other hand, the more popular tags remain unchanged when reducing the number of tags. The tag cloud displaying 100 tags has the biggest percentage of large font size tags (51%). However, it may not be the best because the actual number of large font size tags is about half of that of the tag cloud displaying 200 tags (51 versus 92). Since users can get more tags information if the tag cloud displays a bigger number of tags, the tag cloud displaying 200 tags is the best.

Table 7. Tags distribution of tag cloud using different no. of tags (5 font sizes and Formula A).

Tag Cloud	100 Tags	150 Tags	200 Tags
Font Size 1 (Largest)	6	7	7
Font Size 2	9	9	10
Font Size 3	13	17	17
Font Size 4	23	25	58
Font Size 5 (Smallest)	49	92	108
Large (Font Size 1-4)	51 (51%)	58 (38.67%)	92 (46%)
Small (Font Size 5)	49 (49%)	92 (61.33%)	108 (54%)

Table 8. Tags distribution changes using different no. of tags (5 font sizes and Formula A).

Tag Cloud	100 vs. 150	150 vs. 200	100 vs. 200
Font Size 1 (Largest)	-1	-0	-1
Font Size 2	-0	-1	-1
Font Size 3	-4	-0	-4
Font Size 4	-2	-33	-35
Font Size 5 (Smallest)	-43	-16	-59

In summary, the experimental results show that formula A is the best. Formula A generates the most-friendly tag clouds in 5 and 8 font sizes. Dividing tags into 5 font sizes (comparing to 8 font sizes) can increase the proportion of large font size tags and decrease the proportion of small font size tags. Better contrast inside the tag cloud can be obtained so as to improve tag cloud visualization.

Recommendations

We have the following recommendations on setting optimal formulae, number of font sizes and number of tags for generation of tag clouds.

Recommendations on formulae

Tag cloud generated by Formula C does not have a good appearance. It results into information loss. The tag cloud can be regarded as showing only tags without popularity, because most tags are of the same font size (small font). We can see a sharp tag cloud contrast with formula A. Using formula A, the number of big font size tags is more than that using formula B and C. This is because formula A uses logarithm count, which can handle extreme cases such as a tag with very high or small tag count. It increases the number of large font size tags and leads to the conclusion that formula choice is important in tag cloud display. Our experiments recommend that formula A can generate good tag cloud among other two formulas.

Recommendations on number of font sizes

Table 9 shows the changes on large font size tags for 5-font-size tag cloud and 8-font-size tag cloud. The 5-font-size tag cloud displays better contrast for different font sizes and all groups. As the changes of font size tags are quite large, users can differentiate the tag groups and get more illuminations about the tag popularity. In the 8-font-size tag cloud, the numbers of smaller font size tags are large, thus not giving useful information for users. In the 5-font-size tag cloud, the numbers of smaller font size tags is smaller. Dividing tags into smaller number of font sizes decreases the number of small font size tags and at the same time increases large font size tags. It is possible to remove low popularity tags in a tag cloud, so as to maximize the percentage of large font size tags. We may also adjust number of font sizes accordingly.

Table 9. Changes of large font size tags.

Tag Cloud	Formula A	Formula B	Formula C
8 font sizes	58 (29%)	34 (17%)	20 (10%)
5 font sizes	92 (46%)	58 (29%)	25 (12.5%)
Difference	+34 (+58.62%)	+24 (+70.59%)	+5 (+25%)

Table 10. Comparison of tag cloud in 5 font sizes and 8 font sizes.

Tag Cloud	5 font sizes	8 font sizes
Contrast	Better contrast for different font size	Difficult to see the contrast of font sizes
Tag Number	More larger font size tags and lesser smaller font size tags in tag cloud	More smaller font size tags and lesser larger font size tags in tag cloud

Table 10 shows the comparison of tag cloud in 5 font sizes and 8 font sizes. Tag cloud in the 5 font sizes gives better contrast than that in 8 font sizes. It also displays larger font size tags, which is one of the properties of a good tag cloud as we have presented in previous sections.

Recommendations on number of tags

A high proportion of large font size tags is always the characteristic of a good tag cloud. Although changing the number of tags may not make very significant difference in font size contrast, it can reduce small font size tags, thus increasing the proportion of large font size tags. However, if the number of tags is too small, tag clouds would become unfriendly. If the number of tags is too large, tag clouds have a lot of small tags and lead to information loss. This may also overwhelm users. Therefore, we need to strike a balance between the number of tags and the proportion of large font size tags in a tag cloud. It is possible to define an acceptance range, such as 150-200 tags, which does not distort the tag cloud and at the same time gives users enough information about tags.

Conclusion

In this chapter, we presented an adaptive approach to adjusting the settings of tag clouds in order to improve the tag cloud quality. It is proposed to allow users to adjust and change different dimensions which include formulae, number of font sizes and number of tags. Tag clouds can be dynamically generated by users, thus making the newly generated tag clouds more adaptive to different situations. Good quality tag clouds can be created easily, and user experience and friendliness are also improved.

We conducted a series of experiments on tag cloud generation. Based on the experimental results, we come up with three recommendations. First, we should choose formulas which can handle some extreme cases, including very large or small number of tags. Second, we should maximize percentage of large font size tags (more popularity tags) and minimize percentage of small font size tags (less popularity tags) within a group by reducing the number of font sizes. Third, we have to define an acceptance range of total tags displayed in tag clouds. A tag cloud displaying 150–200 tags is recommended as it gives users enough information about tags but does not distort the tag cloud visualization effect.

Our proposed approach can be implemented as a dynamic tag cloud generation tool. Apart from this, future research direction may focus on investigating other dimensions of tag clouds and the importance of each dimension and HTML elements for visual tag cloud display.

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INTRODUCING LEARNING OBJECTS IN TEACHER PREPARATION

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Abstract

The use of Learning Objects (LOs) promises to increase the effectiveness of learning by making contents more readily available, by reducing the cost and effort of producing quality content, and by addressing the need for greater adaptability to fit the unique needs of learners and to enable greater flexibility for customization of learning. A key issue in the diffusion of LOs is preparing teachers to integrate them into lesson planning and teaching practice. This key factor is often neglected in practice and leads to teachers feeling more puzzled than attracted by repositories of LOs. This paper proposes to explicitly prepare teachers on this activity starting from the beginning of pre-service teacher training. This will cultivate a positive attitude and start a constructive tradition in the sharing of educational material at the early stage of teaching training. Critical reflection has a central role to the success of the diffusion of LOs and helps teachers to better understanding the potential of peers' educational material and producing effective and easily re-usable LOs. This paper provides a discussion of the role of Learning Objects in the context of teacher training. The overall objective is to emphasize on the importance early introduction of LOs concepts and suggest an approach to teacher preparation on LOs based on our collective experiment results over the past three years. Central of the approach is a description of the characteristics of the preparation program and the conceptual framework of approach.

Introduction

The use of Learning Objects (LOs) promises to increase the effectiveness of learning by making contents more readily available, by reducing the cost and effort of producing quality content, and by addressing the need for significantly greater adaptability of learning objects to fit the unique needs of individuals and to enable greater flexibility for customization of learning. Repositories of Learning Objects can contribute to exploit the potentialities of ICT for education and training, since they allow teachers to share materials and experiences with a large number of peers (Malcolm, 2005). Integrating didactical resources prepared by other teachers in one's own lessons and preparing new contributions able to raise peers' interest and to be adapted to different learning situations,

however, are no straightforward tasks for teachers (Littlejohn *et al.*, 2003, Lehman, 2007). Unfortunately, despite the number of recent studies on the potential of LOs to improve the work of teachers (Griffith, 2007, Liber, 2005), little attention is paid to explicitly prepare teachers to become good users and producers of LOs (Bratina *et al.*, 2002). It is not surprising, therefore, that school teachers still feel more puzzled than attracted by repositories of LOs.

This hints a need to introduce pre-service teacher training activities that give trainee teachers an initial competence apt to the technical capabilities, share and reuse educational resources and induce a positive attitude towards it.

Inline with other authors (Friesen, 2004), we suggest that LOs' diffusion is actually an issue of technological transfer and should be addressed as such. In order to give a contribution in this direction, we propose a methodology for teacher training which integrates personal reflection on LOs with the simulation of a sharing activity.

These considerations are the starting point of our work. We designed and implemented the prototype of a collaboration environment oriented to support teachers' activity on LOs. We also added a module on this topic in a teacher training course on ICT, with the aim to build a common ground of shared conceptual and pedagogical knowledge as well as a base of methodological and operative competence apt to favour teachers' collaborative work on LOs.

In the rest of this paper, we first summarize the main features of LOs, then we describe our teacher training approach. Next we highlight out how the proposed activities can facilitate the social construction of individual knowledge. We also discuss how this kind of training can start a knowledge formation process which contributes both to teacher's pedagogical preparation and to the development of a positive attitude and operative competence concerning the use of LOs. Finally, we conclude that the LO paradigm can be a useful tool to diffuse pedagogical innovation in the school and in order to reach this aim, suitable methods should be found, and should be apt to promote a culture of sharing and re-use of educational resources.

What are LOs

LOs are chunks of self-consistent educational material that can be seen as instructional components and are suitable to be used in a variety of contexts. Each of these chunks must be associated with a schematic description of its content and technical features apt to guide its selection by prospective re-users.

The idea of constructing and making use of LOs is not new (Griffith 2007). It has its roots in the early interest of the educational technology community,

when ICT applications were first developed to support teaching and learning, in taking advantage of ICT affordances to re-use pedagogical materials proposed as high-quality and interesting ones by competent peers or institutions. This concept, however, being intuitive to grasp, was not formalized in a unique way, and this caused slightly different characterizations to be worked out in different contexts. (A short overview can be found in (Busetti *et al.*, 2004b)). This has given the concept of LO a slight flavor of ambiguity that certainly did not help it to be appreciated by teachers, even though the discrepancies among the different definitions are more formal than conceptual and not so relevant to actually hinder their practical use.

Another element that contributed not to make LOs very appealing for teachers was the issue of defining metadata, that is, information about features such as type of content, educational objective, technical characteristics, etc., that could allow people to cataloguing them. Metadata are clearly necessary to shift from a voluntary and non-standardised approach to a systematic use of LOs, but defining them suitably by a majority of teachers has proven to be a non-trivial problem. Considerable effort has been devoted to this task (Anido *et al.*, 2002), until an activity promoted by the IEEE Learning Object Standards Committee, based on the joint effort of several initiatives in the field, gave rise to the Learning Object Metadata (LOM) scheme (IEEE, 2002), approved as IEEE-SA standard in June 2002 (<http://standards.ieee.org/>). The standard approval, however, did not really solve the problem, in that it was worked out taking into account more technical than educational needs, and therefore appeared more suitable for the production of software than for that of educational material. For this reason, new alternative solutions are proposed in the literature (see a short review in (Alvino *et al.*, 2008)), and it is often not applied in the realization of small repositories.

Despite the level of ambiguity introduced by the mentioned problems, the LO paradigm appears as a potentially valid tool to improve education. Not only does it offer a viable approach to reduce the effort of producing high quality educational material, hence speeding up the work of teachers, but also provides a simple and powerful way to allow teachers to explicit and circulate their pedagogical experience, hence validly supporting the diffusion of innovation in schools (Busetti *et al.*, 2004a). As such, it is worth diffusing LOs knowledge among teachers, calling attention in particular on its potential benefits as a way to share pedagogical experience, and showing how to deal with the technical problems that can possibly arise in their use.

A Framework for Teacher Preparation

Since LOs are technological artefacts, we believe that preparing teachers to their effective use should be integrated within the general preparation to ICT. Accordingly, our approach to LOs is part of a framework for preparing teachers on this theme that we have been experimenting since 2002 (Dettori *et al.*, 2002).

Main features of teacher preparation on ICT

Even though technology has been used in education for many years, shaping a good ICT introduction is still a delicate point in the preparation of new teachers, in that the level of initial knowledge can vary from almost nothing to a good command of some programs. Those who have little or no knowledge of technological tools usually tend to disregard ICT as a possible help in their profession (Demetriadis *et al.*, 2003). On the other hand, those who enter the teacher training school having already used a number of computer applications as commodities for academic work tend to think that having ICT competence means being able to use applicative software. ICT preparation, therefore, should explicitly address these misconceptions. It should be designed so as to put novice teachers in condition to progressively improve their ability to effectively balance and integrate pedagogy and technology, rather than giving a preparation dependent on the technological tools. This entails to make trainees:

- Acquire *knowledge* on ICT starting from applicative questions and needs and highlighting operations and functions that can help to answer them, introducing technological tools as examples instead of aims in themselves.
- Build *awareness* of the opportunities offered by ICT to encourage and support new forms of learning, not viewing it only as a commodity or problem solving tool.

Awareness and knowledge can be developed by complementing different kinds of competence, that is, by 1) acquiring concepts and tools, 2) carrying out practical experiences, 3) developing abilities of critical reflection, and 4) fostering collaboration. These four kinds of competence are elaborated below:

Acquiring *concepts* and *tools* aims to build a base of common knowledge among the trainee teachers, putting them in condition to use it with confidence in their pedagogical activity, to get updated autonomously, answering to professional needs, and to the evolution of the technological offer, as well as to develop a common language with colleagues, so as to be able to communicate and therefore be in a position to collaborate.

Practical experience aims to let trainees try in person different ways of learning, such as autonomous and collaborative, so as to understand possible difficulties and opportunities offered, as well as operatively analyze possible ways to integrate ICT in the school context, guided by pedagogical objectives. There are different possible ways to help trainees to gain some practical experience. The classical method is to let them spend a training period in a school observing the activity of an experienced teacher. This method has the advantage to immerse the trainee in a real context, but it has the disadvantage to constrain the experience to a particular teacher, class situation and organizational context. Moreover, in case of new kinds of competence, like the use of LOs, it might be difficult to find enough experienced teachers to guide the practice of a whole class of trainees. An alternative way to support the acquisition of an initial base of experience is to let the trainees undertake a carefully planned simulation activity in a controlled setting as in a lab. This will allow better control of the dimension of the experience and avoid to mix conceptual issues and technical problems, and better guide the trainees to reflect on the considered learning tools independently on the applications conditions.

Critical reflection aims to encourage trainees to understand the possible influence of ICT on learning in relation with the pedagogical approach applied. It also lets trainees acquire methods to generalise their knowledge to new areas of professional interest.

Collaboration has an important role to play in the acquisition of all these competences in that it helps trainee teachers become aware of different points of view and different ways to tackle problems. Moreover, even though teaching is an individual profession, school activity can widely take advantage from teachers' collaboration (Riordan & da Costa, 1998), for instance by facilitating the comparison of pedagogical and teaching methods as well as the sharing of educational resources.

This approach to teacher training is in agreement with the current trends of teacher education on ICT, as supported by several research studies reported in the literature. Granger *et al.* (2002), for instance, claims that "supportive and collaborative relationships among teachers, a commitment to pedagogically sound implementation of new technologies are viewed as highly useful factors." Sime and Priestley (2005) identify four major issues for a successful introduction of ICT in teachers practice, namely: addressing teachers' beliefs; giving teachers some practical experience; putting resources at disposal and creating communities of colleagues who can encourage and support each other.

Preparing teachers on LOs

Making reference to the above approach, we conceptualize teacher preparation centred on LOs so as to develop awareness and knowledge on this topic through both individual and collaborative activities. Collaborative activities, in particular, appear to be very important, since the sharing of educational material is an intrinsically collaborative activity (Wetterling & Collis, 2003)

Our proposal is based on three strictly interconnected components, that is, setting a theoretical framework, Integrating LOs in the educational practice and Bridging theory to practice. These components and the competence they put into play are summarized in Fig. 1.

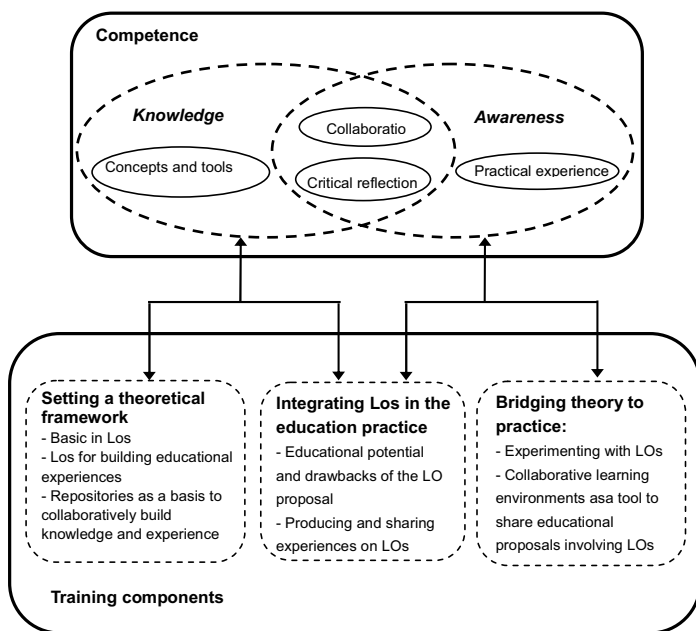


Fig. 1. Our conceptual framework to train teachers on LOs.

Theoretical elements related to LOs include basic definitions and characteristics, standards and possible application in the definition of educational experiences answering to different learning needs. They also include the concept of repository and some acquaintance with the current most diffused realizations (such as retentive software quality guidance, for example, MERLOT, www.merlot.com). This introduction aims to lead trainees to an informed use of shared resources. This activity is to be completed by a reflection

on the fact that educational proposals are characterized by the approach to learning they embody, while the technological resources employed are ancillary to its realization.

Analysing the problems connected to the transfer of LOs into educational practice entails highlighting potential and limitations of this technology. Critical reflection on the difficulties and possible advantages of activities with LO repositories can be encouraged by discussing some examples and by analysing the possibility to use repositories for collaboration with peers. The discussion of good examples is reported by several authors (Granger *et al.*, 2002) as an important activity to facilitate an effective implementation of technological means in education. The issue of checking or evaluating the quality of repositories' content should also be introduced. Critical reflection on the integration of LOs in the educational practice can be supported by examining LOs from a pedagogical point of view, relating this technology to the current views of learning. Activity on this point should be completed by a practical experience, aiming to give trainees a direct knowledge of the main problems teachers are facing when producing and sharing LOs. A good way to carry out this study is to set up a simulation activity on a repository, discussing with peers its characteristics, potential and difficulties, and examining its content, paying attention to a number of features, such as quantity and quality, richness and covered areas of materials. Simulation activities are advantageous in education, as they allow learners to concentrate on the key elements of the object of study, avoiding the complications induced by external elements and therefore speeding up the learning process.

Bridging theory to practice aims to operatively support critical reflection by means of practical experience of collaborative analysis and creation of LOs, sharing comments and plans of use experience (or descriptions of them, if available). This phase aims to lead trainees to a conscious reuse of shared resources. To this end, we think it would be useful to have at disposal repositories enriched with communication facilities, on which the trainees could carry out an articulated five phases activity: 1) *analysis*, that is, individually reviewing a LO retrieved from the repository and its metadata; 2) *construction*, that is, building a LO and an educational itinerary including some LOs of the repository; 3) *sharing*, that is, uploading the produced proposals in the repository, together with some comments on peers productions; 4) *synthesizing*, that is, individually reflecting on the work done; 5) *evaluating*, that is, discussing the work done with the class mates. Some of these phases correspond to the high level cognitive goals of Bloom taxonomy (Bloom, 1956).

Preparing teachers by means of LOs

The starting point of our proposal is a conception of the re-use of educational materials as a possible learning occasion for the teachers (Busetti *et al.*, 2004). This originates from the observation that pedagogical competence has a primary importance in education. A strictly technological approach to the re-use of resources, therefore, does not appear suitable here, since each experience of use differs from the previous ones depending on the situation where it takes place, the learning needs of the students involved and teacher's pedagogical orientation and style. To be effective and of interest to the teachers, the re-use of educational material should be focused not only on products but also on experiences of use in different contexts, highlighting the embodied pedagogical orientation. A LO, in this view, is not a static material but something constantly in evolution, since the pedagogical contribution of the initial author is progressively enriched by the comments and experiences of other users. Reflecting on the variety of experiences carried out with a same LO constitutes an occasion of learning. Re-use of an educational module in different contexts, moreover, often leads to the re-elaboration of the initial view of the module and hence to a number of variants produced by different teachers to adapt it to different educational needs. Considering such variants is useful also to the initial producer, since it leads her/him to take into consideration different perspectives on her/his own work.

As shown in Figure 2, if teachers follow this approach in their work with LOs, interplay between individual and social knowledge construction takes place. The presence of a base of shared pedagogical knowledge, formed by LOs together with comments and suggestions of the re-users, stimulates individual reflection and the creation of new ideas and proposals.

Engaging in a re-use activity of this kind, therefore, can be an effective and powerful approach to teachers' professional development, facilitating their learning from each other's experience. For this reason, we believe that the activity on LOs we propose for teacher training is not only a good way to become acquainted with currently available technology, but can actually contribute to the global formation of teachers as professionals are able to reflect on their activity as well as to learn from their experience and from that of their peers, therefore being in condition to contribute to the renewal of education.

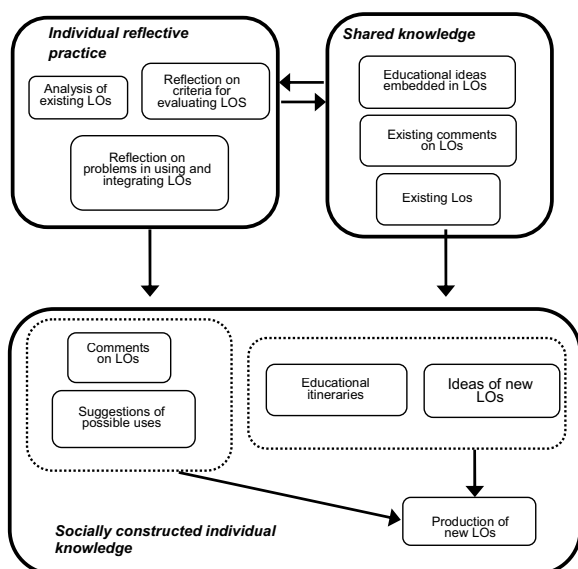


Fig. 2. The interplay between individual and social activity leads to the production of new knowledge in communities of teachers working on LOs.

A Repository with Communication Facilities to Favour Teachers' Learning

In order to realize the above approach to teacher training, we designed and built a prototype of an environment where the trainees could carry out simulations of collaborative activities, named LODE (Learning Objects Discussion Environment) (Dettori *et al.*, 2006). It consists of a repository enriched by a wide choice of discussion facilities, as schematized in Figure 3.

In the repository, three kinds of materials can be stored, that is, LOs, comments on them and educational itineraries based on them. Comments can be associated to each LO, by any teacher in the community, including the LO's author. These are experiences of use or ideas for new ones, as well as pedagogical observations and proposals of variants. Educational itineraries can be proposed by any users and are associated to every LO composing them. Their presence gives rise to a network of connections inside the environment, highlighting for each LO a number of other LOs that complement its content from different point of views. The internal network of connections is further enriched by the presence of semantic links that a LO's author can specify in order to let the users know that her/his creation was somehow inspired by other LOs. These links can take the values a) deepened by; b) a variant of; c) inspired

by; d) related to; or simplified by. While the network created by itineraries concerns relations of content, the network originated by semantic connections includes variants of a same content presented in different ways to suit different learning situations (e.g. different school levels or students with particular learning needs), or even modules that take inspiration in the pedagogical approach. The network of LOs originated by these links, therefore, is complementary to the one determined by the itineraries.

Each LO in LODE has associated two forums, to discuss technical problems and share short considerations on any aspect of the LOs from those using it. Global discussion among users is allowed by a forum on general questions concerning the use of LOs in school teaching and learning; an articulated help function and the possibility to exchange individual emails with the registered users are also provided.

Communication and collaboration are not limited to these discussion facilities but also include comments, itineraries to exchange pedagogical ideas and experience among teachers. The fact that they are stored in the repository together with the educational modules underlines their pedagogical value. In a way, they could well be considered LOs expressed in a different form but as much useful and instructive as LOs containing educational modules.

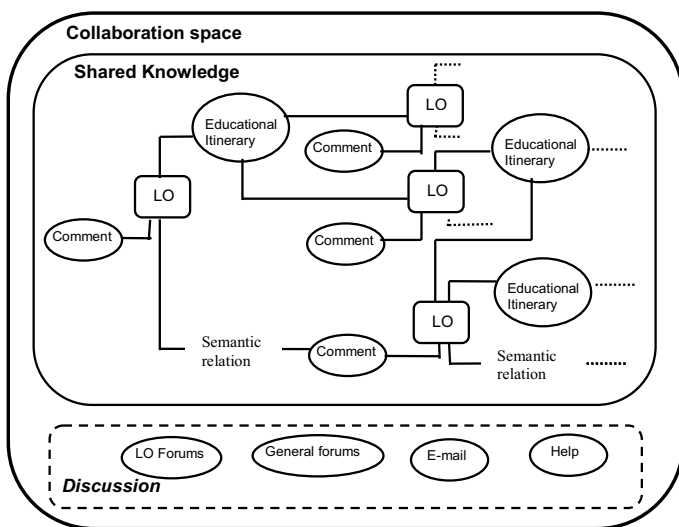


Fig. 3. Organisation of the repository with collaboration facilities that we use to train teachers on LOs.

The main strength of such environment's organisation, from the point of view of teachers' learning, is in the rich net of interconnections among the stored materials and in the integration between materials and communication facilities, realized by associating to every single LO a choice of possibilities for teachers to share their points of view, experiences, doubts, questions and ideas. This facilitates the transformation of individual reflection into shared competence, promoting teachers' collaboration. Handy and easy-to-use communication in connection with LOs fosters the transformation of a sparse group of users of a repository into a community of teachers who support each other's professional growth through joint activity on LOs. These features make LODE a suitable environment in which teacher preparation on LOs can be carried out.

A Teacher Training Experience

Description of the experience

We have field tested our approach in training teachers on an informed and conscious use of LOs in the course 'Multimedia in education' of the post-graduate school for Teacher Specialisation at the University of Genoa, Italy, in the recent three years.

'Multimedia in education' is a 3-credit course for trainee teachers of secondary school in all disciplines. It has an average in-take of around 120 trainees during the period of our experiments. The course is subdivided into modules on different ICT aspects which are considered useful for education. 'Introduction to working with LOs' is one of them.

The work carried out was organized along the lines illustrated in Section 2. Both the theoretical aspects and those related to the integration of LOs in the educational practice alternated classroom and practical work on LODE, that could be carried out in the lab or at a distance, in either case with tutors' support. This activity went on for about one month.

Each year, at the beginning of the activity, the environment contained a meaningful number of educational modules (mainly implemented as ppt or html files) produced by the trainees of the same course in the previous academic years, selected on the basis of their relevance for school work, interdisciplinary and multicultural elements, correctness and self-containedness of the content, technical suitability. These materials had the role of examples of good practices and allowed the trainees to carry out their simulation in a situation close to real, apart from the limited size of the repository (several dozens of materials vs.

several hundreds or thousands). All disciplines were equally represented, in order to avoid that the trainees could consider this experience addressed only to teachers of some school subjects.

Several materials were accompanied by comments and proposals of related educational itineraries were also developed by the trainees. In the first year of this activity a few examples were provided by the teacher and tutors, in order to be in condition to carry out the activity. Metadata were specified for each of the material, following LODE's format (Dettori *et al.*, 2006), which limits them to elements relevant for teachers from a pedagogical or practical point of view.

The activity with LODE started with a lab session aiming to introduce the environment and continued with the following tasks:

1) Selection of a LO from the repository and elaboration of a comment on it from a pedagogical and technical points of view, with proposal of possible applications in different contexts; this aimed to develop ability of analysis and critical evaluation. The activity included comparing points of view with classmates who had chosen the same LO. A comment on metadata was also required. This request aimed to encourage trainees to critically analyse our choices about metadata and to reflect on the difficulties of defining pedagogical metadata.

2) Design of a learning itinerary based on the LOs available in the repository, possibly pointing out the need to develop one or more LOs to address the chosen topic in an articulated and satisfactory way. This aimed to avoid the fragmentation of knowledge possibly induced by the use of LOs, support a global view of a repository's content and stimulate creativity in the re-use of educational material. Itineraries made of LOs were added to the activity only in the past year.

A template was provided for the description of the itinerary, with the aim of calling attention on the need of using standards and agreed schemes to facilitate the sharing and comparison of educational materials.

3) Produce a new LO. This aimed to induce the trainees to make use right away of the understanding on LOs' usability gained with the previous task, converting it into practical knowledge. They also had to indicate the metadata for their productions, so as to further reflect on them. Finally, they had to report about the main difficulties faced in the assigned task.

Outcomes

The experience was quite positive. The trainees appreciated both the LODE environment, that they found useful and not difficult to navigate, and the activity

with LODE, that they deemed a good source of practical ideas to use ICT in school (Busetti *et al.*, 2006). This is an important outcome, in that perception of usefulness and ease of use strongly supports motivation to a thoughtful use of ICT in school practice (Ma *et al.*, 2005).

By analysing trainees' comments to the LOs, we observed that trainees had paid attention not only to the content knowledge of the considered modules, but also to their technological part. Both comments and educational materials showed the influence of analysing peers' productions on the modules worked out. A relation between some aspects of the commented material and the produced ones was often explicitly admitted by the trainees in their reports on the work done. This does not consist simply in copying ideas or parts of products, but shows a personal re-elaboration of different module's aspects that suggests a growth of our trainees as producers of educational material.

We further noted that the trainees' productions showed a positive influence of the activity on the itineraries. In comparison with the productions of the previous years, they were organized in a more straightforward way. The later suggests that the need to adapt materials of different authors within a same itinerary had highlighted the importance of having at disposal well constructed materials.

Finally, by analysing the end-of-activity reports, we noted that the trainees also pointed out some difficulties they found in making use of more than one LO retrieved from LODE in their itineraries. In short, the trainees acquired awareness of some of the main problems of the use of LOs and repositories: the need of having at disposal a considerable amount of high quality material; the heterogeneity of LOs produced in a variety of context by various authors, that made it difficult to integrate them in a single itinerary; and the granularity of the LOs, that often did not correspond to the use they wanted to make in their itineraries.

A wider analysis of the influence of trainees' activity with LODE on their ability to shape learning itineraries by means of LOs is available in (Busetti *et al.*, 2007).

Conclusions

The LO paradigm can be a useful tool to diffuse pedagogical innovation in the school. In order to reach this aim, suitable methods should be found, apt to promote a culture of sharing and re-use of educational resources.

To this end, we designed and experimented a framework in better preparing teachers on LOs technology as integral part of teachers ICT preparation. The

starting point of our work is the observation that ICT preparation should help teachers to acquire knowledge and awareness on the use of ICT in education, through both individual and collaborative activities, in order to improve their ability to effectively balance and integrate pedagogy and technology.

In agreement with this framework, our proposal intends to prepare teachers to an informed and conscious use of LOs by integrating personal reflections with the simulation of a sharing activity.

Qualitative results of our experiments in a post-graduate teacher training course has reinforced our belief that the proposed framework is effective.

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THE SWEET SUITE? A DISCUSSION AND REVIEW OF A RANGE OF COMPUTER ASSISTED LANGUAGE LEARNING SOFTWARE

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Abstract

The potential and shortcomings of Computer Assisted Language Learning (CALL) software have been widely discussed. This chapter focuses on a selection of software reviewed and chosen for use in a CALL lab at one institution. The types of software, the reasons for their selection, and the challenges involved in their commissioning and usage is discussed.

Measurement of student learning, and the necessity for such benchmarked measurement for all stakeholders is described, particularly in the context of developmental English writing and reading courses taught within the institution. Accountability for learning, the roles of extrinsic and intrinsic motivation in learning, as well as the merits of using a cumulative assessment model are explored.

The chapter concludes by suggesting that computer mediated learning, used appropriately, in conjunction with face to face contact, although initially labor intensive, can be effective and efficient.

Introduction

CALL laboratories and software are not new news. Neither is the debate about their real effectiveness and impact on the learning process. This chapter does not directly aim to further that debate, but rather aims at exploring a broad sample of software.

This author is already persuaded that CALL hardware, software and teaching methodologies, appropriately used, can be effective in promoting student learning. The institutions he has been working within for the last 12 years have also, to a greater or lesser degree, been of the opinion that computer assisted learning is one tool we should be using to enable and empower students in their quest for language acquisition.

Having said that, because online design and instruction are largely invisible, institutions are prone to underestimate the amount of time and effort needed for such learning to effectively take place. Research and experience suggest that online instruction is in fact more labor intensive than more traditional modes of

instruction. This is certainly true in the design and startup phases of implementing CALL (Young & McSporran, 2004). One of the prime duties of the CALL administrator/instructor is, therefore, to articulate, and re-articulate to educational managers what is happening: a duty to be ignored at one's peril!

A belief that CALL, used appropriately, is in fact highly successful highlights the need to define goals and objectives and to measure the learning which takes place, preferably against some external benchmark. The conclusion of this chapter includes a description of an attempt to provide some sort of quantified objective assessment of learning.

However, to begin with, I will describe the short history of the Texas A&M University at Qatar, (TAMUQ) CALL laboratory, its main function, and then discuss some key tools we have identified as being useful adjuncts to learning.

Background

TAMUQ and Education City

TAMUQ, a branch of a large American University, is part of Education City, a group of branches of several prestigious American universities invited to the rapidly growing and newly oil and gas rich country of Qatar by the Qatar Foundation, a "private, chartered, non-profit organization founded in 1995 by his Highness Sheikh Hamad Bin Khalifa Al-Thani, Emir of Qatar".

Qatar Foundation "....supports a network of centers and partnerships with elite institutions..." ("Qatar Foundation Home," 2007). These institutions currently include Carnegie Mellon University, Georgetown University, Virginia Commonwealth School of the Arts, and Weill Cornell Medical College, as well as Texas A&M University. These institutions have each been chosen, as they are considered to be leaders in their particular fields of specialty. The language of instruction in each institution is English.

History of the TAMUQ CALL lab

The first incarnation of the TAMUQ CALL lab was in the Technical Communications Center, (TCC), a Writing Center. The CALL lab in the 06/07 academic year, consisted of a group of 10 workstations running Windows XP, set up on tables in the TCC. The room also had a teaching lectern, containing an instructor's workstation and a Crestron multimedia projection control system. The lab was connected to the University network, and via the Internet, to the world at large. In July 2007 we shifted into a new lab in a separate space. The new lab contains 24 student workstations in 3 double sided rows. Instructors

were not consulted as to the layout of the lab. If we had been, we would have chosen something rather different.

Importantly, in the old lab, there was an area in the room where students could sit away from the computers. Oddly, this non IT space proved to be crucial for the learning to effectively take place. Sitting students in front of a powerful portal to a thousand universes and then expecting them to listen to and interact with an at times arguably boring instructor is a recipe for frustration. We had already sourced and purchased a range of software and have continued to identify, source and acquire software suited to our needs. Need is closely related to purpose and function.

Purpose and function of the TAMUQ CALL Lab

The primary purpose and function of the TAMUQ CALL lab has been to teach a lab component of developmental freshman academic English courses, one semester mainly concentrating on reading skills, and a second semester mainly concentrating on writing skills, although clearly we hope, for some development in all skill areas in both semesters. Aiming to improve students' reading skills in isolation, and then writing skills in isolation would clearly be simplistic and naïve. In these courses, students are exposed to two hours of structured lab-based instruction, and two hours of more conventional lecture or classroom-based instruction.

Time is taken during the lab component, on occasions, to explain what is to be done, and also on occasions for more teacher-centered, as opposed to student or learning centered activities.

However, students are expected to spend more than the two hours when they have a timetabled class in the lab on computer assisted learning activities. To ensure that this happens, a cumulative assessment model is used, rewarding students for their learning activities, and assessing under controlled conditions if the required learning has taken place. Students can clearly identify what's in it for them. This pays homage to the important and powerful, if occasionally unfashionable, role of extrinsic motivation in education, particularly with students who may not have developed sufficient skill mastery in the past. (Ryan, 2000). The approach taken with these students includes having them work, regularly, consistently, and effectively. The students are placed in this particular English enhancement program, as they have been deemed on admission to the university to be in need of further development of their English skills. Sometimes lack of prior success has as much to do with insufficient appropriate and regular application, as it has to do with aptitude.

At the same time, we attempt to enhance existing intrinsic motivation by offering a variety of activities, and for example, introducing key language points through songs: the sort of “warmers” that would be used in more traditional learning environments.

On completion of these two semesters of developmental English, students are enrolled in mainstream Freshman English.

Other instructors teaching freshman and sophomore English are now also running classes in the lab. We hope that with a growing sense of shared stewardship the lab will evolve into a true center of excellence.

A secondary function of the CALL lab has been to support student learning on a self-access basis. Lacking the element of extrinsic motivation, this “CALL beyond compulsion” has been less utilized and effective to date.

So, to the essence of this chapter: what software tools have we used, how have we used them and why?

A Suite of Software

“It ain’t what you’ve got, it’s the way that you use it...”

Different choices of software could have been made at TAMUQ. The pedagogical underpinning and methodology used is a more important factor than the choice of software. Although needs have been identified and largely met, software choices have been made according more to availability, expediency, and personal experience, rather than a complete and thoroughly researched study of what is currently available in the wide world of ICT for educational purposes. Visits were made to other educational institutions in Qatar and neighboring Dubai, conferences have been attended and consultants and vendors consulted, but time is limited and the field is vast.

However, the CALL software we have chosen, varying in type and purpose, may offer some guide as to what might make up a good suite of software for a well resourced CALL lab.

The use of operating systems, mainstream application software such as MS Office and networks is not discussed here, although these too need to be used appropriately.

Placement software: Accuplacer

Placement software is widely used to decide starting points for students in English programs. Accuplacer was the software chosen by TAMUQ for this purpose.

Accuplacer at TAMUQ: A brief history

In our case the choice was requiring students to either initially complete two semesters of developmental/foundation English, or placing them directly into mainstream first year Freshman English. For the 2007/2008 academic year we are exploring a further option of requiring some students to do just one semester of developmental English.

When I came to TAMUQ in August 2006, decisions on where to place students in the English courses had already been made.

Students had been required to complete an Accuplacer assessment of their English skills, but it would seem that the results of the test had not really been taken into account when placing students. Students had been placed in the English program after initial screenings by our admission department largely on the basis of a brief interview and a short essay written by hand at the time of the interview. These data seemed almost anecdotal in nature, but students were appropriately placed in most instances.

There were however three students who seemed to be a cut above the level of the rest of the class, and as the instructors concerned were questioning the validity of the placement of these students, this led us to look more carefully at the data produced by Accuplacer. We soon became convinced of the general validity and usefulness of the assessments.

Accuplacer tests chosen

Accuplacer contains a vast array of tests, mainly in English and Math skills at different levels.

The tests we chose to use were: the “Levels of English Proficiency” (LOEP) assessments. Each of the four tests has a number of multiple choice questions, and students receive a mark out of 120 for each test. The LOEP tests are specifically “...designed to assess the English skills of students whose first language is not English.” (“University Testing Services (UTS),” 2007) The four tests are described as Sentence Meaning (vocabulary), Language Usage (grammar), reading skills (comprehension), and Listening Skills (reading and listening). They all use adaptive testing, a technique whereby the software shifts students to a higher or lower level of difficulty according to the accuracy of student response in the previous question. For the 2007/2008 academic year we have dropped the LOEP Listening Skills test, as we found this to be a less reliable indicator of students’ current competence.

A fifth test, the WritePlacer ESL assessment, was also administered. In this test, students are asked to type an essay of at least 300 words on one of three fairly general and accessible topics. Students at TAMUQ were initially given 30 minutes to do so, with the assistance of neither a spell checker nor grammar checker. For the 2007/2008 academic year we have increased the time for writing to 45 minutes.

The writing assessment is banded and given a score of from 1 to 6. A report is also generated.

Analysis and use of accuplacer data

In brief, the three students who I felt should have gone directly to Freshman English all scored highly on the test. I could easily identify a data point, and create a rule which would have prevented the three misplaced students, (and only those three), being placed in the developmental/foundation English group.

- a) If writing is 4 or above and average percentage of other tests is 90 or above go to 104, (Freshman English).

I have also formulated several other rules over the last 12 months to guide future placement, as well as to provide exit points for foundation/developmental English courses. Students are now need to meet minimum Accuplacer requirements as well as passing other coursework.

A cautionary note and tentative conclusions on & about accuplacer

Many contributors to the book Machine Scoring of Student Essays warn us of the limitations and dangers of using data produced by computer assessment of writing as summative assessment. Anson (2006) summarizes, “Machines, in other words, are only machines” (48). In the case of three students “failed” by Accuplacer, a portfolio of other writing samples captured using Criterion, (described later in this chapter), over the course of the semester was examined, which verified the need for further development of writing skills for these particular students. Issues and reservations about machine scoring of student essays are explored a little further in the section on Criterion. It is suffice to summarize here by saying that I would urge anyone using computer generated data to be prepared to take the time to cast a human eye over the situation, to verify that if student success is to be delayed, (I am inclined to the belief, optimistically perhaps, that although for various reasons some may take longer to succeed than others, most can in time succeed), that the right decision is being made.

The good news for TAMUQ is that Accuplacer does seem to be working as a gatekeeper, something we need whether we like it or not. Instructor perception of student progress is sometimes warped. Instructors rightfully and naturally want their students to succeed and feel validated by their success. Further good news is that Accuplacer data can be cross-referenced with other data captured on these students in the CALL environment, which supports and adds greater validity to Accuplacer course exit requirements and decisions made regarding student progress.

More importantly, alarms have been set which will prevent students from having their progress delayed by being initially placed at too low a level.

For better placement in the future, greater integration and triangulation of all available data, including TOEFL and or IELTS scores, school results, Accuplacer results and interviewer perceptions is needed. This process needs to take place in a timely enough fashion to enable adjustments to be made to the number of classes to be run at each level.

Course/learning management software: Blackboard Vista

The course management software used in the foundation year at TAMUQ is Blackboard Vista, (“Blackboard Learning System™ – Vista Enterprise License: Instruction. Communication. Assessment,” 2007), formerly known as WebCT. This is the enterprise-wide platform used, supported and licensed by the parent institution of the University. One issue for us is the fact that the online course is hosted on servers in Texas. This means that there can be short delays when using the system. A 2 to 5 second delay may not seem much, but in a click heavy environment like Vista it becomes problematic, particularly for designers. Online design work is labor intensive enough, without being slowed down by system reaction time, also commonly known as latency. It also means that we have abandoned the idea of using Vista email, where we could have retained all communication between instructors and students within one virtual environment. Time taken for attachments to load, when engaged with process writing, and Java script errors were both problematic.

A four week system-wide outage at the beginning of the 2007/2008 academic year made using Vista particularly problematic this year.

If an institution adopts the use of any IT teaching and learning platform at an enterprise-wide level, the system must be robust and well supported. Monitoring of server usage and what is being created on the server both need to be ongoing. Instructors and designers need to be aware of the need to keep courses lean and

clean. Extraneous files and data need to be removed, and courses need to be kept up to date.

Left to my own devices, I would be just as happy to explore using Moodle, ("Moodle – A Free, Open Source Course Management System for Online Learning," 2007) software that merely requires access to a server, and obviously server space. However, institutions that have invested a lot of money, as well as human and IT resources in a particular platform are unlikely to encourage exploration and development in a different platform. The Learning Activity Management System, ("LAMS: Learning Activity Management System," 2006) would be another contender.

At the end of the day, the platform you use is not the major issue; what you do on that platform and within that system is. I feel I have managed to create an online learning environment that encourages, perhaps even compels, learning to take place in one particular context, for a particular target group of students.

In particular, weekly learning modules, with "Introduction & Agenda" documents which link to learning objects such as reading and listening files, or grammar resources have been created. Assessment towards course grades takes place every week, often taking the form of online quizzes created in Respondus and published to the Vista course, (see below), allowing for instant feedback to both student and instructor. Students are assessed on material presented to them in previous weeks. This cumulative assessment maximizes the opportunity for regular, appropriate learning activities. The role of extrinsic motivation to promote continuous engagement is not to be ignored.

Respondus and Vista

Respondus ("Assessment Survey and Game Applications for eLearning: Respondus, Inc.," 2007) is a quiz making and publishing software, which allows quizzes to be created and stored outside the Vista environment. This is vital to quiz design. Quizzes, or online assessments, once created, are extremely efficient, and offer instant feedback to both students and instructors. Creating good questions, and good quizzes is, however, extremely time consuming. Although Vista has a quiz making function within it, it is far better to create and keep a central repository of assessments that can be honed and improved over time. This leans towards the database model of online design, in which learning objects are created once, and edited and maintained in one location, but used in different places, ways and courses. Quizzes can in fact be retrieved from WebCT courses, even if they were not created in Vista. Hot Potatoes would be a good "free for education" alternative ("Hot Potatoes Home Page," 2007).

Respondus Lockdown Browser

Respondus Lockdown Browser, (RLB), is a program which opens a browser with limited functionality directing students to Vista. When students use RLB they cannot print, copy and paste, browse other websites or access other applications. Virtually any action that would allow cheating is restricted. This is a clear enhancement of the security of the regular summative assessment tasks that students are asked to complete.

Websites/web authoring software

In addition to Vista course websites I have collated or authored a great deal of reading, listening and grammar support material which I use in a variety of courses in a variety of ways. I initially used an old website of mine at my last workplace, Dubai Women's College, (DWC). <http://dwc.hct.ac.ae/courses/hd1english/>

I have now organized and published my new website at TAMUQ.

<http://people.qatar.tamu.edu/douglas-mcpherson>

The Technical Communications Center at TAMUQ has also built and maintains a site for resources specifically to do with writing and technical communication. The TCC site is: <http://www.qatar.tamu.edu/tcc/>.

The advantage of maintaining a collection of material outside the login protected Vista sites is that they can be accessed by anyone, anytime, anywhere. It is also another example of the database model of design referred to in the previous section. Keeping and maintaining a set of resources in one central repository saves time and server space, and enhances quality control. For example, one listening or reading file can be saved on a local web server, and accessed from many different Vista courses. The access time on the local server is quicker, and Vista backups smaller and faster.

Although my previous site was authored and managed with Macromedia Dreamweaver, I am currently using MS FrontPage, certainly not because the code is cleaner, but primarily because of the ubiquitous nature and relative familiarity of interface of the software. Web authoring projects, indeed any CALL initiatives, should be shared, and sharable. It is institutionally dangerous for CALL skills and knowledge of CALL systems to reside with one individual. I have a student worker who, amongst other things, assists with web design.

Grammar and skills software: The Clarity suite

TAMUQ entered into a licensing agreement for the Clarity suite of software ("ClarityEnglish.com," 2007) for the academic year of 06/07, and, despite the fact that it does not fully meet our needs, and has been under-utilized, we have renewed the licensing for the 2007/2008 academic year.

Of the different modules within the suite, TenseBuster, which is primarily a grammar software, is the module most used. It has been cross-referenced to the CALL components of the foundation courses. There seems to be consensus within the English instructors at TAMUQ that student knowledge of grammatical terms is useful. One example is that the TCC offers a tutoring service for students, an environment within which students can explore their writing skills. It seems obvious that student and tutor should be able to use a shared meta-language and effectively communicate about what is happening within the writing.

The multi-media and multi-modal style of delivery used by TenseBuster, and the other modules is attractive, and may suit different learning styles. Revisiting learning points in different ways is a well documented technique to enhance and reinforce learning. The reading, note taking and writing modules within the Clarity suite are also used by foundation and freshman courses. Criticisms of the software include the somewhat patchy coverage of grammar, arbitrary explanation and feedback on language points such as modal verbs, and the odd actual error within the program. The company has been responsive to critical feedback. As is often the case, the more direct the communication with the parent company is, the better.

At this point in time we have chosen to supplement this source material, and our in-house authored material, with the book Inside Writing, and Azar's Understanding and Using English Grammar (Azar, 1998). We are also in the process of acquiring the software package for the Azar book, in the hope of providing more definitive and thorough grammar support for our students, within a user-friendly interface.

Writing evaluation and feedback software: Criterion

"...That is not it at all, That is not what I meant at all..."

The Love Song of J. Alfred Prufrock

T. S. Eliot

The argument as to whether or not computers can truly decipher meaning continues to rage. Mcallister and White (Mcallister & White, 2006) cogently

argue that computer assisted writing analysis is in general, at the least, limited. However, the writing we are asking foundation students to do, does not in fact fall into the same category as “board room brainstorming sessions and dinner party chit-chat” (10), examples of language that the writers suggest may be difficult for a computer to “understand”. Neither are we asking students to write existential poetry. The writing we are looking for at this level is grammatically and structurally accurate, well organized three part academic essay writing, using an appropriate genre, and displaying a reasonable and reasonably accurately used range of vocabulary.

At this level I have found the web-based software service Criterion (“Criterion: Essay Writing Evaluation,” 2007) to be surprisingly effective and useful. The software contains a wide range of ready made essay topics, and instructor topics can also be created. Errors are highlighted, and feedback is offered, instantly and transparently, to both instructor and student. Essays are scored within a range of 1–6.

Feedback and error notification is usually generally accurate, although, on occasion, the software will, for example, mistake an article error with a plural error. We might worry about these computer generated “false alarms”, but I see these inaccuracies as being learning opportunities. We ask our students to consider whether the software is the master or the servant, a concept that resonates well within them, in a culture where many rich families employ servants from less wealthy countries. The students are compelled by the software to “notice” errors. I see the fact that they may have to think about the nature of the error, as opposed to being spoon-fed as a good thing. Feedback in the areas of “Organization and Development” is more general; Criterion resorts to a form of sophistry, asking the students for example if the introduction contains all the necessary elements, or whether their conclusion does in fact conclude, and not offer significant amounts of fresh material.

The software only goes so far, and we are not in danger of having instructors and/or institutions replaced in some sort of Orwellian horror story.

In an attempt to have students write less, but learn more, as opposed to continue to write a lot more different pieces of writing, badly, often reinforcing fossilized mistakes, a typical pattern is to have students write an essay in Criterion under proctored conditions, and then using the software, where they can resubmit their essay, with or without instructor and/or tutor assistance, improve their essay and submit an improved draft. They are rewarded for such an improvement. I look at both the computer’s assessment, and also make my own judgment, the latter most often in accordance with the former. This also

neatly segues into the 3rd phase of essay writing. In the third week of working on the same essay, students, now largely with the assistance of tutors and course instructors, need to get their essay to what we call “final draft”, or “publication standard”, error-free writing that meets all the requirements of the particular essay. Concurrently, over the course of the semester they develop a writing guide, in which they identify common mistakes they have made, understand the reason why the mistakes were made, and check that they do not repeat these errors in the future. They are often directed to our other CALL resources as they do so.

Two other benefits are derived from using Criterion in this way. Firstly, a portfolio of authentic, unassisted student writing is automatically collated for each student from their first proctored attempt. Secondly, later in the semester, some students inevitably wonder why Criterion is not giving them the maximum grade of 6/6 for their writing when they have eliminated all errors. They can then be guided to the realization that excellent writing is something more than simply error-free writing.

Anti-plagiarism software: Turnitin

Students at TAMUQ are required to sign an honor code saying that they will not “lie, cheat, or steal or tolerate those that do.” They are also required to declare at the end of all assessed work that they have “neither given nor received unauthorized aid on this academic work.”

There is a clear reciprocal responsibility for instructors to minimize the possibilities for this to happen. The process writing catalyzed by Criterion is one area where in later drafts students may be tempted to plagiarize, at least in part; the fact that we have the first draft written under controlled and proctored conditions eliminates the possibility for wholesale copying and pasting. Student writing is further checked for plagiarism by using Turnitin. This software checks student work against a database of other writing, from a variety of sources including the Internet and from papers previously submitted to the program itself. The software can be utilized as a plug-in within Vista or directly on the company website.

We require students to submit their final draft to Turnitin. Knowing this will happen largely eliminates deliberate or inadvertent plagiarism.

Typing software: TypingMaster Pro

While typing software may not be considered CALL software as such, efficient keyboarding skills are essential in a CALL program where amounts of writing

are to be done. Indeed, once students move beyond the “asdf” level, it could be argued that they are being immersed in language as they type. The challenge is that unless students have significant prior experience with keyboarding, they may not have covered the entire alphabet while still being required to type efficiently. Fortunately, the majority of timed writing done at foundation level is in the second semester of the academic year. All freshman students are required to complete one hour of supervised structured keyboarding per week using TypingMaster Pro (“Typing Master Typing Tutor and Typing Test Programs,” 2007); they are encouraged to do more.

Immersion software: Rosetta Stone

The home page title for this software, (“Rosetta Stone: The World’s #1 Language-Learning Software,” 2007), rather sets the tone of the company, in its claims to be the “Fastest Way to Learn a Language”. The software can perhaps be better considered to be one powerful tool amongst many.

It is capable of taking a total beginner and immersing them in learning a language. Though some have argued that this software is beneath the level of our students, we have purchased licensing for US English levels 2 & 3 for students, (and Arabic level 1 for faculty). The lack of meta-language is refreshing, and balances the methodology used in our other software. I further feel that almost anything we can do to intensely engage our students in an English environment is useful, and students are intensely engaged when using this software at the appropriate level of difficulty. Students typically find the listening and reading easy, but falter when asked to reproduce or manipulate what they hear, producing text output. This tends to confirm our perceptions that writing is these students’ weakest skill area. Deficiencies in the network version of this software, the licensing we have, include lack of transparency and control from the users’ perspective, and the need to create customized lesson plans. – The administrator needs some database skills, as well as the ability to think through pedagogical issues. I have found using myself as a student guinea pig in the Arabic module useful. Lexical choices and collocations offered in the package seem less than optimally appropriate, and are common to every language offered by the company. Information released by the company about their most recent version of the software suggests that they may be addressing these issues.

Monitoring and lab management software: Dyknow

The monitoring features of Dyknow have proven to be effective in the CALL lab. Instructors can view thumbnail images of student monitors, applications can be blocked, and students can be limited to certain URLs (“Dyknow,” 2007). This enhances the security of the summative assessment done in the lab, and complements the security features employed using Respondus Lockdown Browser.

Another feature that is invaluable is the capability to lock student workstations, with the message “Pay Attention Please” on student monitors. There are clearly times when instructor-centered explanation or instruction is required, and paradoxically it is more difficult to establish focused contact with groups of student when they are sitting in front of computers. In our new lab we no longer have the ability to have the students physically move away from the computers due to space and layout constraints. The separation has to be virtual.

The final advantage of using Dyknow is that it tells the instructor which student is sitting at which computer, assuming that computers are labeled logically in accordance to the layout of the lab.

A disadvantage of using Dyknow is that because the server part of the program is running on computers in the USA, latency or lag-time is a minor problem.

Dyknow contains a lot of other functions, including collaborative note-taking, particularly suited for touch-sensitive screens, and student response tools. We are using only a small subset of the functions. Dyknow is probably an interim solution for us. We are looking towards replacing it with a more complete and appropriate lab management solution. However, the functions we are using work well and are also easy to use.

Conclusions and Results

I feel our endeavors so far have yielded results, and this is verified by pre-test post-test data produced using Accuplacer, although it must be said that the small sample group, lack of a control group and the number of variables involved make any conclusions tentative.

Nevertheless, in our main target group, in the semester when we targeted reading skills, students achieved a 5.4% increase in the results of tests related to reading, with a nominal increase of 0.5% in the writing assessment.

In the semester targeting writing skills an increase of 6.3% was achieved in the writing test, and 0.7% in the “reading tests”.

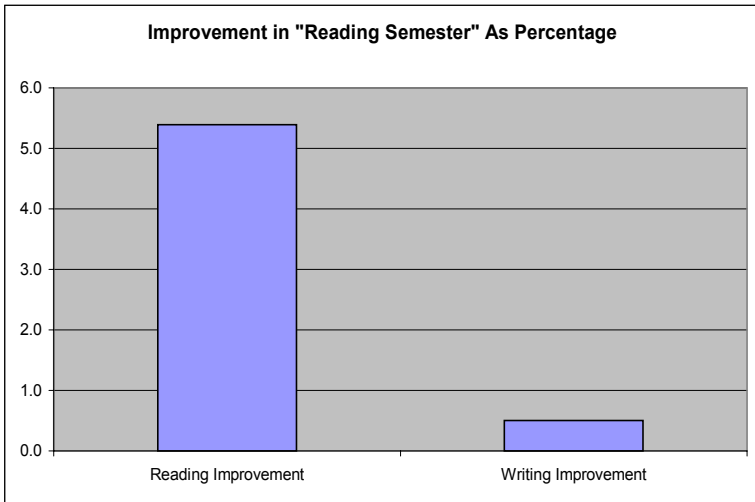


Figure 1. Improvement in skills over “reading semester”, as measured by Accuplacer.

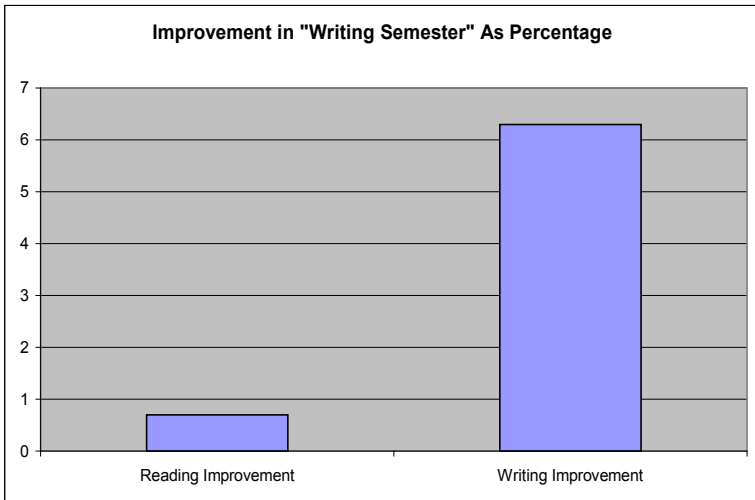


Figure 2. Improvement of skills over “writing semester”, as measured by Accuplacer.

Combining the 2 semesters, there was an increase of 6.1% in reading skills and 6.8% in writing skills. The increase in reading may be of greater significance in that the students are performing at the upper end of the percentile brackets in the reading tests.

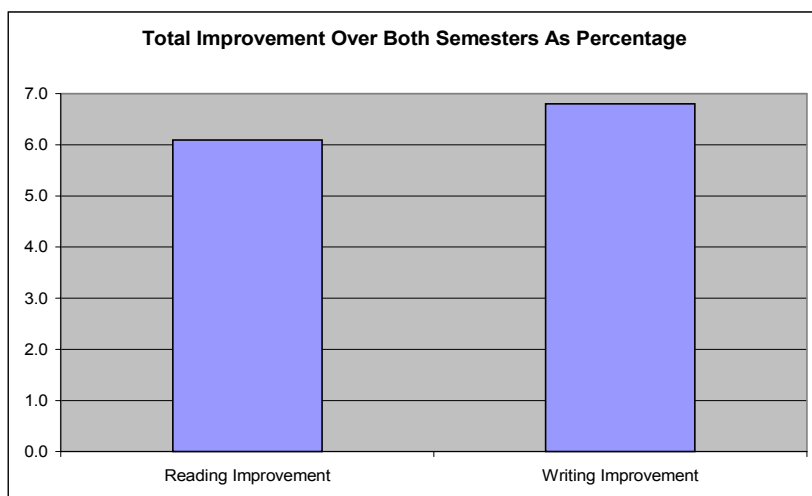


Figure 3. Overall improvement over two semesters, as measured by Accuplacer.

Further needs & future directions

Further software needs include a lab management system. Lab management systems are a convergence of the older language lab concept with that of a CALL lab. Systems we are looking at include products by Robotel ("Robotel's Home Page," 2007), Genesis Linguatronics ("Language Instruction, Classroom Management, Corporate Training," 2007), and DynEd ("Home Page, Dyned International, Inc."). The tool we select must offer one to one communication between instructor and student, and student and student, as well as one to many communication. We also want to replicate the functionality of Dyknow that we currently use. These functions include monitoring student activity, particularly when assessing student learning, application and URL blocking, and the ability to lock student computers and blank student screens, for those times when we wish to draw the students' attention away from the computer.

Given that we want our students to write extensively and intensively using computers, we might also seek to encourage feeder institutions to more rigorously empower students with touch typing skills, a powerful arrow in their quiver of learning skills. We also want to more purposefully target vocabulary, and intend to use the Academic Word List, and frequency word lists as starting points, interweaving this vocabulary into our coursework, and cross-referencing it with our existing CALL tools. Free services offered at www.lexxica.com,

("Lexxica Home," 2007) as well as Paul Nation's level and range software (Nation & Waring, 1997) may well prove useful.

Most functions within software packages we have acquired and those we are interested in include the ability to monitor and measure student learning activities, and we firmly believe that holding students accountable for their learning activities is a positive factor which encourages students to achieve required learning outcomes.

We proceed keenly, with faith, hope and optimism, in the belief, supported by a growing amount of experience and data, that an appropriate suite of software used thoughtfully and purposefully, may well consolidate, enrich, and even accelerate the acquisition of the linguistic skills required in our institution.

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APPLICATION OF EEG IN TECHNOLOGY-ENHANCED LANGUAGE LEARNING ENVIRONMENTS

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Abstract

The aim of this study is to demonstrate how electroencephalography (EEG) can be used as an effective tool to provide valuable insights into the development of listening strategies to be implemented in computer-assisted language learning (CALL) environments. This chapter will first briefly outline the problems and benefits of teaching ‘listening’ in CALL environments, followed by an explanation of how brain imaging technology has recently been incorporated into the study of cognitive approaches to language learning. It will then describe the procedure of our present study, in which EEG technology has been incorporated into ‘listening’ and ‘shadowing’ (the simultaneous action of repeating exactly what the students hear immediately upon hearing it) tasks in order to investigate various factors that affect Japanese students’ listening processes. The findings of this study suggest that the EEG recordings give an objective indicator which reflects students’ mental condition. The results also provide instructors with more detailed information on what kinds of listening practices should be introduced to the classroom and what further work is needed for individual students.

Introduction

It is fully acknowledged that listening is a fundamental area of development in second and foreign language learning (Rost, 1994; Vandergrift, 1999). In spite of this conventional notion, teaching ‘listening’ has long been regarded as one of the most problematic areas for students, requiring appropriate use of a variety of different approaches, skills and strategies (Wilson, 2003). The traditional listening activities commonly include: practicing the recognition of proper usage of words and phrases through multiple-choice questions, true or false drill exercises, and fill-in-the-blank comprehension tests, etc (Black, 1971). Even today, these methods still remain the most prevalent listening comprehension practices in many classrooms, as well as computer-assisted language learning

(CALL) systems. Recent studies have indicated that, however, merely exposing the students to these kinds of spoken language training was not adequate instruction in listening comprehension (Hisaoka, 2004). It is now generally recognized that listening is an active mental process which requires the listener to devote full attention to speech sounds, distinguish between the series of phoneme and the information in the memory, as well as determine various phrases representing different levels of aural processing (Vandergrift, 1999).

Listening is a highly demanding, unobservable process (Goh & Taib, 2006), and, therefore, not much emphasis has yet been placed on how to assess the process, except with some introspective assessment tools, such as listening comprehension checklists (Vandergrift, 1999). Recently, various listening strategies for foreign language learners have been developed, such as 'prediction', 'listening for the main idea and specific details' and 'drawing inferences and summarizing' (Flowerdew & Miller, 2005; Rost, 2002). However, more emphasis should be placed on more objective evaluations of how individual students respond and interact with auditory information during their listening performance.

Listening activities in CALL

Current approaches to teaching listening have been implemented in a various online independent learning or CALL systems (Coniam, 2006; Hoven, 1999). As a panacea for the less than favourable learning environment in the traditional face-to-face classroom, these technology-based learning environments have been regarded as a viable option, in terms of providing students with greater choice and flexibility (Kupetz & Ziegenmeyer, 2006), which helps them develop their language skills even in their free time. These facilities are also regarded as beneficial in dealing with the diversity of language learners. Accordingly, various listening tasks, in combination with a variety of applications of online listening activities and digital audio programs, have been developed in foreign language learning (Flowerdew & Miller, 2005; Hoven, 1999).

Despite these major benefits, language instructors have realized that simply providing students with an environment, where they are able to work repeatedly at their own pace through the technology, is not sufficient for students to make an improvement in their language proficiency (Towndrow & Vallance, 2004). There are very few reports on the topic which would assist students in making the most of these web-based or CALL environments to improve their listening skills successfully (Higgins, 1995). In addition, previous research provides insufficient experimental evidence to examine how individual students interact

with auditory information in technology-assisted learning contexts. Although difficulties in listening result in “a very real psychological problem for effective listening” (Sheerin, 1987), little attention has been paid, thus far, to how the student processes the listening input. Teaching approaches based on the structure of the psycholinguistic mechanisms underlying this process should be fully examined to facilitate the development of effective strategies for listening.

Japanese Students and their Listening Skills

In educational contexts, teaching listening skills have long been neglected in English language programs. In Japanese educational settings, in particular, this has been a more serious problem, since students in secondary schools have little opportunity to acquire English listening skills, and their fundamental exposure to language inputs is very limited (Shimo, 2002). One of the difficulties in teaching English to Japanese students is that they are more likely to decipher messages they listen to. This is partly because, traditionally, more emphasis has been placed on reading and grammar-focused activities in the language classroom (Nakamura, 2003). It is also important to note that it has long been assumed that listening abilities will be acquired automatically, through the exposure to other language learning activities such as expanding students’ vocabulary, as well as understanding grammar and basic phonology (Hedge, 2000). These styles of language teaching have led students to lose their confidence to improve their listening skills and to believe that listening is difficult (Shimo, 2002). Even at the tertiary level, there is a predominant feature that causes students to feel that listening to English is a very challenging task (Shimo, 2002; Yamada & Adachi, 1998).

Recently, listening comprehension components have begun to be introduced into National Center Test for University Entrance Examination carried out in Japan, as a result of consideration that listening serves as the basis for language acquisition, and that students’ listening proficiency is a fundamental aspect of spoken communication (Richards, 2003). As a result, the emphasis on listening comprehension has greatly increased, and a wide array of online listening exercises have been created. However, how to effectively develop students’ listening skills in the language classroom is still the subject of much concern and debate (Cauldwell, 1998).

Shadowing

Shadowing, which requires students to repeat what is being heard with only a split-second delay, has been commonly used as one of the means of students in

training simultaneous interpretation (Tamai, 2005). Among the various ways of improving listening skills, this technique has been widely used in helping Japanese students improve their English listening abilities (Murphy, 2001; Tamai, 2005). This concurrent listening and speaking process is regarded effective in helping students improve their pronunciation and enunciation (Asano, 2004). Unlike just listening to tapes repetitively, this active approach focuses on speaking which entails simultaneously planning the act of listening (Tannen, 1989). This approach is also based on the fact that a greater awareness of every single word is one of the factors which is absolutely necessary to process linguistic information. Students should be encouraged to pay close attention to the speaker's utterances while concurrently, and in just a few seconds, grasping and distinguishing the speaker's utterances as linguistic information (O'Malley *et al.*, 1989). Therefore, shadowing makes students feel stressed and fatigued, especially in the early stages of training. This, of course, has a negative effect on learning.

In recent years, in CALL programs provided by many Japanese educational institutions, shadowing has become widely used to improve students' listening abilities (Tamai, 2005). However, relatively little empirical research has been conducted so far to determine how this teaching approach encourages students to improve their listening comprehension skills. Many listening activities, including shadowing, tend to have been developed without taking into account the students' perceptions of online language learning.

As stated above, listening comprehension is causing a lot of anxiety and worry for second or foreign language students (Graham, 2006). Specifically, for students of beginning and intermediate levels of proficiency, listening activities, which require processing and decoding auditory input as well as generating speech output, make the learning situation even more stressful (Goh & Taib, 2006). It is vitally important for the instructor to understand the mental and emotional conditions in the student's listening processes.

Integration of EEG Technology and Language Teaching

Recent academic literature has focused on the range of emotions which greatly influence how the brain's cognitive functions operate in language acquisition (Arnold, 2000). Unlike mainstream educators of second or foreign language learning, psychological researchers have begun to take notice of the benefits of using brain imaging techniques for investigating mental processes such as reading comprehension and language acquisition (DeKeyser & Juffs, 2005; Sakai, 2005). At the same time, the neurological basis of language

acquisition and the localization of brain activities have been investigated by employing less or non-invasive brain function imaging technologies, such as electroencephalography (EEG or brain wave test), functional magnetic resonance imaging (fMRI), magnetoencephalography (MEG), and positron emission tomography (PET). However, these people have usually tried to find universal brain functions, but not individual differences, which are much more important from an educational view point.

Since the first human EEG reported (Berger, 1929), psychologists and medical practitioners have used EEG to identify a variety of diseases and learning problems such as language delay and behavioral disturbances. EEG is classified as spontaneous oscillatory components such as alpha wave, beta wave and etc., and evoked components or ERPs (event-related potentials) by stimuli given to sensory inputs. Most cognitive researches conducted with EEG have used the ERP technique, applying tens to hundreds of the same stimuli repetitively over a maximum period of several hours. On the other hand, it is usual to use listening or shadowing materials a few times at most in one training session, for this reason, utilization of the ERP technique is limited in educational application.

Among these diagnostic technologies mentioned above, one of the major advantages of EEGs is its fine time resolution (order of millisecond) that ongoing brain activities are easily detected and clearly demonstrated by the visual images (Hirata & Hirata, 2006). Another advantage of EEG measurements is that, because of the portability and usability of the devices, the measurements make it easy even for non-EEG technologists, in various settings, to assess psychological states and disorders. In spite of this recent surge in academic interest, however, not enough research has been conducted so far. More emphasis should be placed on exploring ways to incorporate this technology into language teaching, to better understand students' psychological status and ongoing language learning processes.

Procedures

Participants

There were three participants in this study who were all Japanese undergraduate students, between the ages of 19 and 20. They had studied English in secondary schools for a minimum of 6 years. The participants had taken, or were currently taking English courses at the university, and had attained an intermediate level of proficiency. They rarely had an opportunity to use English for communication

outside class. All the participants were eager to improve their listening skills, but thought it more challenging, compared to other language learning activities, such as reading and writing.

Listening and shadowing tasks

The present study focused on how the amplitude of the alpha band, hereafter alpha amplitude, of the participants changed while they were performing both listening and shadowing tasks. In the listening tasks, the participants listened to 3 lectures approximately 6-minutes in length, given by native speakers of English. This recorded speech was presented twice, with 5-sec interruptions to both ears of the participants. The participants were encouraged to interpret information that came from the auditory clues in order to understand what the speakers said. There were 3 stages which consisted of these consecutive listening tasks. After each stage, the participants' opinions and perceptions concerning the listening tasks they had completed were evaluated. Before starting the next stage, the participants took a 10–15 min break to refresh themselves.

The listening tasks were followed by the shadowing tasks. In the shadowing tasks, another 3 recorded lectures of the same style and duration were used. Using a headset, students were asked to try to produce a complete and accurate version of what the speaker had said. The participants were told to focus on the shadowing tasks, not the content of the lectures. There were 3 stages of shadowing tasks. After which, students completed a questionnaire that investigated their attitudes towards each task.

Experimental setup and data processing

Data recording

Recording spontaneous EEGs, showing large amplitudes compared to ERPs, was our main objective for this study. EEG data of students were recorded continuously using the portable, digital EEG system EEG-9100 (Nihon Koden: Tokyo, Japan) in our laboratory without any electromagnetic shielding instruments. Nineteen EEG electrodes were attached to the student's scalp and earlobes according to the International 10–20 Montage system (Klem *et al.*, 1999). All silver/silver chloride electrodes were referenced to C3 and C4 electrodes, and impedances between the earlobes and each electrode were kept below 8 kOhm. EEG signals, the reference speech sound from an audio player and the student's voice were digitized at a sampling rate of 1,000 Hz. As the conditions of eye-closure and eye-opening strongly influenced the amplitude of

spontaneous EEG in the preliminary test, the students were asked to keep their eyes closed during the whole task. The EEG data of the resting state, where the student's eyes were closed, before and after performing the shadowing task, were also recorded.

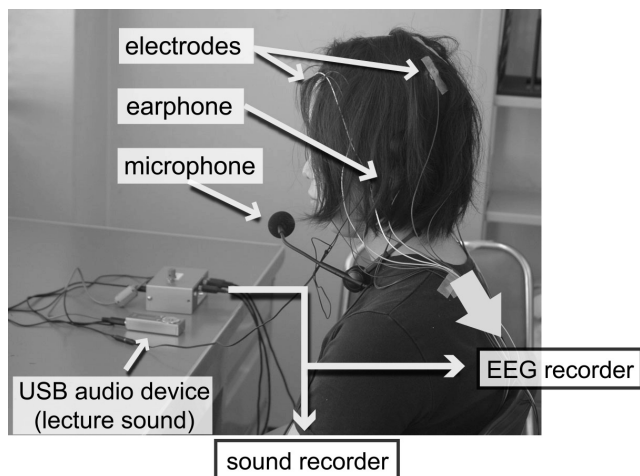


Figure 1. A photo showing how EEG and speech recording setting attached to a participant.

Data analysis

The average potential of the earlobes (A1, A2) was used as a reference. Fast Fourier transforms (FFTs) of 1-sec data were performed on the data sets of 60–90 sec so that we could notice the EEG power spectrum and observe any change between the analyzed periods. In order to obtain alpha amplitude (an index value representing the time-varying magnitude of alpha band EEG), the recorded EEG data was digitally filtered with a bandpass of 8–13 Hz, and root-mean-squared (RMS) for every 1 sec. Finally, the alpha amplitude was calculated by averaging the RMS values of an intended period. The alpha amplitude for each 12-minute stage was compared with the responses to the questionnaire. Alpha amplitudes of the before, during and after stages were plotted in time series to find out task related changes.

Questionnaire and interviews

After the tasks had been completed, data was obtained from the students through questionnaires and interviews. A 15-item questionnaire was distributed to the students for the purpose of gauging their opinions and perceptions of the tasks,

including the advantages and disadvantages of the tasks. The rating scale used in the questionnaire was a 10-point Likert Scale with 1 representing “strongly disagree” and 10 representing “strongly agree”. In order for students to fully understand the questions, the questionnaires were written in Japanese.

Results

Individual students’ EEG alpha amplitudes, responses to the questionnaire and comments will be described below.

Student A

Figure 2(A) shows time transients of the RMS values from student A’s left posterior electrode (O1), during the listening and shadowing stages. The thick gray lines indicate she had a similar trend in both tasks. This trend was commonly observed in all her data. Her alpha amplitude decreased during the task and recovered after a break (Fig. 2(B)). Her responses to the questionnaire indicated an increase of stress at each stage (9-9-7) during the listening and a recovery from the stress (2-5-5) during the shadowing. However, the alpha amplitudes showed a different trend (6.8-7.7-9.0 and 7.8-7.1-8.5) through the listening and the shadowing, respectively. The values of the listening were larger than those of the shadowing.

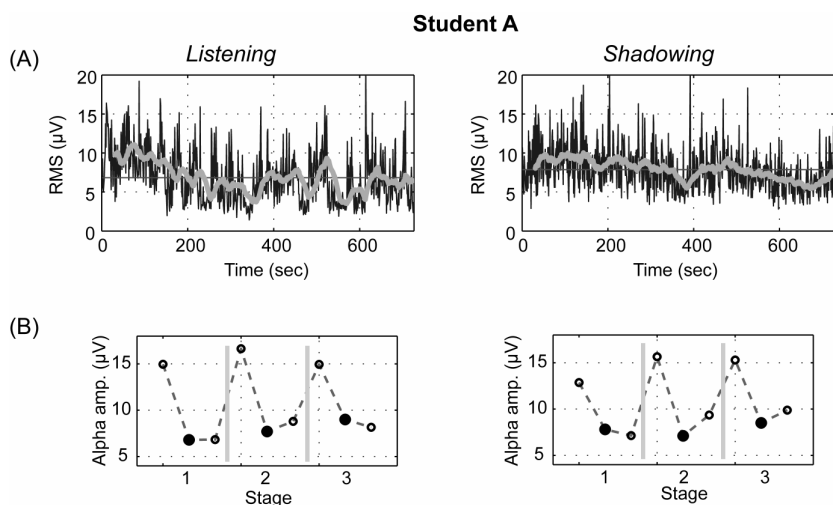


Figure 2. (A) RMS time transients during the 1st stage, and (B) alpha amplitude at each stage, recorded from student A’s left posterior electrode (O1).

This student made following comments on the listening task:

[1st stage] I felt a little panicked when I tried to catch the numbers. I think my stress was not so much.

[2nd stage] I felt I was relaxed compared to the first stage. Remembering the numbers still made me frustrated, but it didn't affect me as much. I think I was more relaxed in the last half.

[3rd stage] I was distracted and only caught a few of the words in the first part of this stage, because I couldn't hear some words at the beginning. This unsettled mind seemed to sharpen my senses compared to the last 2 stages. Of the 3 stages, I concentrated most on this stage. However, I was mentally tired. I caught almost all the words, but I did not understand the contents of the middle part of the lecture.

Comments on the shadowing task were:

[1st stage] During both the 1st and 2nd repetitions I was focused on moving my mouth. This made it difficult to understand the contents of the lecture. My mouth moved well in the 2nd repetition compared to in the 1st. I had thought that I had not remembered and understood the contents. However, when I wrote down the contents, I found I understood it better than I thought.

[2nd stage] I felt I was more concentrated on the 2nd repetition, as compared to the 1st repetition. When I further focused on the shadowing, it was difficult to understand the contents. I felt the speed of this lecture was slower than the 1st lecture and I was able to shadow with ease. I think the part which I shadowed well, was also the part I understood well.

[3rd stage] When I tried to understand the contents by focusing on them, words did not come out of my mouth in the 1st repetition. Then, I focused on the shadowing in the 2nd repetition, however, I could not shadow well. When I could not speak well, or understand the contents, I felt my eyes moved a lot.

Student B

Figure 3(A) shows the RMS values recorded from student B's right posterior electrode (O2). Those showed deflections with a downward trend during the

listening and were mostly constant during the shadowing. All three stages of each task had these trends in common. The responses to the question about stress during the listening and shadowing were 3-4-5 and 2-5-4, respectively. The alpha amplitudes of the listening (6.6-10.1-10.1) could be correlated with her response. But those of the shadowing tasks were 11.0-10.5-10.9, and showed a constant amplitude. Further values for the shadowing were larger than those for the shadowing.

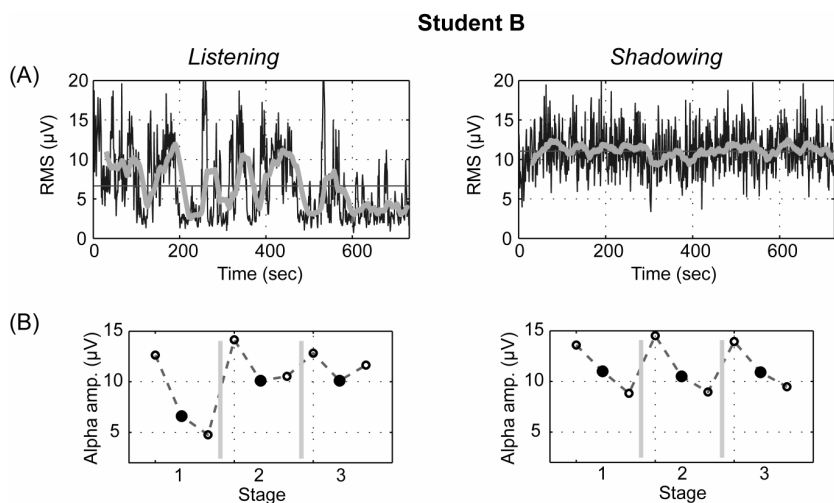


Figure 3. (A) RMS time transients during the 1st stage, and (B) alpha amplitude at each stage, recorded from student B's right posterior electrode (O2).

Comments on the listening task were:

[1st stage] I realized that I got drowsy during the listening which didn't include mouth exercise like shadowing.

[2nd stage] I was surprised that I was able to keep phrases and words for a few seconds in my mind. The amount of words and phrases during listening is less than when I am translating English sentences into Japanese. I feel that I understood what the speaker said better than the first time. However, I was surprised that I did not remember the gist of the story.

[3rd stage] This task reminded me that it was important to listen intensively to the stressed words and phrases and to pay close

attention to the words following “this topic is ...”. However words in the speech sound required a couple of second to understand. And this was not helpful in this stage for me.

Comments on the shadowing task were:

[1st stage] I was able to shadow only the words I knew very well. I could not figure out the gist of the story. However, I feel I understood the story better using shadowing than listening alone.

[2nd stage] Because I did not shadow very quickly, I was able to catch some parts and to shadow popular words and fixed phrases. I could not remember the contents.

[3rd stage] I think I was getting to shadow known words, and even the words which were unfamiliar at first, as I repeated the shadowing tasks. However, this change caused me more stress when I could not catch or shadow words.

Student C

Unlike students A and B, the RMS time transient at O1 of student C showed a low and flat contour during the listening (Fig. 4(A)). And then it showed a downward trend during the shadowing. Figure 4(B) shows an unpredicted change, namely an increase of alpha amplitude just after the 1st rest state. Her responses to stress during the listening and shadowing were 1-1-1 and 1-4-2, respectively. These were the worst of all the students. While the alpha amplitudes of the listening (3.7-4.6-5.4) were lowest values in the experiment, those of the shadowing (8.3-7.1-6.3) were relatively similar to the other students' RMS values.

Comments on the listening task were:

[1st stage] I understood most points and words, but I was not able to remember the numbers. I was irritated with the listening. Maybe it was because I hadn't done English listening recently.

[2nd stage] When the sentences were very long, it was difficult for me to understand the content, even when simple or familiar words were used.

[3rd stage] I could not keep the words in my mind at all.

Comments on the shadowing task were:

[1st stage] I did not understand the words and could not shadow the sound in the last half.

[2nd stage] When I got the gist of the story, I did not feel much stress from the shadowing.

[3rd stage] I think what I did was speculate on what I thought the word was, rather than what I had actually heard.

Discussions

In general, amplitude of alpha wave shows a large value while the subject is relaxing, and becomes small when the subject is doing a certain task. In the listening task, student A's responses to the questionnaire showed an increase in stress during the stages. However the alpha amplitude values (shown as filled circles in left side of Fig. 2(B)) showed an overall increase at each stage. Student A's results in the shadowing task and the other 2 students' results of the both tasks also showed discrepancies between the student's responses and the alpha amplitude. This finding suggests the students' perceptions of both listening and shadowing tasks, which had been revealed by the questionnaire, did not necessarily correspond to what actually happened in the brain activities observed by the EEGs. The students' comments about stress supported the idea that shadowing was more stressful than listening. However, there was no clear difference between the alpha amplitude during the shadowing and listening tasks. Almost all the alpha amplitudes examined in this study decreased during both the listening and shadowing tasks, stayed at a low level, just after the tasks, and then, they recovered after a break. The processed data obtained here might not be directly related to stress, but they could be relevant to the students' mental concentration on the tasks, or some other internal changes related to the tasks.

The results of the present study also suggest that individual learners are significantly varied in the ways they process aural input. As showed in Fig. 2(B)–4(B), the RMS contour lines of individual student varied between the students. However, 3 contour lines corresponding to 3 stages of each individual showed a similar trend. Therefore, the change of RMS contour is thought of as specific to the individual. Student A and B showed typical RMS contour lines in Fig. 2(B) and Fig. 3(B). However, student C's contour lines during the listening was quite different from the other students. This student claimed, after the experiment, that she was in bad shape and was always irritated during the day.

However, we did not realize her condition from her face or air. This fact indicates that alpha amplitude could be a good indicator of a student's mental condition. Monitoring students' initial alpha amplitudes might be useful in determining a student's readiness for language training.

As Jones (2001, p. 366) claims, most language instructors require more systematic approaches to "integrate CALL into their regular teaching, or help learners individually". The findings of the present study suggest that the EEG information provides a more objective evaluation of how individual students respond and interact with auditory information. Another important implication of this study is that the EEG allows instructors to better understand the validity of adopting a specific task as a technique for improving listening ability during independent listening situations. Although EEG technology has not yet been widely acknowledged in educational contexts, specifically in technology-enhanced language learning, it can be a more effective support tool in assessing individual students' psychological traits during the language learning process. One possible EEG-based system, which can be geared to individual students' differences, is a neurofeedback technological system, which provides students with their brainwave activities as real time feedback during their study.

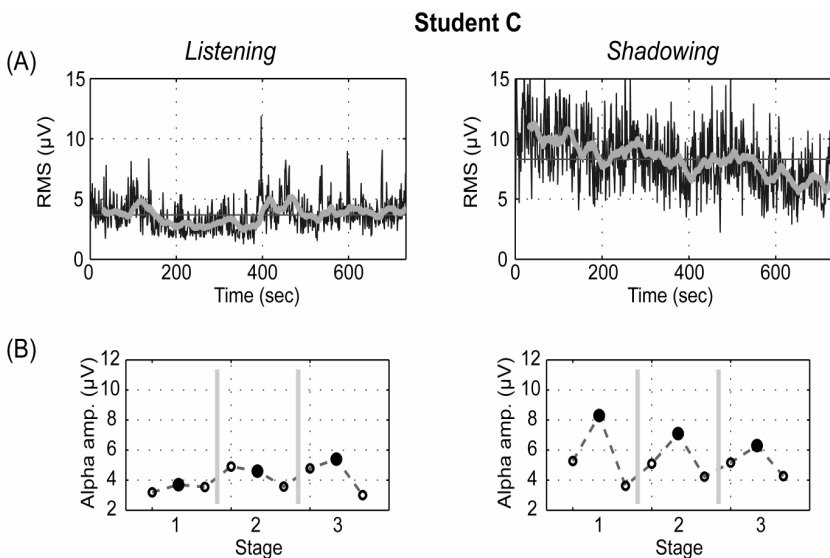


Figure 4. (A) RMS time transients during the 1st stage, and (B) alpha amplitude at each stage, recorded from student C's left posterior electrode (O1).

Implementing this technology could help students to gain “a deeper understanding of the nature and demands of listening” and increase “confidence in completing listening tasks” (Goh & Taib, 2006, p.222). Further examination is needed to address the effectiveness of using EEG approaches to affect L2 students’ performance of language activities and improve their language skills in relation to technology-enhanced learning environments.

Conclusion

The main focus of this chapter was on how EEG technology has been applied to the understanding of students’ cognitive constraints, and the mental conditions observed during the listening process. The present study raised a number of methodological questions, such as the small number of students, and the relatively short experiment period which need to be addressed in a future study. However, the guiding principles outlined in this chapter can be applied to any language teaching situations; in particular, the application of EEG technology to language teaching is well suited to Web-based and technology-enhanced learning environments. Incorporating EEG measurement in educational settings will be a key contributing factor to the development of more effective teaching methodologies in the future.

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A REVIEW OF SECONDARY SCHOOLS' USE OF ICT IN HONG KONG

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Abstract

This chapter focuses on a collective of five international secondary school communities' perceptions regarding technology-led teaching and learning during and after the enforced schools closedown in Hong Kong in 2003, caused by Severe Acute Respiratory Syndrome or SARS. The study initially investigates the response to this real life scenario of what happens when, instead of planning for systemic ICT adoption in the school curriculum, a crisis propels the providers and the learners into total dependency on technology to sustain the system. The study investigates the changes teachers had to make in teaching and learning activities and the demands this placed on them. It also reviews the reactions of students and parents to these changes during the crisis and provides an examination of the changes that have occurred in one of the schools through the views of the school community over the last four years since the closedown. The chapter explores the principal lessons learnt and how these relate to theory and research in practice; and the longer term impact of the SARS induced closedown on the use of ICT in these schools.

Introduction

In 2003, Severe Acute Respiratory Syndrome or SARS spread rapidly throughout Hong Kong. The government put in place measures to guard the citizens of Hong Kong against the virus. One of these measures was to close all schools. Over one million children stayed at home. 50,600 teachers were faced with the challenge of using digital technology to provide an education that would reach beyond school walls into the homes and computers of Hong Kong students. Teachers had to re-think their teaching strategies and provide their students with new and different opportunities to work through curriculum requirements. Students had to re-think how best they could support their own studies from home, especially those preparing for international examinations.

SARS provided a catalyst for intense use of information and communication technology (ICT) in ways which had not been anticipated or prepared for. The plunge into ICT was a voyage of discovery for some and frustration for others. Either way it had an impact on subsequent perceptions regarding the potential and shortcomings of ICT in education in Hong Kong.

This chapter focuses on a collective of five international secondary school communities' perceptions regarding technology-led teaching and learning during and after the enforced schools closedown in Hong Kong. The study initially investigates the response to this real life scenario of what happens when, instead of planning for systemic ICT adoption in the school curriculum, a crisis propels the providers and the learners into total dependency on technology to sustain the system. The study investigates the changes teachers had to make in teaching and learning activities and the demands this placed on them. It also looks at the reactions of students and parents to these changes during the crisis and provides an examination of the changes that have occurred in one of the schools through the views of the school community over the last four years since the closedown. The chapter explores the principal lessons learnt from this experience and how these relate to theory and research in practice; and the longer term impact of the SARS induced closedown on the use of ICT in these secondary schools.

Background

The five international secondary schools in this study are administered by a single organization, the English Schools Foundation (ESF). The ESF was established by the Hong Kong government in 1967 to provide "a modern liberal education" in "co-educational and comprehensive schools" through the medium of English (<http://www.esf.edu.hk>). ESF schools are partially subsidized by the government to cater for children who do not speak Cantonese as their first language and who are not eligible to attend local secondary schools taught through the medium of Chinese. Teachers in ESF schools are predominantly recruited from the UK, Canada or Australia and are well qualified and experienced. The ESF provides funding and staffing for the schools although the schools maintain significant administrative autonomy. When SARS struck Hong Kong in March and April, ESF schools were following the British curriculum culminating in the General Certificate of Secondary Education (GCSE) examinations taken in Year 11, and GCE Advanced (A) level with modular examinations taken in Years 12 and 13. Most of these examinations are

taken in May and June. As of September 2007, all ESF schools will offer the International Baccalaureate (IB) Diploma instead of GCE A Levels.

Around 50 nationalities are represented in each school, catering for expatriate families and families of residents whose mother tongue is not Chinese as well as an increasingly large group of local and other Chinese descent children whose parents favour a more western orientated philosophy of education than that offered in local Hong Kong schools. Around 60% of the student population at the start of this study in 2003 was of Chinese heritage, the remaining 40% from European, North American and other Asian countries. Most of these students were used to a Western style of pedagogy, including collaborative and interactive learning, group work and a focus on interpretive problem solving skills. The culture within the ESF schools is international and Western in orientation and more closely resembles private and comprehensive schools in the UK than local schools in Hong Kong. Nevertheless, similar to other regional Asian schools, there are especially high expectations from the school communities that students will be successful in examinations to ensure they gain acceptance to well recognised universities around the world. Over 90% of students completing GCE examinations at ESF schools go on to study in universities (<http://www.esf.edu.hk>). In 2006, for example, 43.3% of students in one ESF school attained A passes in A levels compared to an average of 24.1% in UK schools while 23.6% of students in an ESF school achieved 'A*' compared to the UK average of 6.3% (<http://www.wis.edu.hk>). These examination results are representative of all ESF schools.

The belief that ICT can positively impact on learning has led many governments and school authorities to develop policies for the integration of ICT into the curriculum. In 1998 "HK\$B3.05 (about US\$M391)" was made available by the government in Hong Kong to equip schools with hardware and software, to provide IT infrastructure and technical support as well as technical competency training for teachers (Plomp et al. 2003, p. 25). ESF schools have kept pace with these developments and are well equipped with ICT and teaching and learning resources. ESF schools have consistently maintained an above average student to computer ratio in comparison to UK and USA government schools. For example in 2006 the computer to student ratio in ESF secondary schools was 3.12 compared to the USA, which claimed a 3.8 average while the UK average was 3.7. The average number of electronic white boards in an ESF secondary school was 41 compared to the UK average of 17 per school, a difference of +141% (BECTA Review, 2005 & 2006; ESF, 2006; Education Week, 2005).

In summary, the five ESF schools participating in this study are large, multi-cultural institutions with high caliber teaching staff catering for international students. At the time SARS hit Hong Kong, the schools were following a wholly British curriculum culminating in major exams in Years 11, 12 and 13 most of which are taken in the months of May and June each year. The schools have high academic expectations and are well equipped in terms of computer technology.

Research Methods

The purpose of the investigation was to find out what happened when the 2003 SARS crisis closed schools and propelled teachers and learners into total dependency on technology in order to sustain the education system and to understand the challenges faced by the schools, teachers and students during the disruption of classes. The instruments used to conduct the investigation were a survey and purposive interviews (Miles & Huberman, 1994) with selected individuals and focus groups. The survey was administered immediately after normal classes resumed, followed by purposeful sample interviews with teachers, student focus groups and parents. The survey focused on the perceived effectiveness of teaching and learning activities mediated through technology, levels of knowledge and skills in using ICT in teaching and learning, and attitudes and beliefs towards ICT use. The questions regarding teaching and learning in the survey given to Years 11, 12 and 13 exam class students were slightly different from those given to the non-examination students in Years 7–10 to cater for the different pedagogical foci for online teaching and learning activities for each group, the activities for the Years 11, 12 and 13 students being necessarily orientated much more towards exam preparation. Teaching and learning experiences for these two groups will be discussed separately and compared, where appropriate in this chapter.

In order to explore the longer term impact of this SARS induced ICT total emersion experience and to find out about the present role of ICT in the curriculum, a survey was given to teachers in one ESF school, followed by purposive sample interviews with teachers, student focus groups and parents, four years later, in 2007.

2003 survey to teachers

The teachers were made aware of the survey by the school principals, via each school's intranet. The principals in each respective school asked all teachers to support the study by completing the questionnaire online. Forty-six teachers

completed the questionnaires, but most were from one school with two schools providing no teacher survey returns (see Table 1).

Table 1. Teacher involvement in the online questionnaire survey.

School	Total no. of teachers	No. of respondents	% respondents at each school
Island	64	11	24
King George V	75	0	0
Sha Tin	64	0	0
South Island	63	12	19
West Island	63	23	35
<i>Total</i>	<i>339</i>	<i>46</i>	<i>14</i>

2003 survey to the students

Each school organized tutor groups¹ of 15-30 students of the same age, but mixed academic ability, for the purpose of pastoral care and daily registration. Each tutor group met with their tutor each morning. In the study, one tutor group from each year level in all five schools was selected from Years 7 to 13, totaling seven tutor groups from each school, to provide a cross section of students in terms of age and academic ability. In order to facilitate completion of the questionnaires, paper copies were delivered to the selected tutor groups. Permission to conduct the study was granted and supported by each of the five principals who contacted all teachers involved to ask for their assistance. This ensured a high response rate for each tutor level sampled. Tables 2 and 3 outline response rates to the questionnaires.

2003 survey to parents

Parent questionnaires were also delivered online but only to parents of one school. There were two reasons for this. Firstly, given the low teacher responses from other schools, a good response from parents at other schools was considered unlikely. Secondly, it was assumed that parent perceptions would not vary greatly across the schools as their involvement was much more indirect when compared to the students and teachers. Parents were made aware of the questionnaire by a letter sent home to them by the school. Out of a total of 532 households which have students at the school, 23 responded, giving a 4% response rate. In addition to the 23 returned questionnaires, a further 15 parents

¹Known in other national systems as form groups or home room.

separately corresponded via email to the researchers and selective follow up interviews were organized.

Table 2. Class involvement in the questionnaire survey.

Secondary School	Number of tutor groups	Number of tutor groups selected	Response of tutor groups	Response rate (% selected tutor groups)	Response rate (% total no of tutor groups)
Island	43	7	7	86	16
King George V	55	7	7	100	13
Sha Tin	42	7	6	86	17
South Island	36	7	6	100	19
West Island	37	7	7	100	19

Table 3. Student involvement in the questionnaire survey.

School	Total student enrolment	Students selected	Questionnaires completed	% total students in all schools
Island	1200	190	190	16
King George V	1500	193	193	13
Sha Tin	1150	189	164	12
South Island	925	194	172	19
West Island	890	186	186	21
<i>Total</i>	<i>5665</i>	<i>952</i>	<i>905</i>	<i>16</i>

2003 interviews

Analysis of the questionnaires highlighted issues which required further investigation and this was achieved through in-depth semi-structured interviews with ten teachers, three focus groups of students from Years 7, 9 and 12, and ten parents. The teachers chosen for interviews were selected on the basis of maximum variation sampling (Patton, 2002) and their positive or negative beliefs and attitudes towards the use of ICT, as described in the returned surveys and informal discussions. In addition, other teachers volunteered their views either by seeking out the researchers or by willingly participating in calls for meetings to discuss what happened with regard to the use of ICT in teaching and learning. Students were interviewed in small focus groups of three to four to reduce any anxiety they may have felt in a one-to-one meeting with one of the researchers. Students in these groups were forthcoming with their views and expressed their feelings with regard to problems and issues raised concerning their studies, the schools' response to the closedown, the role ICT played, and the role teachers played. Parents were selected based on their survey and email

responses and willingness to be interviewed and through self-organised parent meetings wanting to discuss issues arising from the schools' closedown.

2007 survey to teachers

The 2007 survey for teachers was provided online in one of the ESF schools and was only open to teachers who were in ESF schools during SARS in 2003. The number of teachers completing and returning the survey was 31, representing 49% of teachers who were in the school in 2003.

2007 interviews

Purposeful sampled students, teachers and an ESF education officer were interviewed to gain their perceptions of the changes in the schools since 2003 and the role of ICT then and now to support teaching and learning. Four teachers and two focus groups of students from Years 11 and 13, all of whom had been at ESF schools during the SARS schools closedown were interviewed. Five parents whose children were in ESF schools in 2003 participated in follow-up interviews and a focus group discussion.

Results

At the time of SARS schools' closedown, there was no consistency across and within ESF schools regarding ICT provision and, overall, ESF had no clear technology plan. The ESF ICT Development Plan (2001-2004), which focused on the supply of hardware and software, stated that "ESF school 'networks' had 'evolved' rather than resulted from forward planning." The schools which did have ICT plans for teaching and learning focused on the use of ICT to supplement face-to-face teaching with no formal plans for any distance or self-study learning by ICT. Not all schools had student or class email lists readily available and each school operated totally independent school websites and individual teacher websites and resources.

Teachers

The sudden closure of normal schooling was a major shock to all concerned. Most teachers stated that their first reaction was to consider how best they could replicate face-to-face classes using technology and that the first thing they did was to upload teaching resources, lesson notes and activities for students to complete online with minimal or no thought to the need for changes to content or format to take into account teaching at a distance and teaching through online

technology. For most teachers, this form of teaching was an entirely new experience and one which yielded many frustrations and difficulties (Fox, 2007). As all teaching needed to be delivered online, most teachers used the school teacher websites for uploading work.

Forty-six teachers who answered the questionnaires were fairly evenly split in terms of gender, with 52% female and were from a broad range of teaching subjects and specialisms. Only teachers from three of the five secondary schools completed the questionnaires, though two teachers from each school were later interviewed.

Most of the teacher respondents (66%) stated that they felt they had intermediate skill levels in ICT with a further 30% stating they had advanced level skills. Before the school closure, 59% of the teachers had used their own teacher web pages for uploading online teaching and learning activities, including homework (79%), in-class activities (79%), coursework (68%), assignments (32%), feedback on student work (23%), independent study units (59%) and other uses (22%). Technology in all instances was used to supplement teaching and not to take the place of any face-to-face classes. Teachers commented that the online technology enabled students to continue their studies beyond the classroom. All teachers stated that they had had no previous experience in working as distance online teachers.

Changes teachers had to make and the demands this placed on them

When the schools were closed down, suddenly all lessons had to be taught online. Though students were required to stay at home to continue their studies, teachers were required to attend school during school hours. Literally overnight, teachers had to upload lessons onto their web pages for all year groups. Using the postal system to send materials to whole classes of students was not encouraged because the office staff were not equipped to deal with this on a large scale. About 65% of the teachers supported online lessons with email messages sent to their students.

The rate of email response from students was fairly low, with only 41% of students responding to messages sent by teachers. This worried teachers and was of particular concern because examination class students were the ones who received the most email messages from teachers. However, comments from some teachers indicated that there was also a minority of students who made “unreasonable demands” of teachers, with their expectations regarding emails. One teacher described her experience. “I found myself reading emails at 9.30 pm. There was a tendency for kids to think you would reply within an hour,

on the day, as if we were sitting at our computers waiting for work.” (Teacher 2). Another teacher stated:

There's a dislocation of fixed time and place, in working online... students can contact me anytime and at all hours and ... I feel compelled to answer these queries [immediately] to provide space the following day for other work...But ... the next day, there's more messages...the pile requiring responses never ... gets smaller. (Teacher 9)

Teachers noted that teaching solely through technology restricted ways of teaching and that trying to teach in exactly the same way that they had taught in face-to-face classes, mediated through technology just did not work well. As one teacher commented: “It's hard to adjust ... to teach effectively online ...it limits ...ways of communicating ... I have to write what normally I would say or infer with a nod or a gesture”. (Teacher 5)

A key struggle for teachers was a feeling of inadequacy, caused by a perceived lack of experience and knowledge in working entirely online. One teacher commented on her lack of training and experience using her web page for teaching. “I did not know how to present information without the usual immediate feedback and cues from the students that I have in class. ... I couldn't gauge the clarity of my own instructions and explanations” (Teacher 8).

Overall, teachers felt frustrated by their lack of skills and ability to exploit the technology appropriately or fully, to support their students' self-study. When students returned to school, teachers were most concerned with examination class students. Comments indicate that this was mainly because the exam syllabus had not been completed before the school closure and that “teaching online had not been as effective as had been hoped” (Teacher 1). It should be noted, however, that the 2003 examination results for all ESF students was very similar to previous years (<http://www.wis.edu.hk>), indicating that the school closedown had not adversely effected student work.

Student and parent reactions to the changes in teaching and learning during the crisis

Some parallel questions were asked both of students and parents in the questionnaire in order to determine how similar their perceptions were. Where questions were identical, both parent and student responses are presented together.

905 students completed the questionnaires or 16% of the total enrolment of all five schools. In the student groups surveyed, the gender split was fairly equal at each year level, with an average of 47% boys overall. The first language spoken was, on average, 58% Cantonese, 31% English and 11% Other. There was no evidence in the questionnaire results of any significant differences in attitudes and perceptions to the online activities related to gender or first language.

More than half of the students in each group (56% non examination students and 67% examination class students) felt that there was sufficient variation in activities such as completing group and individual tasks, responding to questions, summarizing notes, opportunities to practice past examination papers and getting feedback from teachers on work completed. The parents' views were similar, with about 55% saying that there was sufficient variety of activities in the lessons. With exam class students, the older the students the less variety they claimed to have had in their lessons, but then the less variety they felt they needed. In Year 11, there was, on average, about 60% practice exam questions while in Year 13 that percentage increased to about 80%. There was quite a significant discrepancy between the girls' perceptions and the boys' perceptions in both Year 11 and Year 13. While the Year 11 girls thought that just around 40% of their online lesson time was spent in practice exams, the boys thought that the figure was nearer 90%, indicating that the girls carried out more self-directed work than the boys.

The student group interviews supported the open question responses at the end of the questionnaires. Although there were some common difficulties across the two student group types (exam and non-exam classes), the younger students had different needs from the older ones. Years 7–10 students found it more difficult than older students to motivate themselves and the lack of specific incentives for handing in work resulted in many students not doing the work set. These students favoured more variety in the activities and more teacher support. Years 11 and 12 appreciated teacher emails with their quick response to questions and general guidance offered. In contrast, Year 13 students were happy mostly working alone, content with the occasional contact with teachers when they were having problems with their self-study as key practice exam papers were made available online both from the schools and freely available from the internet from international sources. Exam class students also commented that communication with peers, mostly via mobile phone, was the most efficient and effective in answering clarification questions and queries on

the locations of the best self-study online sites for exam preparation. As one exam class student commented:

practice exam questions available online, supported by explanatory answers to the questions were excellent ... I found sites for posting queries and sample responses ... answers from people ...and experts from around the world was quick and thorough ... Overall, the school closedown actually benefited my study and helped me prepare for my exams independently.

Parental involvement in supporting student learning during the schools' closedown was mixed. Some parents wanted to see what work was set and how their children intended to complete the tasks. Some enforced (or tried to) set school hours for school work during the day. This was harder for some parents particularly those who worked during the day away from home. Others who were able to stay at home did work with their children, asking questions, eliciting what students have been set and how they went about responding to tasks. One parent interviewed stated that she had sat with her child each day working out a schedule and routinely checking progress. However, the majority of parents felt ill-prepared and equipped to provide their children with much real help, while others expressed concern that they felt isolated and had not been given enough guidelines from the schools as to what study activities their children should be completing.

Changes that have occurred in the schools over the last four years since the closedown

The sudden, enforced school closedown and its impact on the school operations, teaching and learning and communications within ESF and with the local community acted as a catalyst for ESF and school management to rethink commitments and strategies concerning the role of technology. As one ESF officer commented:

the experience encouraged us to reflect on how we could better prepare for any future closedown brought about by another SARS or bird-flu scare ...and how technology could best support teaching and learning across all schools during a closedown as well as in normal class situations. (ESF Officer)

A central steering committee to plan strategically for ICT development and integration across all schools was established, headed by ESF's Chief Executive

and including ICT school coordinators, key teaching staff, school deputy principals and technical officers to ensure committee work articulated with overall plans for ESF and schools' development. Central planning ensured that all schools gained appropriate coordinated and articulated ICT networking and infrastructure. One major initiative resulted in the purchase of a centrally networked "open learning platform", the Connected Learning Community or CLC in September 2005 (<http://clc.esf.edu.hk/>). Each school established their own CLC hub, linked to other ESF schools and the central administration. Professional development programmes were initiated and incentives given to teachers to experiment with using the CLC to support teaching and the integration of technology into the curriculum. Staff were encouraged to apply for reduced teaching loads to develop technology-based activities and to mentor other teachers in the use of CLC. Workshops and inter-school seminars were established, good practices in using CLC in the curriculum were identified and staff involved were invited to present their case studies of technology integration to fellow teachers. Examples of good practices, ideas for embedding CLC into the curriculum and stories from teachers and students in using the CLC to support teaching and learning were uploaded into the ESF CLC site (<http://clc.esf.edu.hk/>). However, despite these initiatives, "developments and the use of the CLC remain rather patchy across the five secondary schools." (ESF Officer)

2007 teacher comments

Thirty-one teachers who completed the 2007 survey all agreed that the SARS school' closedown had stimulated interest in using ICT to support teaching and learning activities and all felt it had provided an interesting, though frustrating time to trial ICT possibilities. However, only 43% felt that they used their teacher webpages more now than before SARS, with only 20% using it daily and 40% not using it at all. Use of the learning platform, the CLC, was small with only 21% of teachers using it on a daily basis and 61% using it either rarely or never. The teachers who did use either the teacher webpages or the CLC on a regular basis indicated their main use was to support existing practices (uploading PowerPoints, lesson outlines, worksheets, practice exam papers).

Four teachers took part in purposive sampled interviews in 2007. Their selection was based on differing interests, experiences and positions in ESF schools. One teacher with senior management responsibilities in the school, commented that since SARS in 2003, there had been significant changes in ICT in all ESF schools, "although not necessarily all directly linked to the school

closedown, the SARS experience really did make us think about how we used technology” (Teacher 11). The teacher commented that the common online learning platform, the CLC, had enabled improvements in communication between staff, students and parents through, for example, uploading letters to parents and weekly news bulletins. However, she commented that “the use of the CLC for teaching and learning is still in the early stages and most teachers have not yet used it to support their teaching.” (Teacher 11).

Another teacher with ICT coordination responsibilities for the school, commented on the “wireless access in almost 100% of classrooms and increasing numbers of students bringing into school their own laptops” (Teacher 12). He noted however, that few teachers were taking much advantage of these ICT changes, with only early adaptor teachers effectively integrating the CLC and other new technologies into their teaching and learning. “The key issue confronting ESF schools’ ICT integration into the curriculum is the need for appropriate professional development and incentives to use the technology to support student learning” (Teacher 12). This teacher saw the change to adopt the International Baccalaureate (IB) in all ESF school Years 12 and 13 “as a great opportunity ... the IB curriculum requires more critical reflective learning and ICT is an ideal medium to stimulate and exchange ideas as well as to conduct research for projects.” However, he stressed the need for leadership support in using ICT to appropriately exploit the opportunities made available by new technologies. He noted that a new ESF special interest group had formed, called Vision 2012, tasked by the ESF ICT Steering Committee to develop integration strategies for using ICT across the curriculum. He noted that this initiative needs full leadership support across all schools and “assistance to teachers to help them discover new ways of teaching using the new technologies.” (Teacher 12).

Both these teachers were supportive of harnessing the often more superior ICT expertise that many students have. They felt that teachers needed to develop a broader perspective and accept that they can learn from students by forming partnerships with them. He concluded: “I’m working with selected students helping them become competent in training and mentoring teachers and fellow students ...this will require an adjustment in the relationship, but we can make it work ...” (Teacher 12)

Both teachers were supportive of ICT being “embedded in the curriculum and this is already being encouraged with the ‘Learning to Learn’ and ‘Pathways’ courses offered in Years 7 to 10” (Teacher 12). These courses enhance revision and research skills of students using ICT. Students choose

from a range of subjects they are studying in order to deepen their understanding of particular topics. Both teachers felt that there was a need to map the development of staff ICT skills and increase opportunities for staff development and sharing in exploring pedagogical applications of technology on an ongoing basis, not restricted to single staff development days. However, “collaboration and sharing tends not to happen unless there is ...real, regular support from leadership” and that principals and deputy principals should “model the use of the CLC” (Teacher 11). A key problem faced in the schools at the moment “is a lack of strong support from senior management ...who don’t have the knowledge or expertise in using ICT for learning” and are therefore “limited in their understanding of the importance of providing a vision and leadership in this matter” (Teacher 11). Schools have the “technology to take advantage of the developments but we need a culture and expectation of using ICT and that each teacher needs to improve their use of learning technologies to improve their own pedagogical practices” (Teacher 12).

Another teacher interviewed had trialled an independent learning programme. This had been triggered by discussions in his school about the potential for future increased student laptop use. He had developed a self-study online programme to take the place of some classes, saying he wanted “to empower students through technology and encourage independence” (Teacher 13). However, after several weeks of trials, it became apparent that this self-study learning programme was not working. Students complained and the principal requested that the teacher deliver the course in a more traditional style in face-to-face classes.

Another teacher described the opportunities the school closedown had given her and her students to experiment with various new technologies, notably synchronous chat to complement student worksheets uploaded online. She had also started using the CLC but needed more help in making better use of the technology. “the existing training sessions were inadequate ...what I need is help just when I need it, not during a training session ...and I need longer term help to explore using the CLC for my teaching” (Teacher 14).

2007 student comments

Year 11 students interviewed in 2007 were in Year 7 during the SARS schools closedown in 2003 and Year 13 students were in Year 9. While Year 13 students claimed that they now used ICT significantly more since SARS for completing homework tasks, Year 11 students said they did not. Both groups thought that teachers today used ICT much more in the classroom and especially in using

PowerPoint for presentations, web searches for interpretive and analytical skills development and occasionally discussion forums. However, students said that the amount and type of use of technology very much depended on the subject and individual teachers. The types of activities students described teachers had adopted, reflected a transfer of old methods of teaching to a new technology, with most teachers using ICT mainly for teacher-led presentations, uploading practice exam papers, and summary notes of lessons. There were, however, individual teachers identified that were using ICT in new ways to extend learning activities beyond the classroom by engaging students in projects, for example, that linked them to students in other schools both in and outside Hong Kong, through shared websites and discussion forums. Students said these interschool activities and forums were not only fun but they learned a lot from their peers and they appreciated the online feedback on their work.

The Year 13 students were forthcoming in recommendations for future ICT usage, suggesting that younger teachers who were “techno-savvy” should be hired and current teachers should be trained to use new technologies more competently and that they should not be afraid to ask students for help, as one student commented: “[the teacher] struggles with finding the right way to access sites using the electronic whiteboard ...but he should ask us to help him do that, to allow him to concentrate on the teaching ...the technology often just overwhelms him.”

2007 parents comments

In 2007, parent reflections were mixed on the use of ICT during the school closedown and its impact on student study today. All agreed that they were very keen on students continuing to have full use of ICT both within and outside of school to support their studies, but felt that the schools, the teachers and even the students were not ready for more online classes and fewer face to face lessons. Overall, they felt that ICT should be more fully integrated into normal schooling as technology literacy was an important life skill and that ICT used well allows additional benefits not available to students and teachers who do not use the technology. Some parents commented on the positive use of new technologies on their children's learning, for example, the use of wikis to support collaborative project work. They viewed in a positive way the general increase in the use of technology to support their children's learning at home. The concerns parents expressed were to do with levels of internet security and the amount of distractions found online that could take children's attention away

from their studies. But this they felt was more to do with their children having to learn to deal with the multiple distractions available to them.

Four parents interviewed agreed that teacher support would have to greatly improve if there were to be more online lesson activities. The following comments illustrate this point: “if the children were to have increased online learning options then full, coordinated and thorough, teaching support must be provided” (Parent 14) and “online teaching and learning is good provided there is two-way communication and the students have regular feedback from the teachers” (Parent 15) and “staff should be given opportunities for professional development related to the use of ICT and the potential of e-learning to supplement and at times, to take the place of classes” (Parent 11).

Discussion

Principal lessons learnt and how these relate to theory and research in practice

The experiences of the schools closedown in 2003 and the use of ICT to support student learning highlighted strengths and weaknesses in the schools’ ICT arrangements, both in terms of the technical infrastructure, networking, resources, communications, planning and training and in terms of the ways the technology was used to support teaching and learning. It also highlighted a number of ongoing challenges and barriers to successful technology integration into teaching and learning and these are summarized below, with reference to theory and research in practice.

There were examples of individuals who successfully integrated new technologies into their teaching in all five schools but their experiences have not translated into major changes within and across schools in the way ICT is used in the secondary school curriculum. What appears clear is that no matter how sophisticated the technology supplied, and no matter how much technical support is offered, teachers need additional support to help them integrate technology into the curriculum in pedagogically appropriate ways. Teacher beliefs and attitudes towards the use of technology in teaching and learning (e.g. Becker, 2000); their pedagogical content knowledge and skills in using technology in their subject (Mishra & Koehler, 2006); the organization and school culture, leadership and policy issues (e.g. Plomp et al., 2003); adequate resources and regular access to appropriate technology (e.g. Cuban, Kirkpatrick & Peck, 2001); and existing pressures to meet the demands of traditional examination requirements (e.g. Hennessy, Ruthven, & Brindley, 2005) all need

to be addressed. Each of these issues is briefly described in the following paragraphs.

Beliefs and attitudes

Ertmer (2005) argued that teacher pedagogical beliefs about the value and role of technology will determine a person's attitudes towards using technology. Becker's (2000) review of research revealed that teacher attitudes toward and expertise with using ICT is often cited as a key factor in whether the technology is used to support student learning. Zhao and Frank (2003) conclude that 'unless a teacher holds a positive attitude toward technology, it is unlikely that he or she will use it in teaching' (p. 809). The technology itself is another source that affects teacher attitudes and beliefs about the value of its use in schools. For example, there is conflicting advice about the value and role of technology for education; the technology is constantly changing, making it difficult for teachers to stay current with new developments; and it can also be unreliable and sometimes unstable (Cuban, 2001).

Teachers participating in this study identified a range of beliefs and attitudes towards the role of technology in teaching and learning. Clearly beliefs and attitudes are key factors in whether a teacher adopts technology in their teaching and changing attitudes is difficult and can take considerable time (Fox & Henri, 2005). The related added complexities surrounding the use of technology in educational environments (eg Cuban, 2001) will also impact on technology uptake.

Knowledge and skills

Lack of specific knowledge and skills is another barrier to technology integration. Mishra and Koehler (2006) proposed a conceptual framework for exploring technology applications by building on Shulman's (1986) formulation of "pedagogical content knowledge" to include the use of technology into educational settings. Their Technological Pedagogical Content Knowledge (TPCK) framework "attempts to capture some of the essential qualities of teacher knowledge required for technology integration in teaching, while addressing the complex, multifaceted, and situated nature of this knowledge" (p. 1017). They argue that good use of technology requires the development of a complex situated form of knowledge that takes into account the roles and interplay between "learning environments: content, pedagogy, and technology" (p. 1017). Technology-related classroom management knowledge and skills, Hew and Brush (2007) conclude also require specific attention. Simply learning

how to use the technology and having knowledge of their subject is not sufficient, as teachers also need the skills to use the technology in a way that most effectively exploits the technology in their particular subject and this often means learning about new pedagogies. Hew and Brush (2007) conclude that “many teachers have not been exposed to transformative technology-supported-pedagogy because professional development activities have focused primarily on how to merely operate the technology” (p. 228).

The study into ESF teacher’s use of ICT also highlighted differences across subjects and faculty. Goodson and Maugan’s (1995) research into subject cultures found that subjects taught generate their own set of practices and expectations and these shape that subject as a distinct area of study. If technology is not seen as an essential part of that subject teaching it is less likely to be used.

Organization and school culture, leadership and policy issues

School policies, culture, history, leadership and incentives to adopt technology and integrate it into the curriculum are major issues institutions need to address (Plomp *et al.*, 2003) and this was reflected in the data collected in ESF schools. Fox and Henri (2005) identified head teachers’ lack of knowledge and understanding in using ICT as a major barrier to effective integration, while Yuen, Law, and Wong (2003) emphasized the importance of leadership support for sustainable ICT integration. In ESF schools, principals were not seen as leading the use of ICT either by example or through developing long term policies or through support of ICT teachers and other teachers who want to take ICT forward. They also need professional development support in central planning for technology integration. This is already happening through the ESF’s ICT committee and special interest group, but as yet there appears to be no clear initiatives from subject committees (in and across schools) on how ICT can be integrated into the curriculum to support teaching and student learning. ESF does have a new opportunity to introduce more central planning for ICT integration in the secondary schools through the introduction of the new IB curriculum in all upper schools in September 2007. The IB curriculum requires more collaborative, project-based work and more critical problem solving type activities linked to national and international situations than the UK A Level curriculum required. ICT affordances provide excellent opportunities for this kind of work and study to occur. There is also recognition from some teachers interviewed that students could well provide a variety of ICT support for teachers. Some teachers have already identified this student pool of expertise

and plan to establish teams of student helpers for teachers across the different subjects and year levels. However, in order for the initiative to work in the longer run, visible support from school leaders is considered essential.

Resources and access

Resource and access issues include: the lack of technology, poor regular access to it, timetabling and time limitations and limited technical support. In ESF schools access to computers is generally good, though the computers are located more in the corridors than in each classroom or are located in laboratories rather than in general classrooms. The location of computers in laboratories disadvantages certain subjects and teachers who would see themselves as low priority access users to laboratories or who only want to use the computers for a small component of class activities. This is especially true for the non-technology subjects including arts and humanities (Zhao, Pugh, Sheldon, & Byers, 2002). Time availability is also seen as a major resource barrier for teachers. With high contact hours, even teachers who are very keen to embrace the new technology, feel frustrated by the lack of time to develop their skills and/or integrate the new ICT into their lessons. The lack of technical support goes hand in hand with the lack of time because trying to solve technical problems wastes precious time needed for learning the new pedagogy, further inhibiting the development of appropriate teaching skills in using technology (Cuban *et al.* 2001). The structure of the school timetabling is important as classes that incorporate ICT often require more time to take full advantage of the learning opportunities provided (Lai, Trewen & Pratt, 2002). Double or triple periods may need to be considered.

Pressures to focus solely on excellence in traditional examinations

Pressures on high stakes testing leaves teachers little time to experiment and explore new instructional methods in using ICT. Hennessy *et al.* (2005) saw a perceived tension between using technology and the need to conform to external requirements of traditional exams. ESF teachers interviewed stated they felt restricted in developing their pedagogy, with or without ICT, by the high emphasis on exam results from Year 10 onwards, in preparation for external examinations. There are more opportunities to experiment and learn new instructional methods in their teaching of Years 7 to 9 but this experimentation is abandoned by Year 10 in favour of more traditional methods in order to ensure the highest exam results.

Summary

This chapter focused on a collective of five international secondary school community perceptions regarding technology-led teaching and learning during the enforced schools closedown in Hong Kong in 2003, reviewed the longer term impact on the use of ICT in one of the schools, the principal lessons learnt from this experience and how these relate to theory and research in practice. The findings of the study indicate that these schools are still struggling with integrating technology into teaching and learning. However, the enforced total ICT emersion experiment in 2003 has stimulated ESF schools more consciously to integrate technology into the curriculum.

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KNOWLEDGE MANAGEMENT IN DISTANCE EDUCATION: A CASE STUDY OF CURRICULUM TEACHING AND LEARNING

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Abstract

This chapter presents a case study of knowledge management (KM) in curriculum teaching and learning in distance education in Guangdong Radio & TV University. With action research and systematic analysis methods, we set up a few objects and value propositions of the initiative, which was set up to improve teaching and learning, to enhance the quality of the curriculum, and to extend learning support. The framework consists of technology tools, an online community, instructional design, information resources, and KM, etc. We apply data mining tools to discover behavioural characteristics. Tacit knowledge shared by the virtual community was emphasized. A few strategies for KM in the curriculum development in distance education will be discussed.

Introduction

Information and knowledge are becoming more and more important in today than ever before, they are applied abroad to every aspect in the society. Most organizations regard knowledge as a strategic resource that gives them sustainable competitive advantage (Drucker, 1993). With the realization that knowledge is manageable, people are now attempting to manage knowledge in a more systematic and effective way (Ubon & Kimble, 2002). Knowledge Management (KM) is a systematic management method. Many organizations often use it to encourage the creation and sharing of knowledge that results in improvement in productivity, innovation and competitiveness.

KM has many successful cases, theories, implement strategies and tools in the business context. In general, KM relates to people, technology, process and culture (Lisa & Nodine, 2003), especially the culture factor in an organization can play an important role in implementing KM (Mahesh & Suresh, 2004). Since the culture is different between in enterprises and in education institutes, some good solutions in business cannot ensure success in education. KM in Chinese

universities is only in the trial stage. The application of KM ought to be context-based to fit the local culture (Geng *et al.*, 2004).

Recently people want to apply the concepts, tools, techniques and strategies of KM to solve problems in distance education (DE) (Igonor, 2002; Ubon & Kimble, 2002; Paranjpe, 2003; McMurray, 2004; Butcher, 2004). But there are many problems that need to be discussed further. Problems such as knowledge sharing and creation, instructional design, technology application and online community of practice in distance education context.

Here we try to apply some tools and techniques from KM to a curriculum teaching and learning in order to improve instructional performance and learning support service quality in distance education.

Knowledge Management and Distance Education

Knowledge management concepts

The definitions of KM have been quite diverse, but they all share an emphasis on its distinct nature from information management. In KM, “data”, “information” and “knowledge” are different terms, which differentiate in means and values. As the website of the Commonwealth of Learning describes, data is a collection of facts and quantitative measures, which exists outside of any context from which conclusions can be drawn. By itself data has relatively little value, information is data that people interpret and place in meaningful context, highlighting patterns, causes or relationships in data. Knowledge is the understanding people develop as react to and use information, either individually or as an organization. Data, information and knowledge are separate but linked concepts, which can form a data-information-knowledge continuum. Data becomes information when people place it in context through interpretation that might seek to highlight. For example, reports and strategic planning documents are information. Knowledge can be described as a belief that is justified through discussion, experience, and perhaps action. It can be shared with others by exchanging information in appropriate contexts (Lisa & Nodine, 2003).

Many KM experts agree that there are two general types of knowledge (Nonaka & Takeuchi, 1995; Polayni, 1996; Inkpen, 1996; Dixon, 2000; Krough *et al.*, 2000):

Tacit knowledge – is linked to personal perspective, intuition, emotion, belief, experience and value. It is intangible, not easy to articulate, and difficult to share with others;

Explicit knowledge – has a tangible dimension that can be more easily captured, codified and communicated.

Based on the Nonaka's SECI model, these two versions of knowledge can interact when the "*knowledge conversion*" occurs:

Socialization – from tacit to tacit;

Externalization – from tacit to explicit;

Combination – from explicit to explicit;

Internalization – from explicit to tacit

Nonaka & Takeuchi (1995) believe that knowledge creation process as a spiral and interaction of the tacit and explicit knowledge.

There are many definitions of KM, all of them hinting at the same idea, but highlighting different aspects. In brief, KM is the management of processes that govern the creation, dissemination, sharing, and utilization of knowledge by merging technologies, organizational structures, and people to create the most effective learning, problem solving, and decision-making in an organization.

Rowley (2000) describes the term KM as follows:

KM is concerned with the exploitation and development of the knowledge assets of an organization with a view to furthering the organization's objective. The knowledge to be managed included explicit, documented, tacit, and subjective knowledge. Management entails all of those processes associated with the identification, sharing, and creation of knowledge.

Knowledge management role for distance education

For ten years education has been subject to the pressures of the marketplace and educational institutes need to perform similar to other non-educational organizations (Brown & Duguid, 1996). Today universities have to meet many challenges such as economy globalization, mass higher education, teaching quality, creation, service, ICT application, and corporation, etc. Under complex contexts, universities must learn to effectively manage themselves, to improve service effectiveness and productivity (Balderston, 1995), to innovate the modes of research and service management (McCutcheon, 2006), to make use of all intellectual capitals and integrate all resources to build an innovation circumstance (Leslie, 2006). Now, KM has a direct or indirect impact on education. It becomes one of the successful tools to solve these problems. A good case has appeared in universities (Vervenne, 2006).

Besides the challenges above, DE needs to get the balance in access, quality and costs (Daniel, 2003). It also needs to give enough support for adult learners;

the kind of support different from traditional universities. To control the costs and to provide effective learning support, DE institutes often ally with private companies, traditional universities, and other agencies to form collaborative union (Kham *et al.*, 2003). Technology, management, human resource, collaboration, organization culture, and the social context have profound impacts on DE development, these also affect KM implementation in a distance education institute.

In fact, KM and DE share some common elements such as community, communication, cooperation, information process, knowledge sharing, and knowledge creation, etc (McMurray *et al.*, 2004). DE institutes can use the potential energy of KM to enhance the learning of students and improve the management efficiency (Ubon & Kimble, 2002).

KM application and benefits for curriculum teaching and learning in DE

In practice, there are many applications and benefits of KM for curriculum development, teaching and learning, and learner support service (Kidwell, 2000). Here we pay more attention to following problems:

Repository of curriculum revision efforts that includes effective measures, best practices, courses teaching and learning, enhancing the quality, leveraging practice and monitoring outcomes;

Repository of content modularization and arrangement to facilitate interdisciplinary instructional design and development to improve speed of curriculum revision and updating in time;

Repository of information related to teaching, learning and service with technology to monitor these behaviors and processes, and to improve support service.

Research Methods

Data Mining (DM) technique

Data Mining, the extraction of hidden predictive information from large database, is a powerful new technology with great potential to help an institute focus on the most important information in their data. DM tools can discover behavior rule and predict future trends, allow making proactive and knowledge-driven decisions. DM techniques can be implemented rapidly on existing software and hardware. The main processes include data definition, data gathering, pre-processing, data processing and discovering knowledge or patterns.

Here we use DM tools to solve the task of prediction, classification, explicit modeling and clustering for our application. The application can help us understand learners' learning behaviors, discover the service quality of the website, the media resource and the support service that we are providing.

Web text mining

Web text mining is discovery knowledge from web-based non-structural text, includes text representation, feature extraction, text categorization, text clustering, text summarization, semantic analysis, and information extraction, etc. We use this technology for text analysis of the forum and BBS of our online community of practice.

Learning theory

Learning theories are classified into four paradigms: *behavioral theory*, *cognitive theory*, *constructive theory* and *social learning theory*. For our community of practice, we emphasize learning was a continuous process that was indistinguishable from ongoing work practice. Learning was contingent and contextual (Wright, 2005), "*learning through work*" and "*real time learning*" are considered as the link between learning and work. By discovering the problems, recognizing their types and act, and solving problems in routine work and learning, learners can continuously refine their cognitive, information, social and learning competencies.

Knowledge management

People have given many strategies and key principles for KM implementation. In our practice, we need to establish the basic framework for KM implementation that includes goal, strategy, process and technology. Some principles are applied to our work, such as the successful steps and programs (Walker, 2006), strategies for DE (Butcher, 2003; Ubon & Kimble, 2002; Paranjpe, 2003).

An online & virtual community of practice in our research is another important method, because online interactive behavior is most important in distance learning. The basic framework for community in online setting (McMurray, 2004) is a good source of reference.

In last, we emphasize knowledge sharing and application of the SECI model (Nonaka & Takeuchi, 1995) in our community of practice.

KM System Architecture for the Case Practice

The online course introduction

In this case study, we research online teaching and learning of the course “*tax and account*” in our university for distant and open learners. The course content introduces the account principle in tax and tax regulation in account, it integrates tax law, tax regulation, account auditing and cast accounts. During the national economics development and becoming as a member of WTO, the system of Chinese enterprise account and tax are reforming, changing, and becoming international. It means that the knowledge had changed in the last ten years. We have to meet this challenge in our instruction.

We have set up the course for five years, there are about two hundred learners to study the course each year by distant learning through the Internet. These are adults in different professions. They are from more than 20 learning centers located in different cities and counties all over in the Guangdong province.

The KM goal

We integrate KM theory and technology with our course instruction. The basic goal is the following:

- Upgrade the performance of teaching and learning;
- Leverage our instructional ability and the learner’s problem solving ability;
- Share knowledge in the community;
- Improve support service;
- Enrich the repository with the digital media resource;
- Form collaborative learning mode gradually.

The online community of practice

The online community of practice consists of two professors, one instructional designer and three technicians in the university, more than 15 tutors in different learning centers and all learners. In every term the number of tutors and learners dynamically changes. We also invite a few experts in local enterprises and government institutes to attend our community activities.

The work group is based on the project and keeps stable for several years. This instructional form changes the mode that teaching behavior is individual by one teacher in the technology platform before.

Through the community of practice for teaching and learning, we can initiatively adjust our teaching strategies, improve our media resource, amend

instructional design, get learning information and give necessary support service in time.

The instructional mode and technology platform

Since our social culture is different from the West, we adapt the blended learning mode. In one term there are six or eight face to face tutorials conducted by local tutors in each of the local learning center. Each tutorial lasts for two hour lectures. Activities include but not limited to case analysis and general discussions. This provides a chance for learners' social interaction face to face. However, there are other interactions such as online discussion forums to help form virtual communities.

The online learning is a kind of self-directive learning based on the media resource, such as flow media, web text, online test, case knowledge repository, digital library and relative websites. The course also gives some collaboration tasks.

The university portal and a learning management system (LMS) support our online activities, the system function of the LMS is similar to Blackboard or WebCT. One videoconference system and a few web virtual experimentation tools are also integrated in the course.

The Implementation Strategy and Experience

Understanding our learners' characters

The characters of our distant learners have many different group characters. These factors not only are from adult physiology, but also are from social and cultural environments. Especially the latter often affects their learning behaviors and succeeding (Qi & Le, 2006). Knowing these characters are our fundament for our instructional design, support service and work improvement in the process.

For their specialties, some are the same as their jobs, some are correlative to the jobs, but some have no correlation. For their study experience, the current specialties are different from their study before. In fact, these are some kinds of learner groups for their knowledge background.

For the use of computers and Internet, some factors affect their online learning, such as short of a computer in house, not enough time, meta-cognitive ability, have not enough information literacy, etc. There are few learners who dislike online learning. There are others who prefer online learning, but their job related travels affect their ability to participate in online interactions.

By the analysis, measurement and data cluster for Internet flow in the Portal and the website of LMS, and data clusters, we also discover video resource is the best liking. Average online time in one day for each learner is about two hours, average online time in a week for one course about two hours. Most of the learners like to learn from teacher's face to face in the local center on weekends.

Above different characters are barriers for online interactive and sharing knowledge in the community. These characters are from the local social culture.

In the whole, learner characteristics consist of three parts. The first is the basic character information that is from sociology, anthropology, psychology, geography, information literacy, cultural resource, ICT tool, and communication mechanism. The second is behavior information that is from online time, using media resource, participating group activity, presenting question, answering question, and reading reference material. The last is result information that is from formative test, teaching and learning evaluation, analysis results of the investigation questionnaire. We can discover some learner's collective classification characters from the information.

Long time practice

We have made the online course for four years. During the time, the media resource, websites, database, monitor systems, technique tools and instructional design are becoming more and better. Our learners have given some good ideas for the curriculum development. They also make our design and modification to be more adaptable.

Our learners and their social circumstances are changing; new technology tools are emerging, such as Web 2.0 tool, MP4 Player, free software and open courses in the world, etc.

The knowledge system of the course is also changing fast because of all the new developments. The social network of our learners in the community of practice is expanding.

Because of these factors and to try to keep pace with all the changes, we worked long and hard to improve our KM system for many years. The cycle of learning, practicing and researching are our routine work procedures.

Monitoring behavior and analyzing information

Much information of the KM system can be reflected and extracted from the monitor systems, such as the quality of the resource and the support service, learning obstacle and learners' liking, etc. Because of our Internet services are

distributed on several management information systems, we need to set up a few monitor systems to get relative data.

We set up an Internet flow measurement system for the university campus network by NPD (network probe daemon) technology and a software tool, Sniffer Pro 4.5. The network flow analysis is based on packet level, flow level, and application level. For example, IP network flow of V5 can be analyzed based on IP address, protocol and port, where we can get different information of complex network behaviors.

The following is the network flow in packet level distribution table of the main servers for the one-month data. From the table we can know about the utilization of the media resource.

Table 1. Network flow scale distribution of the main servers for one-month sample.

Server	Out Packets	In Packets	Out Bytes	In Bytes
Univ. Portal	11.88%	15.02%	9.52%	25.19%
E-Learning (LMS)	11.64%	15.01%	8.25%	20.86%
The Subject Website	16.01%	15.30%	16.67%	13.57%
Web Cast for the Courses	20.19%	18.30%	22.73%	12.66%
Video on Demand	28.68%	25.19%	30.67%	17.29%

In the application level, we need to analyze the online learner number, online time, click number, utilization and updating of the media resource, question number in the forum, read number and response number for the forum question, knowledge distribution of the questions, etc.

Based on the web text analysis, we can discover the learner's problems. The following Table 2 is the question type statistical table of the forum from 10:47, March 3, 2006 to 14:30, March 28, 2006.

From above Table 2, we know that the problems are dispersing, so we have to provide individual support for learners.

Table 2. The knowledge classification of the question in the forum for 3-weeks sample.

Number	Question Classification				
	Technology & Resource	Learning Method	Preparation Knowledge	Course Content	Profession Development
Question total	4	2	2	9	4
Click average for each question	22.5	17	30	22	13.75
Click average for each answer	21.25	10.5	25.5	14.44	15.5

Dynamic, in time and initiative response to the learners

The online learning time of masses of the learners is regulative in each evening from 18 to 22:30, in a weekend from 9 to 12, from 14 to 17, from 18 to 22:30. During this time we arrange one teacher or one tutor online, almost all of the questions and problems can be solved in the same day.

From the course BBS or forum, we can find the tacit problems in learning. After that we often give personal advice and help in person. When the contents change, we need to adjust our resources for learners. We also design some new group tasks and throw in guided questionns to lead further learning or interactive discussion for some topics.

Here is an actual case. One learner, his name is Alex200406, asks one question about the new change of The Chinese Value-Added Tax Regulation on 21:51:49, November 28, 2005. The question sparks enthusiastic discussions for the following two days in the community. 53 learners read the question, 33 learners answer the question. Follow on, he gives another related question, then 79 learners read the question, 50 learners answer. Finally, he gives the second related question and gets some satisfactory discussions. This time 35 learners read the question, 25 learners answer. This group interactive behavior means that there are knowledge differences for some learners. To respond to the learners' needs, we make two new learning cases in multimedia and give two online lectures in web cast to the related topics. Within the first week, there are 182 people make use of these learning resources. Students welcome this just-in-time support service strategy.

On the other hand, the problems are not only from the knowledge system of the course, but also from their work, social interaction, technological tool usage, support service, learning subject and professional development, etc. As equal dialogists we try our best to give our advice by teacher group in the community.

In this process teachers and technicians play very important role. They need to get many tasks done in a short period of time because every single day, there are many online discussions on the instructional work among our teachers, tutors, resource designers, technicians, and other servers.

It is critical for the vigor and trust of the community to interact with other learners. It is important that learners take the initiatives.

Encouragement participation

We encourage all kinds of groups or individual to participate all online actions. The network learning behaviors decide their formative assess. We pay our

passions to all learners by our services, behaviors and quality. We also care some learners who can't learn online by email, telephone and CD-ROM.

The self-management mode is very important for the online community. Some volunteers become group leaders or coordinators for the collaborative learning. The group members can be formed dynamically from the same learning center, liking, social network, work experience, knowledge background and profession, etc Teachers or tutors can sometimes help them to form groups. Teachers need to give advice for different groups by analyzing their web interactive texts and group behaviors.

The successful cases for online learning for the course of the former learners encourage our current learners. Their experiences and participating in the special online activity are helpful for the latter.

Tacit knowledge sharing and learning from the work

For some learners, whose jobs are related to taxation or accountancy, and thus their problems solving experiences are often stay in these two areas. As both taxation and the way we do accounting are both under reform, experts are invited to give talks. This involves tacit knowledge and one of the ways to transform it into tangible knowledge is to record the talks as multimedia resources to be part of our repository. Learners can access these recourses later on through the Internet.

Learning behavior can happen in the work and the social context. It is true for the course that learning from the work and the social network. Our teachers and technicians help to transform tacit knowledge to explicit knowledge by recording, collecting, dealing and presenting their individual information, problems and experiences.

Conclusions and Future Work

This chapter has tried to apply the strategies of KM to enhance instructional performance in online distance education. We saw improvement in efficiency. Members of the online learning community showed great promise. We can conclude that the strategies tested to be very useful tools in distance education.

But there are some potential problems that have yet to be resolved. These include organizational culture affecting individual teachers, a shortage of integrated technology tools. We also need to explore how media resources can be better utilized. We also need a more objective device to evaluate the effectiveness of our KM application, etc.

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REVIEWING ICT RESEARCH PUBLICATIONS IN HONG KONG POST-SECONDARY EDUCATION

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Abstract

This chapter reviews published research on information and communication technologies (ICT) in post-secondary education since 1998 and identifies the extent to which this research addresses government policy, indicating areas in which further research would be beneficial to meet the challenges contained in government reports. The chapter is written to inform government agencies and researchers of the gaps in the research to date. The published papers were wide-ranging, informative and enriching in scope and evidenced the important role of ICT in post-secondary education. The majority of publications were based on empirical inquiry of successful small-scale case studies to guide present and future practice, though less research was evidenced to support other government directives, for example, the role of ICT in cross-institutional collaboration and the role of ICT to support sharing of teaching and resources. There was limited research on theoretical inquiry, providing original perspectives, ideas and ideals to shape future thinking and few cross-sector and inter-institutional studies identifying the role of ICT to improve teaching and learning. It was concluded that future research would benefit from a greater balance between empirical research and theoretical enquiry and to identify more strategically significant cross-institutional research to support the government's vision of making Hong Kong a regional education hub.

Introduction

In recent years, many initiatives have been taken to promote the use of information and communication technologies (ICT) in the post-secondary sector in Hong Kong (higher education, adult continuing education and vocational education and training). For instance, *Higher Education in Hong Kong* (University Grants Committee, 2002) recognised the potential of electronically-based teaching and learning to 'transform bricks and mortar institutions' by providing new environments to 'facilitate the tuition, support and management of learners on- and off-campus' and 'the development of collaborative, inter-institutional teaching' (p. 25). The University Grants Committee (UGC), the

government advisory body on funding and strategic development of higher education encourages collaboration and use of ICT through Teaching Development Grants and the Restructuring and Collaboration Fund to support cost effective collaborations and encourage the sharing of teaching and resources between institutions (<http://www.ugc.edu.hk>).

There has been a great deal of research and evaluation about the adoption, implementation and impact of ICT on teaching and learning in Hong Kong's post-secondary institutions. There are seven fully funded government and two self-financing universities, one government funded college, three self-financing colleges and one funded vocational training institution. Research and publications from all these institutions should be included in this chapter. However, the research is not always accessible or comprehensive. Conference papers presented overseas, for example, are not always readily available. Other research and publications either deal with a wide range of issues or do not always identify possible directions for future research about the efficacy of ICT in teaching and learning in post-secondary contexts.

The review of 1998 to 2007 published research on ICT in post-secondary education in Hong Kong reported in this chapter addresses these concerns about accessibility, comprehensiveness and direction. After a period of substantial policy development and the implementation of many ICT innovations and projects, it is appropriate to identify and document the research completed to date. UGC (2002) recommended conducting a review in 2007 to assess progress on the expansion of the post-secondary sector, the interface with the school sector, articulation between the community, colleges and universities and the implementation of the 2002 report recommendations. This chapter identifies research that addresses government directives and indicates gaps and possible directions for future ICT research in education with reference to government policy. The chapter aims to inform government agencies and researchers of the outcomes of this research.

Method

The development of a comprehensive and authoritative bibliography relating to ICT in Hong Kong was a necessary prerequisite to a review of the research completed to date. Only research undertaken and completed in Hong Kong or addressing a Hong Kong context and based either entirely or to a significant extent (e.g., for cross-cultural comparisons) on local participants was included. Research undertaken by local researchers but based on non-local subjects, situations or circumstances was excluded, whereas studies undertaken by

researchers based in other countries were included if they focused on Hong Kong students, teachers, policies, or educational contexts.

The bibliography included research from a pedagogical, practical, cultural, economic, interpersonal, philosophical, sociological, technical, or government policy perspective, in any post-secondary education context, both on-campus and distance education. Due to the large number of publications identified, only research published in the period from January 1998 to January 2007 was included in the bibliography.

The following types of published materials were included - journal articles (print or electronic); book chapters; conference proceedings (print or electronic; CD-ROM or Web-based formats); government documents and related research reports; theses (undergraduate; masters; doctorate) and newsletters and online resources reporting on research (commercial; professional society; academic; non-government organisation).

The bibliography was compiled using the citation management software EndNote®. Publications were located using bibliographic databases, online aggregators (journals and conference proceedings), Hong Kong government websites, online *curriculum vitae* of Hong Kong researchers, online education project sites, Google Scholar and online public access catalogues (theses, dissertations and undergraduate projects) as well as physical searches within Hong Kong universities' libraries. Bi-lingual publications in Chinese and English from Hong Kong, China, Taiwan and elsewhere were also included in the search. Advice from Chinese academics was provided to ensure the inclusion of relevant references from Chinese language publications. The project also employed a Chinese speaking research assistant to collate and translate Chinese only texts into English. For each publication, the following information (where available) was recorded: full citation; abstract; annotation; index terms ('keywords'), Uniform Resource Locators (URL); author affiliation; and reference type identifiers (journal article, book chapter, etc.) and links to the full text.

Results

The bibliographic database which was compiled totalled 461 publications. These publications were grouped into categories, 12 derived from the *British Journal of Educational Technology* Author Guidelines for refereed articles and colloquia (Latchem, 2006) and two additional categories: professional development and teacher education and collaboration, knowledge building and collaborative work online, which reflected a significant focus of recent research in Hong Kong.

The categories and number of publications are shown in Table 1 and the types of publications are identified in Table 2.

Table 1. Categorisation of post-secondary publications.

Category	No. Publications
1. Design and production of learning materials	62
2. Evaluation and monitoring	54
3. Delivery systems for open and distance learning	46
4. Curriculum development and course design	45
5. Professional development and teacher education	45
6. Support for self study and for learners at a distance	43
7. Problems and potential of new technologies in education and training	37
8. Collaboration, knowledge building and collaborative work online	35
9. Priorities in resources, planning, organisation and policy	32
10. Educational research and dissemination	19
11. Assessment, notably assessment on demand and learning from experience	17
12. Psychology of communication	12
13. Storage, retrieval and dissemination of resources and information	10
14. Effectiveness and cost-effectiveness of print, electronic and optical media	4
Total	461

Table 2. Type of publication.

Category	Journal articles	Book chapters	Conference papers	Reports	Newsletter/resources	Masters/PhD dissertations	Total
1	10	9	37	3	0	3	62
2	16	5	23	4	2	4	54
3	24	4	15	0	0	3	46
4	17	4	17	1	0	6	45
5	12	10	19	2	0	2	45
6	15	5	21	0	0	2	43
7	9	3	16	0	0	9	37
8	10	6	17	0	1	1	35
9	6	6	14	3	1	2	32
10	6	4	7	0	0	2	19
11	11	3	3	0	0	0	17
12	6	1	4	1	0	0	12
13	4	0	2	0	0	4	10
14	1	0	2	0	0	1	4
Total	147	60	197	14	4	39	461

Placing publications within specific classifications (Table 1) was not always easy as many items crossed categories. For example, an item placed in the category Design and Production (Category 1) often included extensive evaluation. Classification was therefore based on judgement of the extent to which the item fitted the primary category. The final quantitative categorisation of publications must therefore be treated with some caution. However, broad trends were identifiable and offer a general impression of where papers have been published within the individual categories. Table 2 provides a breakdown of the type of publication within categories and offers insights into the spread of publications across all categories. Few newsletters and resources online that addressed research in ICT in education were identified. This type of publication was therefore not considered very significant to this study, though the numbers found in the various categories are included in Table 2. The research publications in the 14 categories are described in the following section.

Category Findings

1. *The design and production of learning materials (n = 62)*

The largest number of published items were in this category. The majority of items were web-focused case studies identifying increased flexibility in study for learners through the use of ICT, reflecting government initiatives to rapidly increase the availability of online learning materials (Education Commission, 2000). The majority of these publications (37) were conference papers, with only 19 journal papers and chapters in refereed publications. The conference papers in this category represent 21% of all conference publications identified in this study. This is not surprising given the nature of the research which dealt primarily with individual focused projects and uses of technology to support teaching and/or learning in particular classes, laboratories, modules or courses. The category also included items where the learning materials were designed and used for more than one course or module and some were shared across disciplines, notably in English language teaching and learning and especially to provide support, where the principal language of instruction used is different from most students' mother tongue (Chinese).

2. *Evaluation and monitoring (n = 54)*

In the second largest publication category, most papers concerned specific implementations, providing insights on issues and problems encountered in particular situations. A high number of publications (16) focused on research

about the use of technology for English language teaching. There was also a high number (16) of theoretical inquiry publications on original perspectives and concepts to shape future thinking, software implementation projects (12), evaluating professional development programmes (7) and comparing learning management systems (3). This category appears more balanced in publication type with 21 journal papers and chapters compared to 23 conference papers.

3. *Delivery systems for open and distance learning (n = 46)*

Much of the research described or evaluated specific applications of delivery systems, either individually designed 'web-based learning systems' or commonly used learning management systems (LMS) such as WebCT, Blackboard and Moodle. These case studies typically outlined the features of the software, the advantages as reported by participants, the difficulties experienced and how they might be handled.

Other research focused on specific features of LMS such as: (a) synchronous chat, for 'real-time' teaching (online replication of face-to-face instruction) and discussions among students enrolled in various countries; and (b) purpose-built features for learning activities (such as virtual laboratories in biology and engineering, and trading platforms in commerce), student support (vocabulary, lexicon, concordance and multimedia assistance for language learning), administration (assignment submission and management) and library services.

Other publications reported on (a) the initiatives taken by institutions in the delivery of distance/online programmes in Hong Kong; (b) comparisons of Hong Kong institutions with those in other countries; (c) assessments of the potential of web-delivery of programmes in Mainland China; and (d) the importance of instructional designers and support services in developing and maintaining distance education programmes.

In the main, the research methodologies were case studies and descriptive accounts based largely on interview and survey data. One study (Kumta, Hung & Cheng 2001) used a pre- and post-test design to investigate the impact of multimedia web-based 'critical thinking' tutorials with randomly selected groups of final year medical students. Overall, the number of journal publications to other types was high (63%), indicating this is a more mature research category in Hong Kong with a longer history of research into open, distance and flexible learning.

4. Curriculum development and course design (n = 45)

All items took the form of case studies of specific implementations, providing insights about the issues, problems and practices in specific situations. Invariably, these implementations were regarded as ‘successful’ (although ‘modifications for future implementations’ were often recommended). Publications indicated a progression in thinking about curriculum development and course design over time, which in the future will become extremely important leading up to the introduction of the four year undergraduate degree programs in all higher education institutions in Hong Kong. However, no publications in the period reviewed discussed issues directly relating to the four year curriculum to be introduced in 2012. Papers published in this category were evenly spread across refereed journals (17) and chapters (4) and conference presentations (17) and included six masters dissertations.

5. Professional development and teacher education (n = 45)

There were 34 in-service professional development and nine initial teacher education publications, with a further two papers that covered both areas. The majority of papers were concerned with teacher practices and issues arising with the introduction of technology into teaching and learning contexts. The predominant focus was on ways of successfully integrating ICT into existing teaching and learning practices and curricula. Four publications were more theoretically based using frameworks to make sense of practices identified. Seven papers concerned English language teaching, the gender gap and the use of ICT over a two year period and on the improvement of student skills, confidence and uptake of technology in a university over a four year period. Types of publications were evenly spread with 22 journal papers and chapters and 19 conference papers and presentations.

6. Support for self study and for learners at a distance (n = 43)

A high percentage (44%) of publications described tutorial support initiatives for second language learners of English, rising to 52% if ‘online support’ by major distance education providers (such as the Open University of Hong Kong (OUHK) and the University of Hong Kong School of Professional and Continuing Education (HKU SPACE)) is assumed to include language support resources (e.g., academic vocabulary, oral presentation and writing). On the other hand, it was surprising that only one publication (Chao, 1998) dealt with cultural issues and learning, exploring the suitability of adult learning

approaches for local adult learners and the perceived lack of independent learning skills among Hong Kong students.

Other topics reported (each in one or two publications only) included evaluations of face-to-face tutorials in a distance education programme, the provision for 'self-learning' during SARS, and surveys of student perceptions of online support in distance education programmes. Peer instruction, and the use of problem-solving using remote collaboration to support learners (in software engineering, informatics and management) were also reported.

Many of the student support services described used familiar Web-based methods (text, email, chat). However, reports of the use of an intelligent tutoring system for distance learning (Cheung, Hui, Zhang, & Yiu, 2003) and student use of weblogs — said to be a 'significant predictor of learning outcomes' (Du & Wagner (2007) — described other approaches to support learners in face-to-face and distance education programmes. Roughly 50% of publication in this category were journal papers and chapters in texts.

7. Problems and potential of new technologies in education and training ***(n = 37)***

Most publications were descriptive accounts highlighting the practices and challenges of using technology to support teaching and learning in post-secondary education and training (19). Topics included second language learning, autonomous learning, collaborative learning and teacher education. Student and teacher attitudes towards using technology, as well as student experiences and perceived advantages and disadvantages in using ICT to support teaching and learning were also discussed and analysed (18). Four theoretical inquiry papers in this category developed conceptual models to make sense of ICT use and the challenges that can arise for future thinking about technology integration. A significantly higher proportion of publications in this category were presented at conferences (16). This category also included the most dissertations (9).

8. Collaboration, knowledge building and collaborative work online ***(n = 35)***

Research reported on various forms of 'collaboration' including 'knowledge building', 'peer learning', 'active learning', 'group discussion', 'interaction among learners', 'e-collaboration' and, more recently, 'blogging'. In the main, the research focused on online, tutor-moderated, asynchronous, text-based, discussion forums in undergraduate programmes using familiar software

products (such as WebCT and Knowledge Forum) within a single institution. These analyses took the form of case studies of particular modules/programmes, and focused on the perceptions of participants using questionnaires, interviews, and action research as well as the actual messages (content analysis) and the way messages were exchanged among participants (interaction patterns).

In the main, the research focused on identifying 'successful' aspects of working online in specific cases, and suggesting ways in which 'unsuccessful' outcomes could be improved. Many of the case studies identified pedagogical strategies which facilitated dialogue and enhanced 'collaboration' among participants. A couple of studies referred to synchronous discussions, collaboration in graduate study programmes, or to online interaction where student participation was a voluntary rather than a mandatory (sometimes assessed) component of the programme. A few case studies included examples of 'collaboration' involving students in other countries, or explicitly examined theoretical posits or particular aspects of 'collaboration' in multiple situations (modules/programmes). There were few inter-institutional collaborative projects though there were some publications where partnership between higher education institutions and schools had occurred. Fifty per cent of publication in this category were journal papers and chapters in texts.

9. Priorities in resources, planning, organisation and policy (n = 32)

Publications mainly concerned specific implementation strategies and guides for immediate and future practices (23). Other publications in this category concerned policy position papers and frameworks for policy development and implementation (8), professional development programmes and the organisation of courses (4) and government reports (2). A high proportion of papers were published as conference proceedings.

10. Educational research and dissemination (n = 19)

Articles in this category dealt with a diverse range of topics including historical background of distance education in Hong Kong and comparisons of the use of ICT in tertiary and distance education in Hong Kong, other Southeast Asian countries and other parts of the world (North America, Europe, China and Japan). One article proposed a taxonomy of Web learning environments, and another explored the use of narrative in educational research during SARS. More publications in this category were in refereed journals or as book chapters.

11. *Assessment, notably assessment on demand and of learning from experience (n = 17)*

Publications in this category report on peer/collaborative assessment in technology-enhanced learning environments, instructional support for “self-accessed” learning, a meta-cognitive approach for self-assessment of teacher education students, and student assessment in a virtual laboratory in Engineering. The assessments described were all based on existing assessment and criteria, transferred from a text to digital format. Most publications were in journals (11) and book chapters (3), with only three conference papers.

13. *The psychology of communication (n = 12)*

This research focused on the use of computer-mediated communication with non-native English speakers. It included research on the explanatory power of the ‘Community of Inquiry’ (CoI) model (Garrison, Anderson & Archer, 2000; 2003) on students' performance and satisfaction with online conferencing, and the ‘interactional dynamics’ of face-to-face and on-line peer-tutoring in writing by university students. Other research concerned the effect of learning tasks on incidental vocabulary learning, and the use of a CD-ROM dictionary in computer-assisted language learning. Two publications reported research on Chinese language learning – investigations of (a) university students' awareness of elements of effective communication in Chinese practical writing, and (b) the influence of ‘Confucian Heritage Culture’ on Chinese learners (e.g., perceived passivity about expressing opinions and uncertainty about learning without a teacher's assurance) in a web-based learning environment. Most publications were in journals (6) with one book chapter and four conference papers.

13. *The storage, retrieval and dissemination of resources and information (n = 10)*

A low number of items in this category but the very high percentage (89%) of journal articles (4) and dissertations (3 masters and 1 PhD) indicate that this is a new topic of interest in Hong Kong, which is being researched in some depth. Topics include online search behaviours and information literacy skills of staff and students, technology and knowledge management, and library user preferences for e- or printed-texts.

14. *The effectiveness and cost effectiveness of print, electronic and optical media (n = 4)*

All four accounts were case studies, comparing effectiveness, time efficiencies or comparison costs of print to digital technology resources or courses. One publication in vocational training argued that technology-based courses had reduced costs and the length of time needed to run and complete skills-based training programs.

Discussion

The majority of the English, Chinese and bilingual publications in the review were empirical studies based on specific contexts, offering analysis and recommendations towards improving existing practices. These investigations were mainly exploratory in nature, trialling the adoption and adaptation of technology to introduce efficiencies and production gains to existing practices through the use of ICT. In this sense, much of the literature reviewed represented the early stages of technology adoption focusing on awareness raising, learning new processes, understanding and applying, confidence building, and the adaptation of outcomes to other contexts (e.g. Chim & Chen, 2004). The authors of publications of this type were mostly the teacher-researchers involved in the design and use of the technology applications. Many were enthusiastic beginners or struggling aspirers to using ICT to benefit their students' learning and much of this writing was positive, examining the benefits but less the drawbacks of technology adoption. In this sense they should be praised and recognised as teacher-researchers who worked hard to find improvements to the education process and resources they offered their students. Their research focused mainly on the first level effects of technology (Lankshear & Snyder with Green, 2000): the expected benefits from implementing new technologies and the efficiency gains to existing practices. This appears consistent with the major government policy drives to introduce ICT into educational settings in Hong Kong during this period (e.g. Education Commission or EC, 2000; UGC, 2002; Education and Manpower Bureau or EMB, 2004).

The literature however, had few examples of research that investigated the more complex second level effects that relate to changes in the environment of practices and in the practices themselves created by the use of new technologies. Second level effects include: "changes in environments ... (classrooms ...) and in practices themselves (... teaching, learning ...) which result from

participants ... using the technologies. When new technologies are introduced into sites of practice, they change the social circumstances within which they are used” (Lankshear, Snyder with Green, 2000, p. 36). Therefore, one focus for future research could be studies concerned with second level effects and the interrelationships between technology, technology affordances, the environment, the curriculum and teaching and learning. In particular, how technology adoption facilitates certain practices and ways of working but excludes others. As institutions prepare for the major changes in all undergraduate degrees from three to four years in 2012 (EMB, 2004), and the continued increase in student numbers, not supported by equivalent increases in funding (UGC, 2002), research into these new practices facilitated by the adoption of new technologies would help in planning for new curricula activities, use of staff and student time and use of on-and off-campus spaces.

A high proportion of items (16%) of the total 461 publications concerned second language acquisition in autonomous, self-accessed or distance education programmes and on the analysis of computer conferencing and guided self-study. This exploration of more student-centred learning ‘along with educational technologies and cultures that support this’ (Editorial Committee, 2005, p. 6) is in line with government documents, calling for increasing flexibility in study, assisting students to learn at their own pace through self-directed study (e.g. EC, 2001) and supports the changes in the UGC mission to establish Hong Kong as “an education hub of the region” (UGC, 2004).

In line with international publications elsewhere on educational technology, the favoured methods included “case studies, examples of best practices or implementations of new pedagogical tools” in specific contexts within a limited period of time – often one semester or less (Mishra & Koehler, 2006, p. 1018). This research relied heavily on survey and interview data with some use of content (message) analysis and a few studies utilising experimental designs. In most cases, the sample sizes were small and were based on research in one institution: 77% of papers were published by authors from a single institution; 12% of authors across institutions in Hong Kong; and 12% collaboration with overseas institutions. Although a significant number of publications directly concerned collaborative knowledge building online, this was predominantly carried out within a single institution. However, there was some evidence of partnership between higher education institutions and schools. Future research could benefit from larger scale studies conducted across institutions and across several years to guide future practices and planning for the use of ICT in

education in Hong Kong and in support of the government's recommendation for greater collaboration between institutions (UGC, 2002 & 2004).

In line with the UGC (2002) recommendation to "assess the need for staff [and students]... to develop new skills to respond effectively to technological and other changes in higher education" (p. 27), a high percentage of research investigated teacher and student attitudes towards using technology in education. Studies on student attitudes to technology (e.g. Cheung & Huang, 2005) also mirrored international research (e.g. Garland & Noyes, 2005) which includes the examination of student learning experiences and providing insights into the benefits that different study modes encompass (Jefs & Colburn, 2002; Pow, 2006). A large number of studies either hinted at or clearly identified the present limitations of both pre-service and in-service courses and programmes, and staff development and training of teachers at all levels in using technology appropriately in educational contexts. For example, papers identified the need to expand the integration of ICT into the pre-service curriculum in teacher education programmes in Hong Kong and to provide essential support to enable existing teachers in further and higher education to acquire and use technology to support student learning. The research suggests that teachers who are more trained in ICT are more likely to use technology for their personal use and more likely to integrate ICT appropriately into their classrooms and that novice users should focus on user-friendly applications to things they can use (or find useful) themselves. These studies mirror international research which highlights the need for appropriate education and training of teachers in using technology and in providing adequate support that avoids the one-off style workshop for teachers and instead offers a broad range of professional development opportunities for teachers to improve their understanding and use of ICT. Longitudinal collaborative research on a larger scale examining teacher needs across Hong Kong's tertiary institutions would provide a more persuasive document to influence policy on this matter. Though there were a considerable number of papers on vocational education and training, all were descriptive case studies of particular practices and there were very few studies on workplace training and skills development, indicating the need for more research in this area.

Conclusion

This chapter reviewed published research on the use of ICT in higher education, adult education and vocational training in Hong Kong from January 1998 to January 2007, and indicated areas in which further work would be beneficial

to assist Hong Kong tertiary institutions move towards meeting the challenges contained in government reports. The published papers were wide-ranging, informative and enriching in scope and evidenced the important role of ICT in tertiary education. The majority of publications were based on empirical inquiry findings of 'successful' case studies to guide present and future practice. While these examples of educational technology applications are important for building our understanding, they are but the first steps towards developing unified theoretical and conceptual frameworks that allow us to develop and identify themes and constructs that can be applied across the case studies. The predominance of these atheoretical perspectives ultimately can constrain the use of education technology and can limit our vision (Selfe, 1990). Whereas theoretical frameworks can provide us with conceptual lenses to view the world and help us identify relevant issues while discarding irrelevant ones to help shape future thinking. It was concluded that future study could benefit from a greater balance between empirical research and theoretical enquiry and to identify more strategically significant cross-institutional research to support the government's vision of making Hong Kong a regional education hub.

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A THEORETICAL MODEL FOR LEARNING OBJECTS REPOSITORIES AND A PILOT IMPLEMENTATION OF THE NATIONAL LEARNING OBJECTS REPOSITORY FOR CYPRUS

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Abstract

This paper presents a theoretical model and a pilot implementation of the National Learning Objects Repository for Cyprus (NLORC). The NLORC provides a web-based application allowing indexing, uploading and downloading of e-learning resources, creation and modification of Learning Objects (LOs) and querying. Two alternative database designs are considered and briefly discussed herein. The first design is a relational database design whereas the second design is an object-oriented one. The implementation described herein utilizes concepts from both designs. Although the relational database design is adopted, the choice of implementing the NLORC using Ruby on Rails framework provides the functionality of object-oriented implementation. Thus, the main contribution of this paper is the novel theoretical model and the system implementation, which enjoys the advantages emanating from the utilization of object-oriented features. The proposed database application has been designed based on existing LO Metadata Standards and a survey we carried out amongst University professors in Cyprus. The results of this survey are also presented in this paper.

Introduction

A huge number of learning resources is available either on stand-alone machines, or on local networks or on the Internet. Some are restricted to particular users and some are available without any restriction to anyone interested in using them. Learning Objects Repositories (LORs) are web-based applications allowing the sharing of learning resources over the web. These learning resources are better known as Learning Objects (LOs). A Learning Object (LO) is basically any digital asset which can be used to enable teaching and learning (IEEE, 2005). Learning Object Repositories (LORs) (ARIADNE, 2001; EdNA 2005; GEM, 2005; Law, 2003; McGreal, 2004) allow the storage

and manipulation of LOs. A comparison analysis of the various LORs models can be found in (Verbet & Duval, 2004), where various models (Barrit, Lewis & Wiesler, 1999; Brown, 2002; Dodds, 2001; Eliot, 2005; L' Allier, 1997; Wagner, 2002) are explained and analysed. LORs are underpinned by database applications that provide the data structure representation of LOs. The properties (metadata) of the data structure representing the LO entity have been standardised across different countries and regions through Learning Objects Metadata Standards (LOMS) (DCMS, 2005; EdNA, 2005; SeLeNe, 2005) which provide a data dictionary for LOs.

This paper presents a National Learning Objects Repository for Cyprus (NLORC). Currently, there is no strategy for e-learning in Cyprus. A recent attempt towards defining such strategy was made in (CeE, 2004). Our current research work involves the collection and centralisation of information regarding e-learning in our country. This will help us later to identify the main participants of the e-learning National network which will be supported by the NLORC. Herein, we present a simple theoretical model that will underpin the development of the NLORC. The model is an extension of the model proposed in (Rigaux & Spyrtos, 2003) and was presented in (Pouyioutas & Poveda, 2005a,b; Pouyioutas, Poveda & Apraksine, 2006a,b).

Two alternative database designs are considered and briefly discussed herein. The first design is a relational database design whereas the second design is an object-oriented one. The implementation described herein utilizes concepts from both designs. Although the relational database design is adopted the choice of implementing the NLORC using Ruby on Rails framework provides the functionality of object-oriented implementation.

The main contribution of this paper is the novel theoretical model and the system implementation, which enjoys the advantages emanating from the utilization of object-oriented features. The database application caters for the creation, storage and manipulation of LOs and has been designed based on existing LO Metadata Standards and a survey which was carried out amongst University professors in Cyprus (Pouyioutas & Poveda, 2005b)

The work presented herein is part of a project (Kokkinaki & Pouyioutas, 2004), which attracted a grant of 80000 Euros from the Cyprus Research Promotion Foundation and is in line within the e-learning applied research work at our University [Pouyioutas *et al* 2004-2006]. In the rest of this paper, in Section 2 we present a theoretical model for the creation of LOs. In Section 3, we present the results of a faculty questionnaire and the views of University professors in Cyprus with regards to the NLORC and address the impact on the

design of the Data Dictionary and hence the database application of the NLORC. In Section 4, we propose two alternative database designs, namely an object-oriented database design and a relational database design. We also give the running example of the paper and address the advantages of utilizing object-orientation in our application. In Section 5, we discuss the implementation of our database application using Ruby on Rails. In Section 6 we briefly illustrate the pilot implementation of the NLORC by giving some screen snapshots of the system. Finally, we conclude by discussing our current and future work.

A Theoretical Model for a Learning Objects Repository

In this section we present a theoretical model which caters for the creation of LOs. The proposed model is an extension of the simple model proposed in (Rigaux & Spyratos, 2003) and was presented in (Pouyioutas & Poveda, 2005a,b; Pouyioutas, Poveda & Apraksine, 2006a,b). In (Rigaux & Spyratos, 2003) and a LO is defined as being either an atomic LO or a composite LO (consisting of other parts). All parts of a composite object are computed by (recursively) taking the union of all parts of the LO. In our model, LOs are built from scratch or by using existing LOs or by modifying existing LOs or by a combination of all the aforementioned ways. More specifically, a LO can be created in one of the following ways (a,b,c,d):

- (a) From scratch (without using an existing LO)



Figure 1. LO1 is created from scratch.

- (b) By using existing LOs (line shows component relationship)

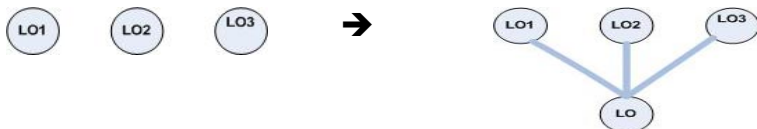


Figure 2. LO is created by using LO1, LO2 and LO3.

- (c) By modifying an existing LO (arrow shows modification relationship)

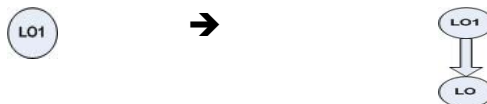


Figure 3. LO is created by modifying LO1.

(d) By a combination of (b) and (c) above

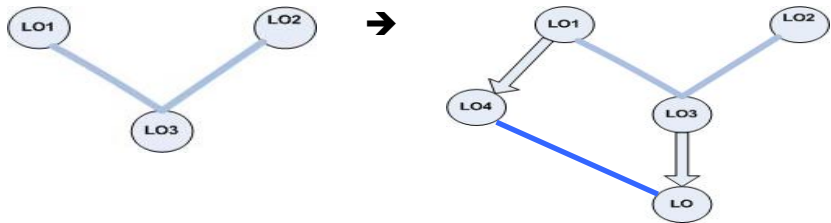


Figure 4. LO is created by modifying LO3 by modifying LO1 (LO2 has been deleted – not shown).

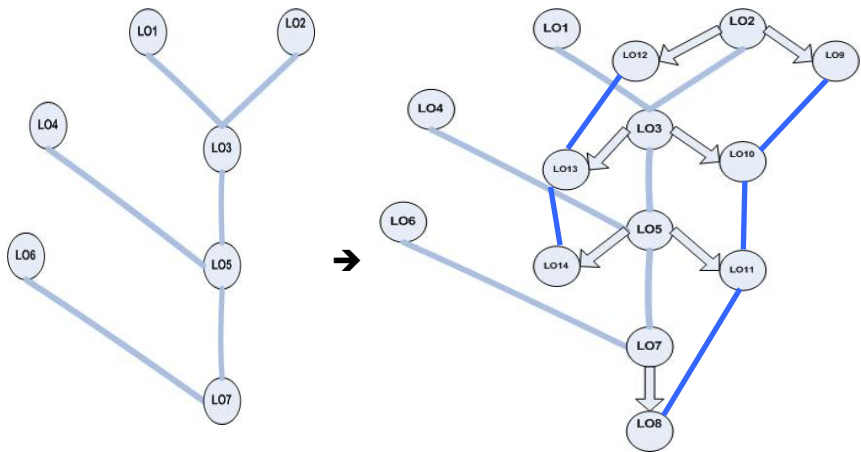


Figure 5. Creation of Learning Objects.

When a LO is modified through a modification of another LO to which it belongs to (as a direct or indirect component), all the LOs to which it (directly or indirectly) belongs, are also modified. As a result of this, a new LO is created for each LO modified. This is better explained through the given example. Given the LOs shown in the left part of Figure 5, we consider a user wanting to create a new LO as a version of LO7 with LO2 modified and LO4 deleted. We also consider a user wanting to create a version of LO5 with LO2 and LO3 modified and LO1 deleted. The result of these changes is the creation of four new LOs, namely LO8, LO9, LO10 and LO11 for the first user and three new LOs namely LO12, LO13 and LO14 for the second user, as shown in the right part of Figure 5. The modification of LO2 results in LO9. LO3 is hence modified since one of its component is modified giving a new LO, namely

LO10. LO10 uses LO9 as one of its components, hence a line is drawn from LO10 to LO9. In the same way LO11 is created as a version of LO5, using LO10 as a component (hence the line is drawn from LO11 to LO10). Finally LO8 is created as a version of LO7. The LOs and the component relationships are similarly created for the second user. Table 4 shows the way that LOs are stored in our proposed database application.

The Views of University Professors in Cyprus for the NLORC

In this section we present the results of a questionnaire that was distributed to University professors in Cyprus. The questionnaire aimed at finding out their beliefs in terms of the need of a NLOR and their attitude towards using (read/write access) others' LOs and letting others use their own LOs. The results of this part of the questionnaire are presented in Table 1.

Table 1. The views of university professors in Cyprus with regards to a NLOR.

	YES	NO	MAYBE
Q1. Do we need a LOR in Cyprus ?	77%	6%	17%
Q2. Would you use a LOR?	74%	6%	20%
Q3. Would you use (without modifying) others' LOs assuming you had the technical support/training?	40%	23%	37%
Q4. Would you use/modify others' LOs to create your own LOs if you were allowed to do so and you had technical support and training?	73%	12%	15%
Q5. Would you allow others to use (without modifying) your LOs?	76%	12%	12%
Q6. Would you allow others to use/modify your LOs to create their own ones, assuming they clearly refer/acknowledge your work?	89%	6%	6%

Table 1 clearly shows that that most of the University professors in Cyprus believe that there is a need for a NLOR. Most of them would use the NLOR and they have no problem allowing others to use/modify their own LOs and vice versa. It is interesting to compare the results of Q5 with those of Q3 and the results of Q6 with those of Q4. The (YES + MAYBE) percentage of Q5 and the (YES + MAYBE) percentage of Q6 are higher than the corresponding ones of Q3 and Q4 respectively. Firstly, we have to note that the said percentages are all high and show the positive attitude of academicians towards sharing LOs. Secondly, this comparison reveals that academicians feel more willing to let others use their own LOs rather than using the LOs of others. This maybe explained due to the fact that professors (and researchers) like sharing their own findings/educational material but they are more sceptical in using other than

their own material in teaching (especially if they cannot modify the teaching material and customize it to their needs).

Summarising the above results it is obvious that professors support our initiative and would make use of our proposed system. Furthermore, the questionnaire aimed at identifying the main characteristics of LOs needed to implement the LO data structure. It presented to academicians some core characteristics (title, description, creator, creation date, language, subject, keywords, duration, access (read/write)) asking to identify them as essential or not. Finally, the questionnaire asked academicians to add any other characteristics they thought are essential to describe a LO. The results of this part of the questionnaire are presented in Table 2 and Table 3.

Table 2. The views of university professors with regards to LO characteristics.

Characteristic	Essential
Title	100%
Description	100%
Creator	82%
Creation Date	91%
Type	97%
Language	100%
Subject	97%
Keywords	97%
Duration	67%
Audience	85%
Access (Read/Write)	91%

Table 3. Suggested characteristics for LOs.

Suggested Characteristic
Date of Last Modification
Time Needed for Downloading
Aims, Objectives and Expected Learning Outcomes

Two Alternative Database Designs for the NLORC

In this section we present two alternative database designs for the database implementation of the NLORC. The main database entities have been created based on most Learning Objects Metadata Standards (DCMS, 2005; EdNA, 2005; SeLeNe, 2005) and the results of our survey amongst University professors in Cyprus presented in the previous section. We first give an object-oriented database design and then a relational database design.

An object-oriented database design

On designing the main object-oriented database structure, we focus on the properties needed for the identification of the *relation* property, which keeps a record of which objects have used which objects as components (LOComponents, LOCKind) or as modified versions (LOModified, LOMKind) or have been deleted (LODeleted). The object-oriented database structure is given below, using abstract object-oriented notation:

Learning-Object

LOURI:	String
LOTitle:	String
LOCreator:	Creator
LOType:	String
LODescription:	String
LOCreation Date:	Date
LOLanguage:	String
LOSubject:	String
LOKeywords:	String
LODuration:	Time
LOAudience:	String
LOAccess (Read/Write):	String
LOModified:	Learning-Object
LOMKind:	String
LOComponents:	Set of [LOC: Learning-Object, LOCKind: String]
LODeleted:	Set of Learning-Object
LOALLComponents:	Method
LOALLDeleted:	Method

Table 4. The Learning Objects of Figure 5.

LOURI	LOModified	LOMKind	LOComponents	LODeleted
LO1				
LO2				
LO3			[LO1, ispartof], [LO2, ispartof]	
LO4				
LO5			[LO3, ispartof], [LO4, ispartof]	
LO6				
LO7			[LO5, ispartof], [LO6, ispartof]	
LO8	LO7	isversionof	[LO11, ispartof]	
LO9	LO2	isformatof		
LO10	LO3	isversionof	[LO9, ispartof]	
LO11	LO5	isversionof	[LO10, ispartof]	LO4
LO12	LO2	isformatof		
LO13	LO3	isversionof	[LO12, ispartof]	LO1
LO14	LO5	isversionof	[LO13, ispartof]	

Using the Learning-Object object-oriented database structure we can build the database application for the NLORC. In order to show how the LOs could be stored and hence manipulated using this structure we give, in Table 4, the LOs of Figure 5, stored as class instances of the Learning-Object structure. We only list the properties needed to exemplify our model. When LOs are created as modifications of existing LOs or using/referencing other LOs, the LOMKind and LOCKind values are generated by the system based on the kind of modification/usage.

The LOALLComponents is a method which returns **all** the components of a Learning Object (not only the LOModified LO and the other LOs which are stored in LOComponents) and is defined by:

Given a Learning Object LOX

$$\begin{aligned} \text{LOX.LOALLComponnets} = & \{ \text{LOX.LOModified} \} \text{ Union} \\ & \text{LOX.LOModified.LOALLComponents Union} \\ & \text{LOX.LOComponents.LOC Union} \\ & (\text{LOXI.LOALLComponents, where LOXI} \in \\ & \text{LOX.LOComponents.LOC}) \end{aligned}$$

The above method basically implements the *relation* property of LOs as it returns all LOs used as direct or indirect components, in the construction of a LO. The method can be made more generic by introducing a variable to specify the depth up to which we want to calculate the components of a LO. We can also extend the method to return only the components which are associated with particular type(s) of modification (LOMKind) and/or particular type(s) of components (LOCKind). This method provides solution to the well known “bill-of-materials” issue of relational database applications. The LOALLDeleted, used in the above definition, is another method which returns **all** the LOs which have been deleted during the creation of a new LO based on other LOs and is defined by:

$$\begin{aligned} \text{LOX.LOALLDeleted} = & \text{LOX.LODeleted Union} \\ & \text{LOX.LOModified.LOALLDeleted Union} \\ & (\text{LOXI.LOALLDeleted, where} \\ & \text{LOXI} \in \text{LOX.LOComponents.LOC}) \end{aligned}$$

Given the Learning Object LOX, the set difference (LOX.LOALLComponnets-LOX.LOALLDeleted) gives the set of all components used by LOX.

A relational database design

The main difference of the relational database design as compared to the object-oriented design is that data needs to be decomposed into a number of tables and may result in slow retrieval of data (because of the need of joins). The retrieval of data may even be worse in this particular application because (a) it is expected that there will be a very large number of LOs, (b) there will be many indirect components of every LO and (c) LOs contain large amounts of multimedia data.

An equivalent relational database application would need the three decomposed and normalised relational tables Relational-Learning-Object, Relational-LOComponent and Relational-Deleted as shown below (and also in Tables 5, 6 & 7). The Relational-LOComponent table stores the direct components of a LO, whereas the Relational-Deleted stores the LOs that have been directly deleted. It is a well known issue in relational databases that any indirect component of a LO (e.g. LO10 of LO8, since LO11 is a direct component of LO8 and LO10 a direct component of LO11) can only be computed if SQL is embedded in a programming language (“bill-of-materials”). Recent implementations of SQL3 cater for the transitive (recursive) closure operator that provides a solution to the need of a programming language.

Ruby on Rails Implementation of the Database Application

In this section we address the issues concerned with the choice of the implementation platforms for the NLORC and explain our choice, namely the Ruby on Rails framework. An alternative object-relational database implementation was given in (Pouyioutas & Poveda, 2005b; Pouyioutas, Poveda & Apraksine, 2006a,b).

Relational-Learning-Object		Relational-LOComponent	
LOURI:	String	CLOURI:	String
LOTitle:	String	LOComponent:	String
LOCreator:	String	LOCKind:	String
LOType:	String		
LODescription:	String	Relational-Deleted	
LOCreation Date:	Date		
LOLanguage:	String	CLOURI:	String
LOSubject:	String	LODeleted:	String
LOKeywords:	String		
LODuration:	Time		
LOAudience:	String		
LOAccess(Read/Write):	String		
LOModified:	String		
LOMKind:	String		

Table 5. The Relational-Learning-Object table.

LOURI	LOModified	LOMKind
LO1		
LO2		
LO3		
LO4		
LO5		
LO6		
LO7		
LO8	LO7	isversionof
LO9	LO2	isformatof
LO10	LO3	isversionof
LO11	LO5	isversionof
LO12	LO2	Isformatof
LO13	LO3	Isversionof
LO14	LO5	Isversionof

Table 6. The Relational-LOComponent table.

CLOURI	LOComponent	LOCKind
LO3	LO1	Ispartof
LO3	LO2	Ispartof
LO5	LO3	Ispartof
LO5	LO4	Ispartof
LO7	LO5	Ispartof
LO7	LO6	Ispartof
LO8	LO11	Ispartof
LO10	LO9	Ispartof
LO11	LO10	Ispartof
LO13	LO12	Ispartof
LO14	LO13	Ispartof

Table 7. The Relational-Deleted table.

CLOURI	LODeleted
LO11	LO4
LO13	LO1

The main reasons for choosing the Ruby on Rails framework over the Oracle 10g system are:

- the Ruby on Rails framework provides for automatic translation of relational tables to objects; additional functionality that may be required from these

objects can be easily programmed in the model class; hence there is no need for the object relational features of the Oracle 10g DBMS;

- implementing the system specifically for the Oracle 10g DBMS makes the system tight to the specific DBMS and hence render its migration to a different DBMS a difficult, complex and error prone procedure; it is preferable to use the database configuration file of the Ruby on Rails framework that makes the migration from one DBMS to another a matter of simple configuration change, provided that both DBMS have the required schema; and
- Oracle 10g is a proprietary commercial product with high costs compared to some open source alternatives available nowadays.

Based on the above arguments it was decided to implement the NLORC system on an open source DBMS, at least for the development phase. The choice was among two DBMS, MySQL and sqlite3. Sqlite3 was preferred for the following reasons:

- it is lightweight, and consumes very little computer resources; and
- the database is stored in a file so the database can be reset simply by deleting the database file and loading the database schema.

The second concern of the implementation was the way to specify the database schema. Two options are available, using SQL or using Ruby to define the database for the application. Using Ruby to implement the database schema has the following benefits:

- database-agnostic schema: since no SQL is used, the schema is independent of any DBMS specific implementations; hence a simple configuration change in the db configuration file and a call to the rake db:schema:migrate is all needed to change the DBMS used;
- Ruby in app representation of the schema; the schema is represented using Ruby, the language used to implement the whole project; this makes the system more consistent;
- data-preserving evolution of schema; when changes come, something almost certain for most projects, using migrations will enable the system to preserve data and create populate the new columns with sensible data; and
- distributed schema changes: all the changes can be distributed to all the application db servers by simply implementing the rake db:schema:migrate command on each server.

To implement the relational to object translation the Rails ActiveRecord was used, which provides various benefits such as automatic identification of the schema and generation of the attributes, validations, specification of relations between entities, easy search with no need for SQL and much more.

The Pilot Implementation of the NLORC

In this section we present the pilot implementation of the NLORC by giving the main screenshots of the system and briefly explaining its functionality by referring to these screenshots.

The pilot implementation allows registered authors to create and modify LOs. The LOs can easily be found and retrieved by both authors and the users of the NLORC. Searching can be made based on title, subject, type, keywords, description, etc. and the retrieved LOs can be downloaded and used in read and/or write access. Authors are allowed to sign up for a new account in the system. They have to login to be able to create, modify and retrieve LOs. Non-author users have to login as well so that to have access to the LOs. Finally, the system provides support for system administration. The system administrator is able to login with administrative privileges. These privileges include removing users from the system, removing LOs after the request of authors and maintaining some tables that provide the data for the types and the language of the LOs.

Figure 6 below shows a screenshot of the NLORC that illustrates the updating of a LO. This screen interface is also used for creating a LO. The author creates/modifies a LO by providing data for the various fields of the LO. The Type and the Language used in the LO can be selected from a drop-down list, since these data is maintained in related tables, as mentioned above.

Figure 7 shows the result of retrieving LOs as a result of a simple user search; a simple user search is basically a google-like search; the text provided in the Search box is matched with text in the NLORC and the LOs which include the search text are retrieved. By choosing a LO and clicking on the download link, a user can download the selected LO. If the user needs more information s/he can click on the LO and the system will display the full information of the LO (Figure 8).

Figure 9 shows an advanced search; an advanced search allows users to do a more specific search on the underlying database. Users are presented with the same screen interface as the one for creating/modifying LOs. We would like to point out at this point that it was our intention to have the same screen interfaces so that users are provided with a consistent, easy-to-learn/remember interface.

The advanced search allows users to be more specific in their search request allowing the conjunction of conditions. For example a user can search for a LO in a subject area, of a specific type, using a particular language, developed by a specific author, etc.

Edit your "caching with instance variable" Learning Object

Learning Object

Title	<input type="text" value="caching with instance variable"/>
Description	<input type="text" value="This podcast describes how to use instance variables to reduce the database usage."/>
Type	<input type="text" value="Video: avi mov mpeg wmv"/>
Language	<input type="text" value="English"/>
Subject	<input type="text" value="Web Programing"/>
Keywords	<input type="text" value="rails ruby database instance variable caching"/>
Duration	<input type="text" value="01:07"/>
Audience	<input type="text" value="Web Developers"/>

Figure 6. Editing/Creating a LO.

National Learning Object Repository of Cyprus

Search

[Advanced Search](#)

Search Results for "map"

[Map Of Cyprus](#) by Chrysa Theodorou
This is a geomorphological map of Cyprus. created on the 17th of June, 2007 [Download](#)

[Map of Greece](#) by Chrysa Theodorou
This is a geopolitical map of Greece created on the 23rd of October, 2007 [Download](#)

Common Tasks

[Back to Index](#)

Login

Username

Password

Not an author yet? [Sign up!](#)

Figure 7. The results of a simple search.

National Learning Object Repository of Cyprus

Search [Advanced Search](#)

Map Of Cyprus

Created By Chrysa Theodorou [Download](#)

Description This is a geomorphological map of Cyprus.

Type Picture

Subject Geography

Duration 03:29

Audience Primary School Pupils

Common Tasks

[Back to Index](#)

Login

Username

Password

Not an author yet? [Sign up!](#)

Figure 8. Retrieving full information of a LO.

National Learning Object Repository of Cyprus

Advanced Search

Advanced Search

Title

Description

Author

Type Audio: mp3 wma Video: avi mov mpeg wmv Picture: gif jpeg jpg png

Language Greek English French

Subject

Audience

Common Tasks

[Back to Index](#)

Login

Username

Password

Not an author yet? [Sign up!](#)

Figure 9. Advanced search in the NLORC.

Conclusions

This paper has presented a theoretical model for Learning Objects Repositories data and a pilot implementation of the National Learning Objects Repository of Cyprus using the Ruby on Rails framework. The NLORC will provide a centralised repository for a national network of e-learning service providers. The

database application has been designed based on existing LO Metadata Standards and the results of a survey amongst University professors in Cyprus. We are currently in the process of the full implementation of the NLORC by developing further additional functionality in the system with regards to various reports and queries required by users.

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RECOGNIZING FAIR USE OF THIRD-PARTY DIGITAL CONTENT IN E-LEARNING

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Abstract

E-learning, applied to distant learning and face-to-face learning, inevitably includes the delivery and publicizing of copyrighted content between educators and learners. We regard the compliance with copyright law as an important consideration in the current phase of e-learning. Taiwan is no exception; most colleges have been developing their respective e-learning resources in recent years for improving competitiveness in the information era. The most common measure is publicizing instructional digital content written by the faculty on the Internet. This will encounter potential copyright infringements, since most colleges in Taiwan do not have a legal service of copyright counseling and/or authorization. On the other hand, the current Taiwan copyright law has not yet included clear regulations for fair use of digital content for educational purposes, whereas in some countries such regulations have been reinforced, such as the TEACH Act of the United States. As a result, major college teachers in Taiwan usually confuse the fair use on the Internet with the fair use in classroom presentation. This can be shown by a questionnaire survey we have done at our school for this study aimed at evaluating the faculty's recognition of fair use of other persons' digital content. The result shows broad dispersion of their recognition of fair use and clearly implies risk of copyright infringements. The result is further analyzed to locate the most misunderstood cases of fair use. The criteria for fair use on the Internet for non-profit, educational uses are suggested by the authors according to the current Taiwan copyright law in conjunction with the ideas in the TEACH Act. Based on our understanding of digital copyright laws and the technical-protection mechanisms in the Blackboard learning system, we provide a selection of common e-learning conducts with advices to approach fair use in educational institutions.

Introduction

This Chapter elaborates the problem of the recognition of fair use by teachers involved with e-learning. The target group for this study is teachers at our university, the National United University, Taiwan. The original goal of this study was to provide our teachers with a copyright guideline so that they could comply with the copyright law of Taiwan, without running into potential legal

troubles. However, because of the essence of copyright laws that will be described later, it is found that an official copyright guideline for e-learning would be very stringent and therefore impractical. This problem is caused by the qualitative definition of fair use in the copyright laws (those of Taiwan and the United States), making a general rule for testing fair use impossible; the criteria for fair use are even more uncertain with respect to digital content. However, stepping into the gray area of copyright infringement often does not lead to legal troubles, as long as the market interest of the rights owner is not significantly endangered. We therefore provide some practical tips for keeping teachers involved with e-learning in the safe zone of fair use.

The Copyright Laws and the Technology

The purpose of copyright laws is to encourage copyright holders continue to create intellectual properties for the public. The system of copyright has worked successfully so far because it allows the owners to rely on the marketplace to find financial reward for their creativity. Especially in the information age, the marketplace is probably the most efficient means for sustaining the function of the copyright system when facing rapid technology changes (Peters 2006). The evolution of copyright law is driven by an imbalance between the interests of the intellectual property owners and the public (Gantz & Rochester 2004). The imbalance is often induced by changes in technological environments. As shown in Figure 1, as the technology advances (indicated by the solid curve), the copyright laws will undergo an adjusting process (dashed line) to attain a new balance in which the interests between the rights owners and the public are

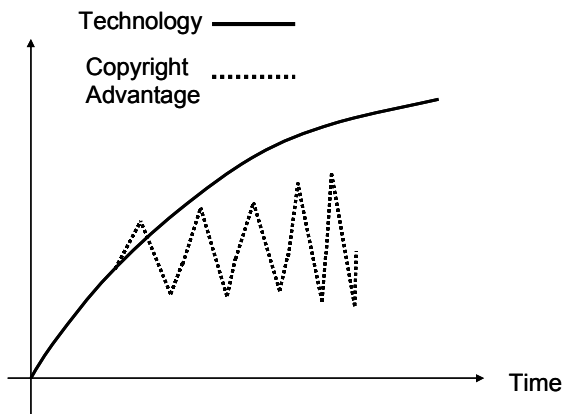


Figure 1. The response of copyright law modification to technology advance.

compromised. We maintain that the adjusting curve of the copyright laws, swinging between the public and the owners, will become wilder as the technology becomes more advanced. In other words, it is more difficult to maintain a stable equilibrium between the two parties. This theory extensively agrees with the current problems on the digital copyright in e-learning (Fisher & McGeeveran 2006, Peters 2006).

In the regard of education, the rise of the Internet and the associated IT technologies have already caused a transition of learning activities from face-to-face type to web-based type known as e-learning. This therefore runs into another conflict between the copyrights owners and the public, given the permeability of the Internet and the reproducibility of digital content. For at least two reasons modern teachers need to have an awareness of fair use in e-learning. First, the teachers should be free from legal troubles when they facilitate teaching on the Internet. Second, the compliance with copyright laws by both of the teachers and the students is in itself an important citizen education in the information age. However, this awareness does not come naturally, as can be shown by the following comparison using Google Trends (2007). In this survey, we analyze the Google-search frequencies of three keywords, “e-learning”, “copyright” and “fair use”, over all regions around the world. The Google Trends provides the ranking of relative search frequencies of a keyword, which is the ratio of the frequency of the keyword to all search, and therefore we can study the significance of a keyword in the web users in a particular region (can be as local as a city in Google Trends). By comparing the rankings of two keywords, we can visualize the “distance” between two keywords (and the concepts thereof) in a particular region of the world. For example, in this study we would like to ask, “If the people of a country are interested in ‘e-learning’, will they also aware of ‘copyright’?”. The answer is no. We have found that out of top 10 countries searching “e-learning” more frequently, only 2 appears also on the top 10 list of “copyright”. Further, out of top 10 countries searching “e-learning” more frequently, only 1 appears also on the top 10 list of “fair use”. On the other hand, “copyright” and “fair use” are more related, the number of countries overlapping are 4. It may need time for countries which are enthusiastic about e-learning to catch up the copyright concept, but before that actually happens the reinforcement of copyright laws will inevitably cause struggles between the innocent public and the copyright owners.

The copyright laws for e-learning and the associated problems

To restrict unauthorized retention and dissemination of copyrighted works on the Internet, the current Copyright Act of Taiwan (2006) allows fair use of

copyrighted works under the condition of *public broadcast*, if some conditions are met. A new term *public transmission*, defined as “making available or communicating to the public by wire or wireless network ...” (The Copyright Act of Taiwan, Chapter 1, Article 3), is generally not included in the domain of fair use (The Copyright Act of Taiwan, Articles 44 to 63). This brings a serious uncertainty of what educators’ can do with web-based e-learning (Chiang 2007). To meet the stringent explanation of the current law, every piece of copyrighted work, a graph or a text, needs to get permission by the copyright owner for public transmission, which is an impossible mission for most of the higher education institutions in Taiwan. For example, a teacher takes several pictures from a textbook to make PowerPoint slides for online presentation; this could be an act of copyright infringement even the slides are made available only to the students enrolled in the class. Although there is a government-run platform for this purpose (Creative Commons Taiwan: <http://creativecommons.org.tw/>), its content is still far from sufficient for college education, however. The key problem is a lack of supplementary law that particularly defines and regulates fair use in the domain of transmitting content for educational purposes by the teacher of a class.

On the other hand, the legislation of copyright in the United States had encountered the same problem. But, with the passage of the TEACH Act (2002), the guidelines for educators using web-based e-learning has become clear. A brief summary, with its spirit clearly specified, can be found at: <http://www.lib.ncsu.edu/scc/legislative/teachkit/overview.html>, for example. With respect to e-learning in nonprofit educational institutions, the TEACH Act says that it is not copyright infringement for teachers and students at a nonprofit educational institution to transmit the content of copyrighted works as part of a course if certain conditions are met. Two most important conditions, from our view, are reinforcing technological protection from unauthorized retention and distribution of those copyrighted works and promulgating institutional copyright policies.

For understanding educational digital copyright, it is essential to distinguish educational exemptions defined in the TEACH Act from fair use. The concept of fair use is loosely defined in the copyright laws. There are four criteria, which are:

- “(1) *the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes;*
- (2) *the nature of the copyrighted work;*

- (3) *the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and*
- (4) *the effect of the use upon the potential market for or value of the copyrighted work.”*

(U.S. Copyright Act, Section 107; Taiwan Copyright Law, Section 65)

These are not a mechanical test for fair use. When it comes to lawsuits, previous cases are the major standard. Furthermore, the standard of law court judgments is changing, especially in recent years when digital copyright is involved (Fisher & McGeveran 2006). On the other hand, the educational exemptions are guideline for educators for ensuring a compliance with the copyright laws. Therefore, the educational exemptions are a subset within the domain of fair use, as shown in Figure 2. However, it is criticized that the regulations by the TEACH Act are so stringent that full-pledged e-learning is hard to follow. Further, carrying out supplementary measures for the exemptions needs official resources to support the technologies, such as a school-run e-learning system (Fisher & McGeveran 2006). In many occasions of e-learning, educators would like to use other online free spaces, not only for saving money but also for popularity.

Accordingly, in this chapter we will sum up the most common e-learning conducts by the teachers at our school and design corresponding methods of preventing copyright infringement; those methods are reinforced by either the e-learning system supervisor or the teachers. Before that, a pilot study was done on a group of randomly selected teachers to test their recognition of fair use in e-learning; the result and the analysis are displayed in section 2. In section 3, the methods of preventing copyright infringement and their respective legal bases are provided. In section 4, we summarize the results and further discuss the educational aspect of recognizing fair use to both learners and educators.

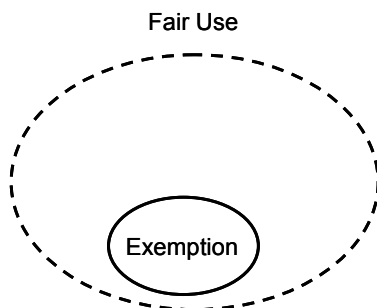


Figure 2. The relationship between fair use and the digital exemptions.

Pilot Study

The school in study is National United University (NUU, hereafter), a teaching-oriented university in Miaoli, Taiwan. NUU started promoting e-learning about three years ago. The purpose of our e-learning is assisting face-to-face teaching after class. About 35% of the courses per semester use the university e-learning platform, which is a Blackboard learning system (Tsai 2007). Except for a small portion of faculty members who actively exploit online learning of Web 2.0 style, for example, e-portfolios, the major function of a course website is for displaying the instruction content used in the classroom and the students' works. The following table shows a collection of commonly used e-learning methods which may have the risk of copyright infringement.

A group of randomly selected teachers at NUU are selected to answer an online questionnaire anonymously. The objective of the questionnaire is to test those teachers' judgments on whether the e-learning activities listed in Table 1 meet the concept of fair use. Since there is no clear regulation by law in Taiwan at this point of time, our focus is not on the testers' correctness of recognizing fair use. Instead, we are concerned with the following: (1) the response to a question showing the testers are uncertain; and (2) the response to a question having large variations. Based on a 5-pointed score rule, the first situation corresponds to a mean around 3, the second to a large standard deviation or variation coefficient. Table 2 shows the mean, the standard deviation and the variation coefficient to each of the questions. We have to be careful about the scores assigned to various options of a question, since the recognition of a concept (here, fair use) with respect to an activity is hard to quantized (Oppenheim 1999). But, again, the goal of the survey is to detect the testers' uncertainty of copyright issues, and therefore we think the 5-pointed score rule is still valid.

According to Table 2, the responses of the testers to those activities having a mean between 2.5 and 3.5 are: (A1) "Web-based instruction and classroom instruction follow the same copyright regulations required by law."; (A7) "Without licensing, the teacher of a class may retrieve a short section of the content included in a commercial audio CD or movie DVD and post it for educational purposes at a website that only admits students enrolled in the class."; and (A12) "Once placed in an e-learning system, the instructional content with unlicensed copyrighted materials of a class can be opened to enrolled students even after the closure of the class, thereby continuing to serve the students as a learning database.". A mean between 2.5 and 3.5 indicates the testers are averagely uncertain whether the activity is a fair use or not. Based on this result,

it is inferred that the teachers at NUU are not sure about: (1) the difference in fair use between classroom teaching and online teaching; (2) the fair use of commercial digital media in an e-learning system with technological protection; and (3) the time limit to the availability of instruction content to the students.

Table 1. A collection of commonly used e-learning methods by NUU teachers.

A 1: Web-based instruction and classroom instruction follow the same copyright regulations required by law.

A 2: Without licensing, the teacher of a class may copy a small portion of text or graphs from a textbook to make instructional content and post it at a website that only admits students enrolled in the class.

A 3: Without licensing, the teacher of a class may copy a small portion of text or graphs from a textbook to make instructional content and post it at a public website.

A 4: Although containing unlicensed materials, the teacher of a class may remove the instructional content posted at a website soon after the closure of the class, so as to agree with fair use.

A 5: The teacher of a class may post the teaching-assisting content provided by the publisher of the textbook at a website that only admits students enrolled in the class.

A 6: Without licensing, the teacher of a class may use graphs taken from the Internet to make instructional content and post it at a website that only admits students enrolled in the class.

A 7: Without licensing, the teacher of a class may retrieve a short section of the content included in a commercial audio CD or movie DVD and post it for educational purposes at a website that only admits students enrolled in the class.

A 8: Without licensing, the teacher of a class may retrieve a short section of the content included in a multimedia CD published by the government and post it for educational purposes at a website that only admits students enrolled in the class.

A 9: Without licensing, the teacher of a class may reproduce the graphs from book of arts or design and post them for educational purposes at a website that only admits students enrolled in the class.

A10: Without licensing, the teacher of a class may reproduce the news from newspapers and post them for educational purposes at a website that only admits students enrolled in the class.

A11: Without licensing, the teacher of a class may reproduce the editorials from newspapers or magazines and post it for educational purposes at a website that only admits students enrolled in the class.

A12: Once placed in an e-learning system, the instructional content with unlicensed copyrighted materials of a class can be opened to enrolled students even after the closure of the class, thereby continuing to serve the students as a learning database.

Table 2. The mean, the standard deviation and the variation coefficient to each of the questions.

Sample Number: 34			
Scoring: from very disagree, 1, to very agree, 5			
Online Instructional Activities Tested for Fair Use	Average Score, μ	Standard Deviation, σ	Variation Coefficient, σ/μ
A 1	3.38	1.28	0.378
A 2	4.03	1.087	0.27
A 3	2.24	1.499	0.67
A 4	3.8	1.322	0.348
A 5	3.79	1.321	0.348
A 6	3.75	1.209	0.322
A 7	3.24	1.615	0.499
A 8	4.1	0.912	0.222
A 9	3.71	1.268	0.342
A10	4	1.044	0.261
A11	3.75	1.118	0.298
A12	2.75	1.41	0.513

We next pick up the activities of which the responses have variation coefficients (σ/μ) above 0.4. Besides the previous three, activity (A3) stands out, which is “Without licensing, the teacher of a class may copy a small portion of text or graphs from a textbook to make instructional content and post it at a public website.” Although the testers averagely tend to negate it as a fair use, the variation is wide.

Suggested Solutions

As we have analyzed in the Introduction, effective e-learning will inevitably step out of the educational exemptions defined by the TEACH Act. Further, the range of fair use described by those four judgment factors is unclear in the regard of digital copyright. In Taiwan, a law that regulates educational exemptions, similar to the U.S. TEACH Act, is actually not available. Therefore, it is natural for us to go back to the four factors of fair use, defined in U.S. Copyright Act (Section 107) and Taiwan Copyright Law (Section 65), and deduce some basic principles of attaining fair use. The means for technological protection in the U.S. TEACH Act are valuable references.

There are extensive annotations of the four fair-use factors with respect to higher education. The following table is a set of annotations rewritten by us, together with our suggestions.

Table 3. Four factors for judging fair use and their respective educational annotations.

Factors	Annotations*	Our suggestions
Factor 1: the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes	<p>Nonprofit educational use is not the only consideration; it has to be considered with three other factors.</p> <p>The educational use in a university can be explained as a profit one in some recent cases.</p> <p>Transformative reproduction is more favorable than verbatim copying in judging fair use.</p>	<p>The more open of an educator's content online, the less room for being judged fair-use.</p> <p>Therefore, it is safer for an educator to use a restricted website open to students registered to the course only. (The registered students should better be official students of the school.)</p>
Factor 2: the nature of the copyrighted work	<p>It weighs in favor of fair use if the work is factual, as opposed to works involving creative expression.</p> <p>Facts and ideas are not protected, and expression is protected; if there is only one way or very few ways to express an idea, the expression becomes factual and without copyright protection.</p>	<p>The nature of a course determines the nature of copyrighted works the educator will use. Courses of science and engineering have teaching content weighed in favor of fair use, in contrast to courses of art and design.</p> <p>It is easier to find online resources for the former courses. On the contrary, legitimate e-learning for art and design is difficult.</p>
Factor 3: the amount and substantiality of the portion used in relation to the copyrighted work as a whole	<p>Quality, as well as quantity, is both weighed in the determination of the substantiality.</p> <p>Factors 3 and 4 are usually considered together, because the more of the original taken, the greater is the negative impact on the market for the copyrighted work.</p>	<p>Substantial copying of textbook content posted in a restricted website should be avoided.</p>

Table 3. (Continued)

Factors	Annotations*	Our suggestions
Factor 4: the effect of the use upon the potential market for or value of the copyrighted work	<p>the most important of the four</p> <p>The effect on the market is not what have already happened but what is anticipated.</p> <p>If the use is likely to form widespread distribution of the copyrighted work, this factor would weigh against fair use.</p>	<p>An educator should use protective measures to hinder further distribution of the teaching materials beyond the register students and the course running period.</p> <p>The associated technology is usually simple, such as setting entry passwords to each of the teaching materials.</p> <p>The educator can also make the course website unavailable to the public out of the course running period.</p>
* For example, http://www.lib.byu.edu/departs/copyright/tutorial/intro/page1.htm		

From Table 3, we can see the most important thing to go along with fair use is to avoid hurting the marketplace interest of the rights owners. It is easy to reduce the uncontrolled distribution of copyright content significantly by using an institution-run e-learning system and assigning passwords to the teaching content. An institution-run e-learning system should provide the functions of filtering users. Meanwhile, since the restricting effect of a password on the distribution of digital content is exponential with a negative power, it will significantly reduce redistribution of materials having copyrighted works. On the other hand, it is a fact that many educators have long violated the spirit of fair use but never got sued, because the impact on market is within the tolerance of the owners. Further, the textbook publishers usually want to maintain good relation with the educators. However, the equilibrium between the publishers and the educators violating fair use cannot be stable forever. There are at least two reasons for us to anticipate future changes. More and more college educators adopt the Web 2.0 concept in the instruction, resulting in digital content made by the students. Since it is more difficult to ensure fair use on the student sides, the risk of infringement increases significantly. The second reason is the trend of using more and more video clips on the course websites, which are highly expressive and thus more protected (Factor 2).

Table 4. Judgments of the 12 activities for fair use.

Common Online Instructional Activities	Fair Use?	Solution
A 1	The statutory copyright exemption known as fair use differs in web-based instruction and classroom, face-to-face instruction.	
A 2	It is a fair use as long as the small portion is not the only core part of the textbook.	1. Meet the basic conditions; 2. make your own slides, instead of posting the digital slides supplied by the book publisher without modifications; 3. always indicate the source.
A 3	It is not a fair use, unless the content is not copyrighted or is permitted by the owners.	1. Meet the basic conditions*.
A 4	It depends on the property of the unlicensed materials; restricting availability to the students beyond the class period is always a safe play.	1. Meet the basic conditions.
A 5	It is not a fair use, unless the publisher permits the teacher for public transmission. Usually, the slides included in the teacher's pack of a textbook are only permitted for public broadcast (in the classroom).	Do not post the digital slides supplied by the book publisher without significant modifications.
A 6	It is not a fair use, because the pictures are already available to the public.	1. Meet the basic conditions; 2. make hyperlinks to those pictures in your documents.
A 7	It is not a fair use, because the content is already available in the market and in digital forms.	Do not post them, even the basic conditions are met.
A 8	It is a fair use, because the content is published by the government and can be reasonably reused even for public transmission (the Taiwan Copyright Act, Article 50).	1. Use a reasonable amount; 2. always indicate the source. (However, we do not know the situation outside Taiwan.)

Table 4. (Continued)

Common Online Instructional Activities	Fair Use?	Solution
A 9	It is not a fair use. Those images are highly original, and the books containing them are for sale. It will be even more serious if a digital copy of the picture is available in the market.	We suggest not posting them, even when the basic conditions are met. It is difficult to prevent redistribution of the picture by the students.
A10	It is a fair use even for public transmission.	
A11	It is not a fair use, because editorials are copyrighted.	1. Meet the basic conditions; 2. use only a small amount of it; 3. always indicate the source
A12	It is not a fair use.	
* basic conditions: (1) using institution-run e-learning system; and (2) setting an opening password to each teaching material.		

Based on the above analysis, in conjunction with the U.S. TEACH Act, we propose the following guidelines for each of the e-learning activities listed in Table 1. However, it should be noted that our suggestions do not guarantee full prevention from legal problems, since there always exists “gray areas” in laws, left to the judges for the final decisions. In copyright laws, there are some criteria for a judge to consider when assessing the degree of infringement (for example, Section 65 of the copyright law of Taiwan). It is also possible that some of our solutions may restrict e-learning activates too much. The principle of our design is a balance between a reasonable compliance with the laws and the opportunity cost a teacher has to pay when observing our guidelines.

Summary

Taiwan, as well as many other countries, is short of a law particularly regulating the conducts of fair use in e-learning, a law similar to the TEACH Act of the United States. Still, it is necessary for a school to provide the educators with a fair-use guideline, because they are not responsible for taking care of the legal details. As can be observed in the survey, we first find the recognition of our teachers toward fair use in web-based e-learning is polarized, not a strange phenomenon given the uncertainty of Taiwan’s copyright law in regard to e-learning. Therefore, we go back to the original definitions of educational fair use

and the four judging factors. Although the four factors are not a mechanical test for fair use, we can still draw some principles for complying fair use (Table 3). Further, the U. S. TEACH Act can provide clear instructions for an institution to follow, which are basically: (1) making its own copyright policies in compliance with the copyright law; (2) educating its students and teachers; and (3) providing technology protection means for the instruction content. Why Taiwan educators are encouraged to take the TEACH Act seriously? One reason is based on the bleak fact that a major part of textbooks used in Taiwan's higher education institutions are imported from the United States. In the survey, each of the instructional activities commonly adopted by NUU teachers is analyzed and provided with technical solution in compliance with the TEACH Act. The solutions thus designed are valuable not only to NUU teachers but also other institutions in Taiwan. Since the solutions are closely related to applications of simple IT technologies, implanting them will not cost much to the teachers. Further, without bothering the teachers, some of them can be easily implanted by the technical support of e-learning once the concept is instituted.

However, it should be stressed that the TEACH Act is so stringent that it will inevitably form obstacles for full-pledged e-learning, those rich in the Web 2.0 spirit, for example. There is plenty of room between the dogma of the TEACH Act and the principle of fair use, but the educators should equipped with more knowledge of copyright laws; or, in a more reasonable sense, an institution should offer legal counseling to its educators.

What about using online open resources to form teaching content? Thanks to many knowledge contributors on the Internet. Nowadays, knowledge of almost any subject is available online for free linkage. Organizing the teaching content with links to selected open resources is indeed becoming more and more popular (Man, Ng & Leung 1998). However, there are several reasons why the concept is not yet widely accepted in colleges. Many college professional courses are highly specialized and online resources are not easy to locate. For example, introductory physics is a popular course with many available online resources. On the contrary, mechanism I, a basic professional course of mechanical engineering, has much fewer resources; the resources are usually not complete or well-organized. Therefore, adapting a textbook will be much easier. Even high quality online resources are available for a course, a college professor still wants to use a textbook, since he or she is already tied up with research. Another reason is about mind setting. Even with the availability of web resources, college faculty members are more likely to be skeptical to new learning concepts,

perhaps it is because most of their education career occurs before the information age.

In a wider sense, what is the relation between the recognition of fair use and the enhancement of learning? Based on our teaching experiences, the attitudes toward knowledge and learning achievements are closely related. We therefore believe that educators and learners should learn to respect other persons' intellectual properties, thereby creating a more orderly and civilized environment for learning. This is by all means not a new idea; information laws are regarded as an essential chapter in the innovative liberal-art education of information literacy (Jeremy Shapiro & Shelly Hughes 1996). As an extended education, an awareness of fair use can be bred in a class following the guidelines not only among educators but also among students, since the students may realize the concept of fair use and respect the intellectual properties of their teachers and classmates. Therefore, each class following proper guidelines on fair use will at the same time become a class of information literacy (TILT 2004) and information ethics.

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AN INTELLIGENT ONLINE ASSESSMENT SYSTEM FOR PROGRAMMING COURSES

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Abstract

Plagiarism is a common problem in education, and detecting it is a very difficult task if a marker is responsible for marking only some of the scripts. The situation becomes worse for distance learning as some students are allowed to submit assignments after the due dates and markers may have to mark assignments over quite a long period of time. They might forget ‘similar’ scripts that they marked some time before. This chapter introduces an integrated online assessment system for markers to detect plagiarism of program codes in a more structured, less computational and more flexible way. We propose a new algorithm using parse tree for detecting plagiarism of programming codes. The use of parse tree introduces a structured and systematic way for detecting similarities among computer programs. The assessment system provides multiple features to aid in the effective marking of assignments, such as plagiarism detection, automatic program testing and students performance statistics. The aim of these features is to relieve the burden of teaching staff and provide an alternative way to paper-based marking.

Introduction

Plagiarism has been of concern to instructors in universities for many years. With the boom in computer science, many universities provide one or more computer-related courses. Some courses may require students to learn and write computer programs. A serious problem then arises — the plagiarism of programming assignments — since copying programs from someone else as one’s own is an easy task for the students. The simplest way is to substitute the variable names or function names with different names and change the sequence of the declaration statements of variables. These actions can easily escape the eyes of instructors or markers. In fact, it is very difficult and time-consuming for markers to find those plagiarized programs from a large set of programs. The

markers can usually only find the careless mistakes made by absent-minded students who may forget to change the name of the authors or leave some serious mistakes in their programs.

The case is even worse for the markers to detect plagiarism of programs in a distance-learning environment if students are allowed to submit their work after the due dates because markers may have to mark assignments over quite a long period of time. Sometimes, more than one marker is responsible for marking the same set of student work. In these situations, plagiarism is more difficult to detect. A powerful and flexible system is required to search for plagiarized programs among a set of programs and distinguish the unintended similarities. The traditional ways for detecting plagiarism include metrics-based and structurally-based plagiarism systems. These systems mainly depend on the number of occurrences of the variables and the operators. They convert the program into a stream of tokens and then compare these token streams to find common segments. The more advanced systems, such as JPlag (Malpohl 2002; Prechelt *et al.* 2000), use the “Greedy String Tiling” algorithm to check the similarity of the source programs.

This chapter introduces a new method that uses parse tree to check for program similarities. For each programming assignment, the source program can be parsed into a tree structure for checking the syntax. The characteristics of the parse tree (Sebesta 1999) structure are studied and will be applied to detect plagiarism. For each programming assignment, the source program will be parsed into a tree structure for checking the syntax. The parse tree is then broken down into several sub-trees according to the program structure. These sub-trees are compared and a score is assigned in relation to their similarities. The system also provides three different levels of comparisons — file-to-file, file-to-directory and directory-to-directory comparisons.

Many research and implementation studies have been carried out on electronic and online assignment submission and management (Thomas 1998, Thomas and Carswell 2000, Jones and Behrens 2003, Baillie-de Byl, P. 2004). However, most of the proposed solutions have focused mainly on administrative efficiency in collection and distribution of assignments. Very limited attention has been given to how to mark the assignments effectively and correctly.

Our integrated assessment system provides a flexible way and a user-friendly interface for markers to evaluate and test students’ programs. Markers can check for program similarities for a batch of computer programs submitted by students, compile individual programs or run a batch of programming assignments with the given test cases. At the end of the testing phase, an

individual report for each student is available for the marker to review and add comments.

Previous Plagiarism Detection Methods

Many systems for detecting plagiarism have been built since the 1970s. This section summarizes some of the well-known systems.

The earliest system, *counting-metric system* (Berghel and Sallach 1984; Faidhi and Robinson 1987), detects plagiarism based on the feature vector. First, each program is converted into a number of software metrics and then mapped into an n -dimensional Cartesian space. After converting all programs into metrics, the system calculates the distance between points. Two programs having very similar points will be considered as being plagiarized. However, this method for detecting plagiarism can be easily thwarted by simple program transformations. Also, no matter how many dimensions are used in the Cartesian space, converting a program into system-metrics will lose much structural information.

More accurate and reliable systems were developed after more powerful computers were produced. The new methodology relies on the structural comparison rather than just looking at the frequency at which keywords appear in the program. Some systems adopted hybrids between structure and metric comparison. The well-known structural comparison systems include *YAP3* (Wise 1993; Wise 1996), *MOSS* (Aiken 1997) and *JPlag* (Malpohl 2002). *YAP3* and *JPlag* use the same basic comparison algorithm — the “Greedy String Tiling” algorithm. *JPlag* applies a set of optimizations for improving the overall efficiency of the system. *MOSS*, however, adopts a slightly different approach to check for plagiarism. *MOSS* maintains a database that stores an internal representation of programs and then looks for similarities between them.

The basic approach of these systems is to convert the program into a stream of tokens and then compare these token streams to find common segments. However, a program consists of both structure and data, where the data refer to expressions in the decision statements or values of the variables and formal parameters. Although the conventional approach can capture and analyze the structure of the programs to determine the similarity of the programs, it ignores the ‘data’ ingredient of the program. Ignoring the structure or data of the program may consequently misinterpret the meaning of the program.

In this chapter, our new approach uses the parse tree to detect plagiarism in a pair of programs. Parse tree checking is also a kind of structural comparison. Using parse tree not only explicitly reflects the structure of the program but also

stores and examines the program data on the parse tree. Checking plagiarism using parse tree is a more accurate and more suitable approach as both the program structure and data are considered.

Plagiarism Detection Methodology

Our plagiarism detection algorithm uses parse trees to check for program similarities. The module is currently available for detecting plagiarism of programs written in Java and C, and other programming languages will also eventually be covered. Before describing the new methodology, the following assumptions are made. The system will ignore:

- meaningless information in the program, such as white spaces, comments, import statements and name of identifiers;
- the order of the fields, methods and statements;
- programs with syntax errors.

The new algorithm operates in two phases:

1. All programs to be compared are parsed into a parse tree structure.
2. These parse trees are compared in pairs to calculate the similarity. The comparison traverses all parts of the parse tree. Each sub-tree represents a logical part of the program. Different sub-tree may have different weights to be measured. The final result of the comparison is shown in tabular format.

Parsing the Program into Parse Trees

Except for those programs having syntax errors, all programs will be converted into parse trees by a parser before making any comparison. The parser ignores the comments, import statements, white spaces and line breaks in the program. A parse tree is composed of nodes and tokens. The structure of the parse tree is well defined. Each parse tree represents a single complete program. All the essential data of the program will be stored in the parse tree. Figure 1 shows the conversion of a simple Java program into a parse tree.

Different kinds of nodes in the parse tree represent different parts in the program, for example, *UnmodifiedClassDeclaration* stands for the class declaration of the program (in Figure 1). The parser used to parse the program into parse tree is language-dependent. A parser requires a set of grammar that describes the rules for how the program can be constructed. Apart from grammar, a Java-based parser generator is required to generate a language

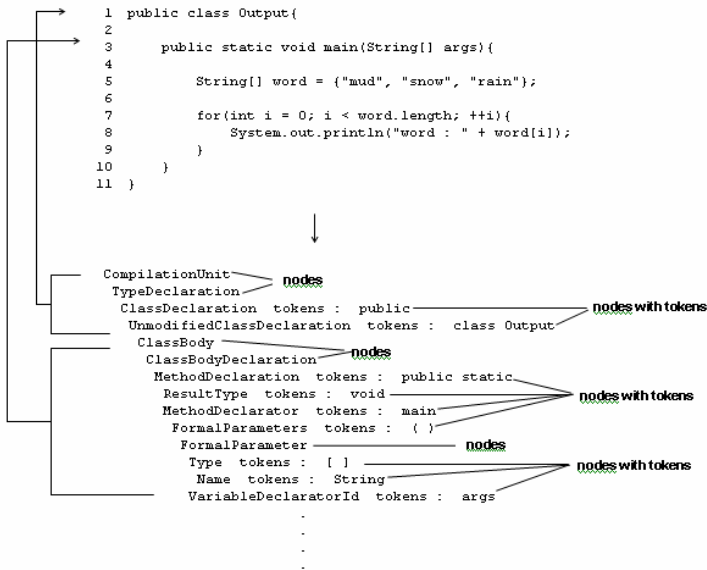


Figure 1. Example of converting a Java Program into a parse tree.

specific parser. JavaCC (WebGain 2000; Lee 2002) is used as our parser generator.

Compare Parse Trees

Besides the parser being language dependent, the comparison process is also language dependent. Therefore, checking a new language requires a new set of programs because different programming languages have their own grammar structure and characteristics. This section introduces the approach that can be generally used in checking for plagiarism with parse trees.

After all programs have been converted into parse trees, all parse trees will be compared with one another in pairs. The following steps will be performed to check the similarity of a pair of parse trees:

- Step 1: Break down the parse tree into the sub-trees and classify those sub-trees into different groups according to their types (e.g. methods and variables). Each sub-tree stands for one type of programs in a program segment.
- Step 2: If the sub-tree consists of other structures, then repeat step 1. Otherwise, if all nodes in two sub-trees are of the same type or same group of

program structures, they will be compared with each other. A score will be given for the similarity of a pair of sub-trees.

Step 3: A matrix of similarity for the members in two groups will then be formed. The next step is to find the most similar pair of members and calculate the similarity using the weights for the group.

Step 4: Sum up the scores for all sub-trees. The final score, which indicates how similar the two sub-trees are, is displayed.

After making comparisons of a set of programs, the result is produced in a tabular form, as shown in Figure 2. From Figure 2, it can be shown that each program will be compared with every other program in the program pool. For example, the similarity between the LogonMenu.java and Registration.java programs is 18.94%, and the similarity between the LogonMenu.java and ShopHistory.java programs is 30.36%.

In addition to our new algorithm, some enhancements on flexibility and accuracy in detecting plagiarism are also introduced in our system. The following sections describe these enhancements.

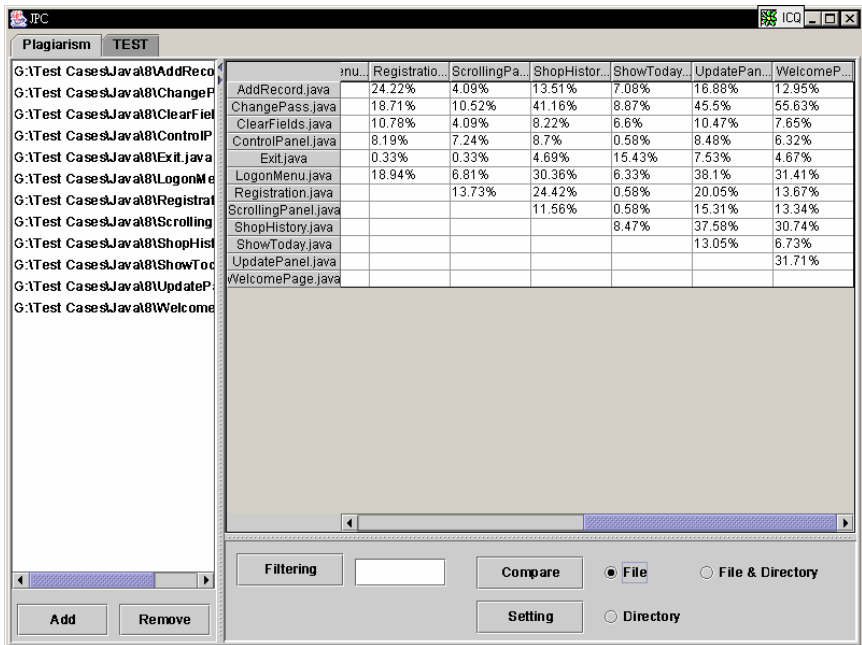


Figure 2. Comparison results of a set of 12 programs.

Different levels of comparison

With the trend toward using object-oriented languages, universities have provided more courses to teach object-oriented programming languages instead of conventional programming languages. Owing to the nature of object-oriented programming languages, a complete program will consist of more than one file. Existing systems for detecting plagiarism can only check programs at file-level. In order to check programming assignments with more than one file, our system provides directory-level comparison in addition to the file-level comparison.

Generalizing the interchangeable structures

Some structures in the programming language can be easily changed to another form having the same meaning or semantics. For example, the following if-statement and switch-statement have the same meaning, but they are of different syntactic forms.

<pre>if (num > 2 && num <=5) result = num % 2; else result = num * 2;</pre>	\Leftrightarrow	<pre>switch (num) { case 3: case 4: case 5: result = num % 2; break; default: result = num * 2;</pre>
---	-------------------	---

The new system provides an alternative way to check interchangeable structures such as for/while and if/switch structures. Therefore, our system can detect the similarity of the program structures as well as the semantics between program pairs. It is always arguable that this function is not worthy to implement, as programs with different structures should not be considered as plagiarism. Our system provides a means for markers to pick up ‘similar’ programs and alert markers that these programs have different structures but the same semantics.

Adjusting the weights of different components of a program

The purpose of programming assignments is to evaluate the students’ ability in writing programs. Sometimes, the instructors or markers would like to examine some particular components of student programs in more detail. For example, if a marker wants to evaluate the student’s familiarity with using ‘inner class’ in Java, then he or she can adjust the component ‘inner class’ to a higher weight in the system.

The new system provides a way for the markers to adjust the weights of the components to be examined in a program. In other words, it can increase the

accuracy of the system in detecting plagiarism. Figure 3 shows a sample screen for adjusting the weights of components in a program. Note that the total of all the weights in class components and interface components should be 100%.

Class Component		Interface Component	
Declaration	1.0	Declaration	1.0
Constructor	15.0	Field	39.5
Field	32.0	Method	39.5
Method	32.0	Inner Class	10.0
Inner Class	10.0	Inner Interface	10.0
Inner Interface	10.0	Total	100.0
Total	100.0		

OK Cancel

Figure 3. Adjusting the weights of components in a program.

System Architecture

After discussing the new plagiarism detection algorithm, we focus on the descriptions on the integrated assessment system. The overall architecture of the system is shown in Figure 4.

The workflow of the system is as follows:

1. The Course Coordinator (CC) can upload assignment questions, sample programs and sets up marking criteria.
2. Students can submit assignment files through World Wide Web.
3. Students will receive instant feedback about program quality and submission rate.
4. The system helps tutor detect plagiarism and test programs automatically.
5. Tutors can type in their comments and suggestions into program files directly.
6. Tutors can mark the assignments according to marking criteria determined by the CC.
7. Students will receive marks, comments and suggestions provided by tutors via the web.
8. The CC and tutors can refer to various assignment statistics on the web.

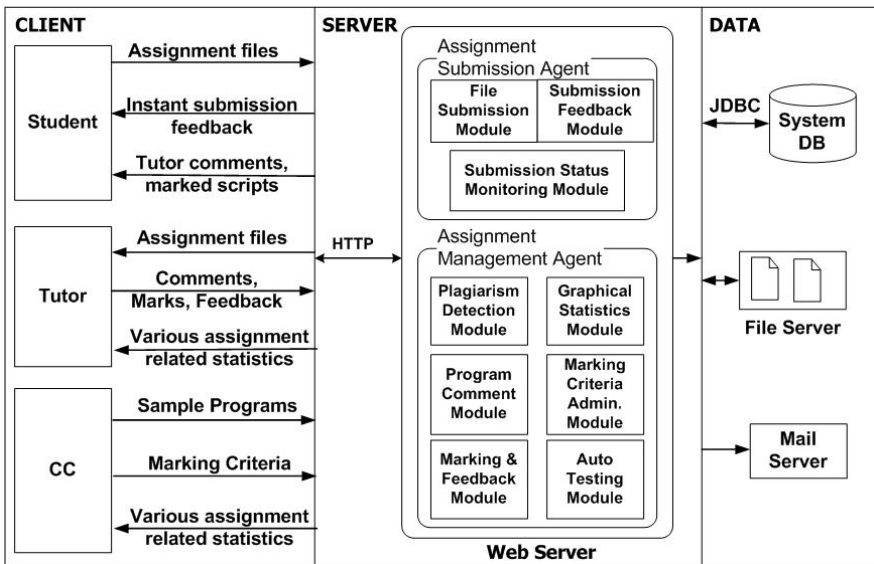


Figure 4. System architecture.

System Functions

The objective of our assessment system is to provide an online assignment submission and management system, which help tutors and CCs mark and manage programming assignments efficiently. We will briefly describe the two components of the system in this section.

Assignment submission agent

This agent provides a web interface to students for submitting assignment files online. A sample screen is shown in Figure 5. Students can submit separate files or a zip file. There is no limit to the number of submission trials before the cut-off date. Students are free to amend and upload their files on the server. Once the file is submitted, the system will provide automatic feedback about the submitted programs and current submission rate. It will also automatically send an email to the student with a safety code as evidence of successful submission.

Assignment management agent

The agent provides a web interface for CC or instructors to manage student assignments systematically. Figure 6 shows a sample screen for the status of

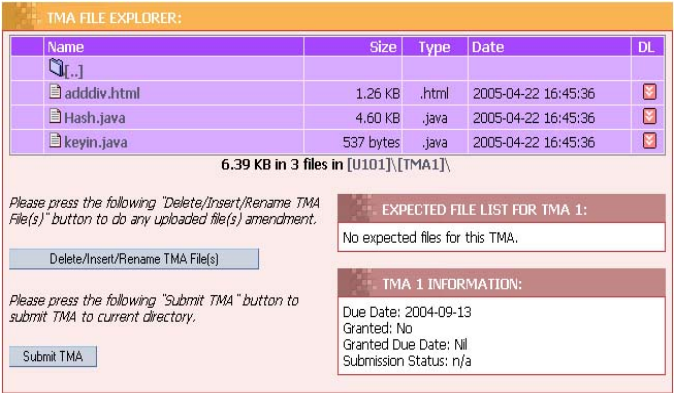


Figure 5. Assignment submission screen.

STUDENTS TMA SUBMISSION for MT356 TMA1:					
Student ID	Name	Status	Detect Plagiarism	Marks	
s0278514	Chan, Tai Man	Normal	OK	67.00	
s0658587	Chan, Siu Ming	Normal	Suspect	74.00	
s0857284	Chan, Tai Keung Kenny	Late	Suspect	72.00	
s0574484	Wong, Chiu Fun	No Submission	----	----	
s0358486	Yeung, Lok Ming	Normal	OK	----	

Figure 6. Assignment management screen.

assignment submission. The system is able to detect suspected cases of plagiarism automatically on behalf of the markers. The plagiarism detection algorithm has been discussed in the previous section. It uses parse trees to check for program similarities. Each program to be compared is converted into a parse tree first. A parse tree is composed of nodes and tokens and the structure of parse tree is well defined for any particular programming language. Then the parse tree is broken down into sub-trees. Each sub-tree represents a sub-part of the program. Different sub-trees of the same type in different programs are compared. A mark is assigned for the similarity of that pair of sub-trees. The final score for the two parse trees is calculated. If the score is higher than a preset threshold, the system considers those cases as suspicious plagiarism copies.

The system also provides a feature for tutors (markers) to run and test the submitted programs using different test cases (see Figure 7). Tutors can read an automated testing report of a student’s program, and input useful comments or

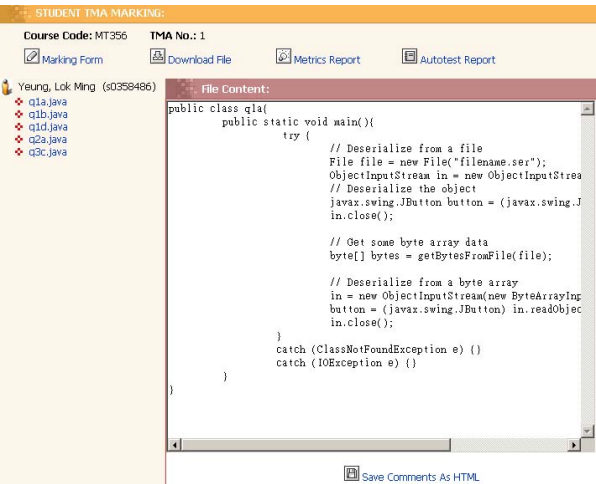


Figure 7. Programming assignment marking.

TMA MARKING FORM for q1a.java:

Course Code: MT356 TMA No.: 1 Name: Yeung, Lok Ming (s0359486)

Criteria	Marks
1. Program compiles successfully.	<input type="text"/> /20
2. Program indentation.	<input type="text"/> /30
3. Program readin file correctly.	<input type="text"/> /20
4. Read in button responses as expected.	<input type="text"/> /30
5. Comments:	<input type="text"/>

*** Late submission for 7 days.

Total Marks Calculate /100

Figure 8. The marking sheet.

suggestions directly into program files. It will then be saved in HTML format for students to review the marking result. To ensure a correct and consistent marking process, CC or instructors are required to specify all the marking criteria for each program. After the assignment cut-off date, tutors can mark the online submitted programs and input individual marks for each criterion displayed on an electronic marking sheet (see Figure 8). Marks can be calculated

by pressing the “Calculate” button. Tutor can also input further comments about student’s work in the marking sheet. The agent can also generate different charts with statistics about the submission and students’ overall performance on individual assignments (see Figure 9).

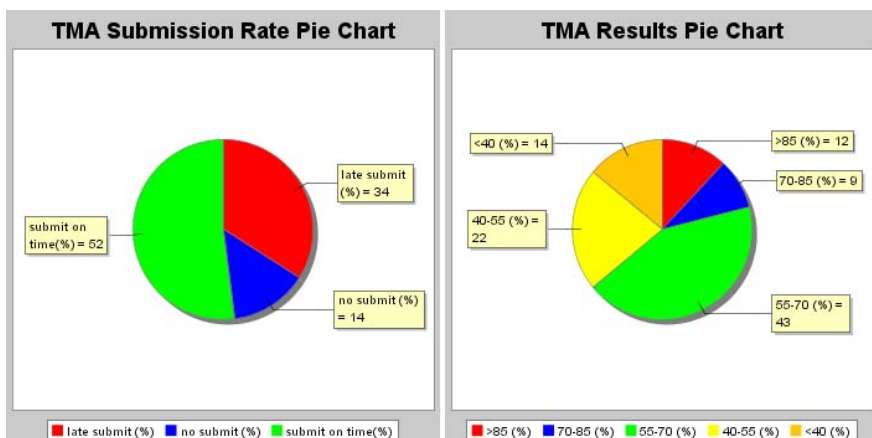


Figure 9. Statistics on student’s performance.

Discussion

This section shows the results generated by the plagiarism detection module of the system. The performance of our new algorithm is evaluated and compared with an existing plagiarism system, *JPlag*.

A set of programs given in (Malpohl 2002), which had been used to evaluate the performance of *JPlag* before, was used. These programs are related to some graphical user interface (AWT) programs. The results of comparison are summarized in Table 1.

In general, the percentages of similarity generated by *JPlag* and our system are very close to each other for very ‘similar’ programs (set 1 and set 2). For other sets of programs, the two systems have larger differences because our system uses a different detection method to check for plagiarism, as it also checks the meaning between the two programs. As those programs are AWT programs, the weights of the components were adjusted and compared again. The results after adjustment of weights are also shown in Table 1. Since the weights are adjusted according to the nature of the programs, the searching and checking criteria are changed accordingly. The results of our system after adjustment of weights will differ from the original one.

Table 1. Comparison of results between JPlag and our system.

Program set	% of similarity using JPlag	% of similarity using our System	% of similarity using our system (after adjustment)
Set 1	100%	99.95%	99.93%
Set 2	98%	99.67%	99.92%
Set 3	64%	82.77%	78.73%
Set 4	52%	42.3%	42.85%
Set 5	36%	46.47%	57.47%
Set 6	32%	47.79%	43.28%
Set 7	22%	43.28%	45.04%
Set 8	21%	26.59%	12.16%

Table 2. Performance of our system.

No. of programs (n)	No. of comparisons $(n * (n - 1)) / 2$	Time taken in our system
10	45	2.1s
20	190	4.7s
50	1225	8.2s
100	4950	10.1s

Since students turn in hundreds or even thousands of programs every year, the efficiency of the system is a very important factor to reduce the workload of the markers. We aim to provide a system that is able to find out the plagiarized programs within a very short period of time. Table 2 shows the efficiency of our system. To test 100 programs with an average 100 lines, the system needs to make 4950 comparisons and it took only 10 seconds to complete all the comparisons.

The system was tested by colleagues in the computing team in The Open University of Hong Kong. It has been tested and used by tutors in some programming courses offered in distance learning mode. The system was further enhanced to have the following features:

1. Allowing markers to run the plagiarism detection part in a batch mode
2. Capable of checking and opening the compressed files (*.zip)
3. Filtering out those pairs with thresholds
4. Outputting the testing reports to users in html format

Conclusions

Plagiarism is currently a serious problem in academic institutions. Programming assignments, especially computer programs, can easily be copied and modified

by students. An accurate and flexible system can help markers identify the plagiarized pairs of program among a large set of programs. This chapter reports on the development of an integrated online system with assignment submission, management and marking system for handling programming assignments in distance learning courses. The system can streamline the process of marking programming assignments and relieve the workload of instructors and markers. As a result, students can enjoy the benefits of online submission. With features like plagiarism detection, automatic program testing and the online marking sheet, the system enables the teaching staff to mark and manage assignments more efficiently and accurately.

Acknowledgments

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ENHANCING STUDENT LEARNING THROUGH TECHNOLOGY: A CASE STUDY OF “ONLINE GAME” AND “WEBGAME” EXPERIMENT

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Abstract

This chapter presents an Internet experiment in which untrained subjects were asked to defined pairs of terms and their relation to each other using the Internet as their resource. It surveyed variations in the ways people understand and perceive meanings of “research” and “experiments”, and the Internet concepts of “online game” and “web game”. The chapter should be of interest to all online educators, be they from business, law, art or science disciplines.

Introduction

From the novice user to the expert of a subject or discipline, the Internet is an important place for information and references. In the academic sector, research is an essential part of a university education and career. Proper research involves a range of processes and activities including searching for relevant information and assessing its importance, among other things. It should be pointed out here that all information sources on the World Wide Web are not the same. Some are useful, others may be misleading.

There has been a paradigm shift in terms of teachers’ roles. As facilitators of learning, they are no longer the authority, or the most knowledgeable of the knowledge they teach. Learners in the information age no longer take whatever it is from the facilitator.

In the following sections, we provide the theoretical framework of our *SIR* (Searching-Involvement-Reasoning) experiments, experimental design, findings, discussion and conclusion of our exploratory experiments.

Theoretical Framework

It is important that we be able to see things in the right perspective and right premise. We begin this section with a quotation which is not from others but from us:

“If one knows history, sees things in the right perspective and right premise, one will be better prepared for the future in the information era.”

Internet Special Project Group

In the next two subsections we touch on the major disciplines that help us to put things in the right perspective and to see the right premise. These include: concepts of computer-mediated communications, learning style theories, and reasoning.

Seeing things in the right perspectives

In the context of this chapter, several important concepts may assist us to see things in the right perspectives. These are computer-mediated communications (CMC), learning style theories, virtual community and virtual gaming.

CMC and learning style theories

In the past few years, CMC, especially Internet communication, has emerged as a fast-growing area of research. It and its related disciplines such as e-learning and virtual communities have also attracted the interest of academic scholars from various fields, including communications, law, business, and computer science, among others. Game experimenters and educators are in a position to make a unique contribution to online communications, since games and language are involved in Internet CMC in the most fundamental way.

Learners have preferences regarding how they learn. In the information age, the learning style of our students and children are quite different from those of the pre-Web era.

In the literature, a number of systems exist for describing learning styles. Kolb (1984) suggests that there are four stages that follow on from each other to complete the cycle of learning: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Honey and Mumford identify Activist, Reflector, Theorist and Pragmatist as the four main learning style preferences.

Most students have elements of more than one learning style. With the formation of virtual communities, what becomes the natural style of the learners is closely related to their community of learning — and many Internet learners are pragmatic. Of particular relevance to our online learners is the pragmatic style of learning. Pragmatic learners are eager to try things out. They like concepts that can be applied to their job. They are practical and down to earth.

Virtual communities and computer gaming

Typical virtual communities include those formed by using Internet Mediated Communication tools/systems such as MUDs (Multi-User Dungeon), MOO (*MUD object oriented*), IRC (Internet Relay Chat), chat rooms and electronic mailing lists, discussion forums, Weblogs and Wiki.

Today, "virtual community" is more loosely used and interpreted to indicate a variety of social groups connected in some ways by the Internet. A strong bond among the members is no longer a required condition. An email distribution list may have tens of thousand of members. This is illustrated in Table 1.

Table 1. Sample of distribution lists.

Name of List	No of Subscribers
SCOUT-Report	31358
TESL	23395
JAVA-ANNOUNCE@JAVA.SUN.COM	17131
PACS-L	10118
Net happening	9300
Linguists	8382
DOES-L	2807
TESLK-12@CUNYVM.CUNY.EDU	2682

More recently, another form of virtual community has formed. This is known as Weblog, which is often shortened to blog. Blogs often provide commentary or news on a particular subject, such as news, specific topics or personal online diaries. Most blogs are primarily textual links to other blogs, web pages, and other media related to its topic. The communication that takes place in the virtual communities could be in simplex (one way), half-duplex (one way at a time) or in full duplex (simultaneous) mode.

Cultivating civilizations

The explosive growth of the Internet was also accompanied by the proliferation of virtual communities and the associated civilization. Of interest is that the word civilization has a number of meanings. WikiPedia has the following definition:

**A civilization or simply civilization can refer to a city-dwelling human society, human culture in general, etiquette and sophistication, or the imperialistic act of “civilizing lesser peoples”. *Civilization (board game) is board game by Francis Tresham (game designer).*

[<http://en.wikipedia.org/wiki/Civilization>]

The impact of such Internet communities affects both the theoretical definitions of word meanings and introduces many news ones. It also enlightens psychological research on the sensitivity of human reasoning to task and in the case of our experiment on online academic assignments.

Seeing the right premises

We are constantly bombarded and overloaded with information (which stretches across the spectrum from spam to highly relevant) from traditional media and the Internet. We consume, file, and discard information every second. We search, collect, filter, analyze, interpret, decide, conclude, and select daily. As such it is of paramount importance in understanding the reasoning related to tasks, as we shall see in the following sub-sections.

Human reasoning related to task

Over the past few decades, reasoning has been the focus of enormous interdisciplinary attention, attracting interest from philosophers, psychologists, advertisers, marketers, and even education managers. The widespread interest in the topic reflects the central status of reasoning in human affairs and the competitiveness in the information society. How do people solve problems? There are the linear and the parallel models. For the linear model, according to Newell & Simon (1972) and Newell (1990): in solving a given problem we must first comprehend it, define the initial condition of the problem and the desired result, and then load the problem into working memory — be it straight in the brain or have it all written down. The conventional model suggests that two

orthogonal variables determine performance. One variable is the wording of a problem. This variable determines whether an individual is able to comprehend the problem. The second variable is familiarity with the domain from which the problem is extracted. The nonlinear model as exemplified in Prudkov & Rodina (1999).

Modern logic provides accounts of both interpretation and derivation, which work together to provide abstract frameworks for modeling the sensitivity of human reasoning to task, context and content. The pragmatic learning style of learners — together with the semantic distinction between descriptive and denontic rules — interacts with the task specifics to provide certain insights in our exploratory study of meanings of the following duples [(Online Game), (Web Game)] and [(research), (experiment)].

Wason's selection game

Wason's game is probably the most intensively studied task in the reasoning literature. In essence, close to 50% of his students (Approx 50) chose to turn A and 4. Only 5 of the subjects chose to turn A and 7. Wason (and the great majority of researchers up to the present) assume that correct performance is to turn the A and 7 cards only. In later section, another view of the ‘correctness’ will be presented as the game has continued to draw debates among researchers and scholars. For our monograph readers who are formal logic oriented, the following translation makes the game rule and question more precise.

1. $F(x, y)$ ‘ x is on the Front side of card y ’
2. $B(x, y)$ ‘ x is on the Back side of card y ’
3. $O(x)$ ‘ x is a vowel’
4. $E(x)$ ‘ x is an even digit’

and the rule is then translated as the following pair

$$\forall c (\exists x (F(x, c) \wedge O(x)) \rightarrow \exists y B(y, c) \wedge E(y))$$

$$\forall c (\exists x (B(x, c) \wedge O(x)) \rightarrow \exists y F(y, c) \wedge E(y))$$

However, for some of us the above may be considered being pedantic, for most of the undergraduates are without formal logic training and many will go astray. Further, by doing so, we might be accused of confining the domain of thinking and accepting only one approach in solving the problem.

Hardly had we finished accepting the reasons for the correct answer to Wason's game when we were challenged by Stenning and Lambalgen's article on “A little logic goes a long way”. The little logic of the famous Wason AK47

card game has continued to draw interpretations, arguments and counter arguments among researchers and scholars (Giroto 1991) (Leighton & Dawson 2001) (Yama 2003) (Samuels, Stich & Faucher 2004) ever since it was published in the late 1960s.

We no longer lack of information; instead, most of us are heavily information overloaded. What we need is the skills/knowledge in reasoning and extracting the right information. This is of paramount importance for us Life-Long Learners.

From premises to conclusion

Most reasoning studies are interested in how subjects chose action from premises in the process of selection. But premises have to be interpreted before any conclusions can be drawn. Although premise interpretation has received recurrent attention, the full range of dimensions of interpretation facing the subject has not been considered in the online environment. Our general thesis is that integrating accounts of interpretation with accounts of derivation could lead to deeper understanding of life-long learning in the online environment.

What is the caveat?

When one is making a decision or selection of choices, formal logic suggests one should be concerned with reasoning about the natural language conditional “if ... then”. The selection task assumes that the logical form assigned to such IF THEN conditions should be the connective \rightarrow with semantics given by propositional logic. That is what Wason used to derive his answer in section Watson’s selection game. Stenning and Lambalgen (2003), however, take an opposite position on the subject and play down the complexity approach of assigning logical form in the process.

They argued,

“It does not make sense to determine a priori what is the right logic. This depends on one’s notion of truth, semantic consequence, and more. But once these parameters have been fixed, logic as the mathematics of reasoning systems, determine what is and isn’t a valid consequence.”

They presented the reasons that it is of fundamental importance in determining the type of quantifiable characteristic or feature that goes into the definition of what a logical system is, and, of course, the psychological purpose that might

lead subjects to choose one or another setting in their reasoning. There is a different purpose and thus important distinction between following the case of “reasoning *from* an interpretation”, and “reasoning *for* an interpretation.”

The crux of the matter lies in natural language formation of the premises that lead to potentially different interpretations of the given “facts” and “intended task”.

Evaluation of meanings on the Web

Instead of being given concrete premises or definitions, subjects of our experiments have to search the net for meaning of the words under study (more in Section 4). They turn to the Net for information. Given the wide range of other meanings of the words, the subject must read and bracket his or her own most prominent meanings for the key concepts involved. However, the “bracketing” process is what subjects with little logical training typically found hard to do.

Experiment

In our case, instead of giving our subjects concrete premises or definitions, they had to search the net for the meaning of the two words under study. Just like many in the information generation will do, they turned to the Net for information. To explore how learners find out new concepts related to terminologies, — and draw conclusions — two experiments in online settings were conducted. The authors asked undergraduate students in a network programming class to use the web for two tasks: (1) to find definitions of “online game” and “web game” and then categorize two games (which were given as part of the task, and accessible via web browser) as one or the other; and (2) find a definition of “research” and “experiment” and describe how the two concepts were related by classifying it into one of the five relations investigated.

Method

Participants and Design. The subjects were 254 undergraduate students in a distance learning class of 254. Based on a certainty factor of 95% and an acceptable error of .10, this sample size is acceptable. The response rate was 90% with 229 students attempting the tasks assigned. The experiment was conducted in seven groups and the tasks were given as part of their Tutor Marked Assignment (TMA). Students downloaded the TMA from the course

Open Learning Environment with IBM's Lotus Notes as backend server. Figure 1 shows the general screen of the course OLE and Figure 2 shows a snapshot of the Assignment Page.

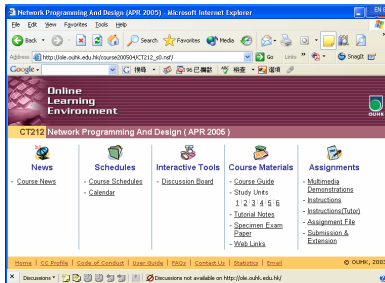


Figure 1. CT212 networking programming design, OLE.

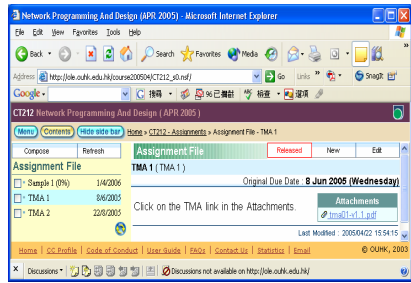


Figure 2. Tutor Marked Assignment (TMA) Page, OLE.

Materials and procedure

The TMA was available from the server from the beginning of the course in April 06. Ninety-one per cent submitted their TMA on or before the cutoff date, while nine per cent applied for extensions and submitted on or before 29 June. The last question (question 5) of the TMA reads as:

Instruction This question is related to one of the network games exercises that you will encounter in later TMAs.

- Use your favorite search engines/electronic resources to find TWO definitions of 1) “Online Game” and 2) “Web Game”. (Please bookmark the urls/sources as you will need to access the same pages again in your next TMA). Compare and contrast “Online Game” and “Web Game”.
- Compare the two games illustrated in Figure 3 and Figure 4. Which one is an online game and which one is a Web game?
- Use your favorite search engines to find FIVE definitions of 1) “Research”; 2) “Experiment”. Remember to provide the source of reference in your answer.
- Based on your findings from question Q5.c, how are these two concepts related? Use “game research” and “game experiment” to support your discussion. Your discussion is likely to fall into one of the following five categories (See Figure 5). In your answer, you should state which category (i.e., 1, 2, 3, 4 or 5) you are supporting.

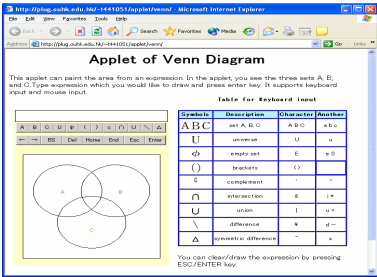


Figure 3.

<http://plug.ouhk.edu.hk/~t441051/applet/venn/>

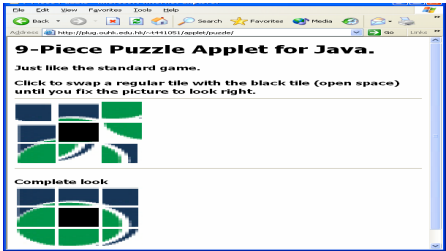


Figure 4.

<http://plug.ouhk.edu.hk/~t441051/applet/puzzle/>

Cat	Description	Relation in E Venn Diagram	Mathematical Model
1.	Research (R) and Experiment (E) are two distinct Concepts		$E \cap R = \emptyset$
2.	Experiment is part of Research		$E \in R$
3.	Research is part of Experiment		$R \in E$
4.	Research and experiment are two different concepts but they do share common areas		$E \cap R \neq \emptyset$
5.	Others: please illustrate with examples.		

Figure 5. The five experiment relations.

The same experiment was repeated in the 2007 class which consists of five groups and a total of 189 students. The experiment attempt rate was 84%. The consolidated results are presented in the next section.

Results and Discussion

For the question comparing the two games (Applet of Venn Diagram and 9-piece Puzzle Applet for Java), and selecting which one is an Online Game and which is a Web Game, the result of the groups are presented below:

Table 2. Raw results of the game experiment 2006.

	Order Pairs Respondents	(O,O) 6	(O,W) 54	(W,O) 16	(W,W) 150	Others 1
N						
G 1	35	1	3	1	30	0
G2	27	1	9	1	16	0
G3	36	0	5	0	31	0
G4	32	0	8	4	19	0
G5	34	1	14	2	15	1
G6	36	3	7	7	19	0
G7	29	0	8	1	20	0
<i>Total</i>	229	6	54	16	150	1
		2.62%	23.58%	6.99%	65.50%	0.44%

Table 3. Raw results of the game experiment (2007).

	Order Pairs Respondents	(O,O) 3	(O,W) 23	(W,O) 19	(W,W) 110	Others 4
N						
G 1	32	2	4	3	22	1
G2	33	0	4	4	24	1
G3	30	0	4	4	21	1
G4	30	0	6	3	21	0
G5	34	1	5	5	22	1
<i>Total</i>	159	3	23	19	110	4
		1.89%	14.47%	11.95%	69.18%	2.52%

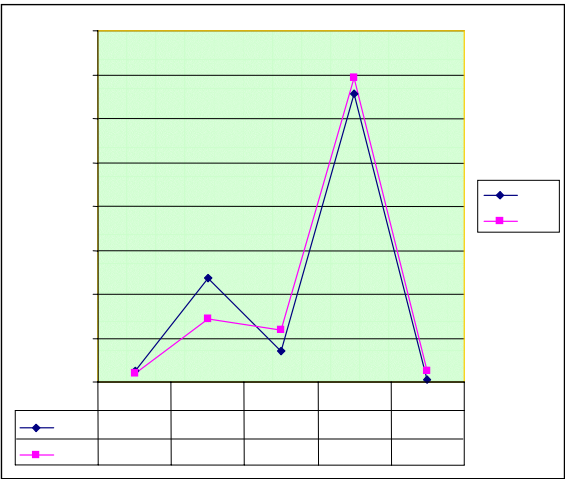
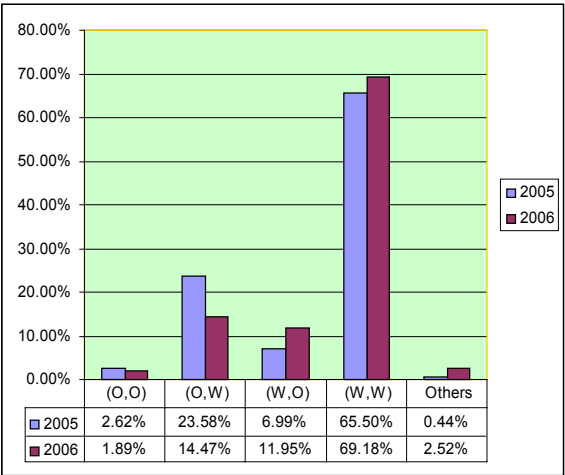


Figure 6. Graphical results of Venn diagram experiment.

The order pairs have the following meanings:

- (O,O), Both are Online Game
- (O,W), Applet of Venn Diagram is an Online Game and the Puzzle Applet is a Web Game
- (W,O), Applet of Venn Diagram is a Web Game and the Puzzle Applet is an Online Game
- (W,W), Both are Web Games

The modal response (65%) was (W,W). That is, both Applet games are Web games. The next most common answer (24%) was (O,W).

We might point out that for causal readers that it may be not clear what, if any, distinction there is between “online game” and “web game”. This group of readers might further ask even if one could distinguish being merely connected to a network from being on the World-Wide Web — in practice most people use “online” and “on the web” synonymously. Both games appear to be accessible via a web browser.

In the question of finding the relationship of the 2-tuple [(Research), (Experiment)] using Game Research and Game Experiment as a reference, the results are summarized in the following tables:

Table 4. Raw results of “Research” and “Experiment” 2005.

		Category				
	Respondents	1	2	3	4	5
G 1	35	2	12	2	16	3
G2	27	1	10	0	13	3
G3	36	1	11	1	20	3
G4	32	0	12	3	14	3
G5	34	0	9	5	16	4
G6	36	2	12	2	17	3
G7	29	0	9	1	16	3
<i>Total</i>	229	6	75	14	112	22
		2.62%	32.75%	6.11%	48.91%	9.61%

Table 5. Raw results of “Research” and “Experiment” 2006.

		Category				
	Respondents	1	2	3	4	5
G 1	29	0	8	0	19	2
G2	31	1	9	3	12	6
G3	35	0	9	2	20	3
G4	32	1	5	0	23	3
G5	32	1	6	1	17	7
<i>Total</i>	159	3	37	6	91	21
		1.89%	21.89%	3.55%	53.85%	12.43%

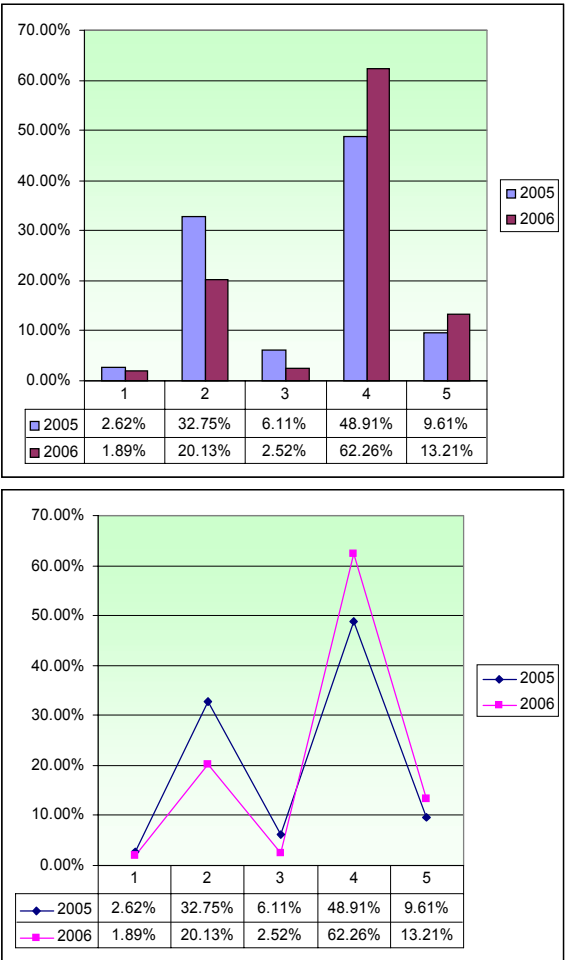


Figure 7. Graphical results of “Research” and “Experiment” experiment.

The modal reply of the second experiment is that only 48% of the subjects got the “formal answer” — Category 4 — correct. The next most common answer was category 2.

Running a Chi-square test similar to that of Hattori (2002), $\chi^2(1, 151) = 23$, $Ps = 0.001$ on the two sets of results of the two experiments (2006), the difference in the ‘logically expected’ answer obtained in the two experiments is statistically significant as the following Chi-square simulation indicates:

Correlations of Games and R&E

	Category 4 (✓)	Other Cat. (✕)	Total
(W,W) ✓	70	25	95
Not (W,W) ✕	19	37	56
Total	89	62	151*

Degrees of freedom: 1

Chi-square = 23.0093506351053

p is less than or equal to 0.001.

The distribution is significant.

* It is not 159 as some data were discarded

The result suggested a high correlation of the “correctness” between the answers to the two questions. Most students got both answers ‘correct’ followed by students getting both answers ‘wrong’.

Conclusion

As the Internet has become an integral part of life, the public is becoming more and more dependent on the net for information and reference material that can help us to understand/interpret the meaning of a given premise when faced with a problem or question. In experiment conducted, the principle concept applied was “*SIR* — Search, Involvement, Reasonable-interpretation”. In both the experiments, the types of characteristics of the online reference resources used by the subjects were widespread. It was found that “how” and “where” they “*Searched*” information does matter. For example, a few of the students searched WordNet for information. Other used the advanced Google techniques such as “define:” to find the meanings of the words “Research” and “Experiment”. It is suspected (as one would normally assume), what reference they used affected how they understood the premise and drew conclusions.

From the exploratory results, it could be concluded that selection questions which demanded appropriate physical involvement in the reasoning process seemed to help the subjects draw a more reasonable answer as the case of two Applet games might have implied when compared to the more theoretical selection game of “Research” and “Experiment”. This is in line with the general constructivist approach of learning, which argues that learners must actively “construct” knowledge by drawing it out of experiences and have meaning and importance to them (Dewey 1996) (Roussou 2004). The subjects (learners) in the experiments constructed their own knowledge by testing ideas and concepts based on their own or others’ prior knowledge on the Internet.

When all the "incorrect" answers (in the case of Game Research and Game Experiments) were examined, at least 20% of these answers were worth giving credits. This is because accepting only the logical form as the basis for reasoning is not pragmatic. Subjects or learners should also be judged on the appropriateness of their selection based on any *reasonable interpretation* of the question.

Throughout the study, it was found that educators can take home a variety of lessons from the outcomes obtained in this experiment. Since the manner and source used by subjects can affect interpretation, instructors can help their students to better understand assignment requirements. Put simply, educators may need to define the scope as well as the methodology (including the interpretation of the questions, the search engines, portals, and even parameter usage) to enable students to find the answers that are deemed "correct". Moreover, educators should be aware of their own academic orientation (pedagogical codes) and be prepared to accept as many answers as possible if such limitations on the front are not provided. Otherwise, the instructor can expect a lot of appeals and grade changes when those cases are successfully challenged by students.

Most of all, the experiment and outcomes show that the search for knowledge using the World Wide Web has a lot of room for improvement. In particular, advancement in the area of reasoning may require the combination of experts from all areas. Yes, the Web search process and term extraction can be made faster and more refined by information specialists. However, that does not ensure users needs are met. In particular, attention must be given to how the search process is initiated. Then, an understanding of what user processes are involved is necessary. Finally, why such an interpretation is derived by the user must also be examined. All in all, this means that linguist and other behavioral scientists are just as important as the technical specialist in the development of global Web-based knowledge enterprise portals that can actually deliver the type of information that is germane to the needs of a specific end-user.

Limitation of the Study and Future Research

As the experiment was conducted at the subject's own time and place, there was no guarantee that answers to the questions were independently constructed. Furthermore, it is possible that one or two tutors in the course might have provided the subjects guided answers to the questions and thus had potentially corrupted the data. Both these weaknesses can be minimized by using a more controlled environment for the experiment in the future.

Despite the limitations provided, the significance of the outcomes reported is not minimized. The sample size was large enough to allow for the outcomes to be generalized. Great care was taken in the interpretation of the results. Last but not least, the methodology applied and the tests conducted were robust. Even if some minimum bias have existed, it is not likely to have affected the overall outcomes and significance of the results.

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LEARNER-CONTENT INTERACTIVITY: INSTRUCTIONAL DESIGN STRATEGIES FOR THE DEVELOPMENT OF E-LEARNING MATERIALS

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Abstract

Interaction in different forms is beneficial to the learning experience and the overall effectiveness of learning. Levels of interactivity can be interpreted into various aspects. Many scholars identify various types and different levels of interactivity (Jonassen, 1988; Rhodes & Azbell, 1985; Schwier & Misanchuk, 1993; Sims, 1994). Sims (2001) identifies four levels of interactivity in the context of the e-learning environment. They include: learner and learner; learner and teacher; learner and content; and learner and interface. This chapter discusses the level of learner-content interactivity.

Since learner-content interactivity in e-learning is basically a two-way communication process between a learner and learning materials in various formats by using multimedia technology, it is important to focus on both components as potential sources to promote students' engagement. Multimedia learning content can arouse learners' interest and motivation at the beginning of participation in e-learning. It also prevents learning from becoming boring because learners must stay alert and play an active role in their learning process. With good instructional design strategies and adequate technological resources, e-learning can provide a high level of learner-content interactivity that can motivate learners to engage in their learning. By engaged in e-learning, learners are actively involved in the process of creating, problem solving, reasoning and evaluation. This chapter investigates the impact on e-learning materials and evaluate how to promote students' motivation and participation in e-learning.

Introduction

Interaction, in fact, has been a defining feature of formal education. Garrison and Anderson (2003) traced back the definition of interactions from the learning concept raised by Dewey (1916). They stated, "Interaction is the defining component of the educational process and occurs when students transform the inert information passed to them from another and construct it into knowledge with personal application and value" (p.41). Wagner (1997) distinguishes the terms 'interaction' and 'interactivity'. The former involves "behaviors where individual and groups directly influence one another" (p.20) and the latter focuses on the exchange between the user and the technology. Jonassen (1999) depicts interactions as a function of the type of learner response, the meaningfulness responses and the quality of the feedback provided. As Sims

(2003, para. 6) mentioned, “Interactivity refers to those functions and/or operations made available to the learner to enable them to work with content material presented in a computer based environment.”

In short, each event that is connected to an instructional strategy is an interaction that occurs between the learner and other human or technological resources. Interaction allows learners/ participants to experience the learning content, make sense of meaning, actively involve or participate in the learning process. Interactivity can be viewed as descriptions of technological capability which involves input, responses, feedback, actions actively connected between learners and computers (Bork, 1982; Wagner, 1994).

Levels of interactivity can be interpreted into various aspects. Many scholars identify various types and different levels of interactivity (Jonassen, 1988; Rhodes & Azbell, 1985; Schwier & Misanchuk, 1993; Sims, 1994). According to Moore (1989), there are three types of interactions in distance learning, namely, learner-learner interaction, learner-teacher interaction, and learner-content interaction. With the chat, email, and discussion board, the learning platform provides the first two types of interactivity, both synchronous and asynchronous. Furthermore, students can have learner-content interactivity through the existing approach of e-learning. Human-computer interaction is the fourth type of interaction which stresses how the users access to the necessary hardware and software (Booth, 1989; Bork, 1982; Hillman, Wills and Gunawardena, 1994; Reyna, et al, 2001). Such interactions allow learners to manipulate e-learning tools to complete tasks and participate in other learning activities. The interface including the navigational aids, layout of text as well as the graphical elements acts as the means of interaction between the learner and the content, participants or others.

Sims (2001) identifies four level of interactivity in the context of e-learning environment. They include: learner and learner; learner and teacher; learner and content; and learner and interface. Here, the level of learner-content interactivity will be discussed in this chapter. This chapter will also investigate its impact and evaluate how to promote students’ motivation and participation in e-learning.

Impact of Learner-content Interactivity

Learner-content interactions are defined as a process of “intellectually interacting with content to bring about changes in the learner’s understanding, perspective or cognitive structures” (Moore 1989, p. 2). In recent years, most of e-learning courses have been delivered via the online platform. Normally, most of the e-learning materials are basically ‘printed text on the Web’ and various

types of interactivity have not been effectively promoted. They are in PDF format, like the ‘page turner’ or in static text format with graphics. This type of learner-content interactivity is very passive.

A study conducted by Leung, Tsang and Choi (2000) discovered that students would prefer reading text material on paper rather than on the screen. In addition, the materials on the Web were also considered to be not interactive enough. Therefore, the students did not read the materials on the web. Cornell and Martin (1997) point out that the level of interaction that is provided and available in e-learning course would affect students’ motivation.

Belanger and Jordon (2000) identify four levels of student interactivity with e-learning materials. They also point out that the level of learner-content interactivity is closely related to the technical complexity of courseware such as the interactive multimedia. They assert that there is an association between the complexity of the instructional content and the achievement of learning. The higher level of engagement generally requires more complex use of multimedia.

Interactivity with the content implies that the course has multiple branching alternatives, and learners are presented with different content and sequencing of content, depending on choices and decisions they make while progressing through this content (Belanger and Jordan, 2000). In order to strengthen the learner-content interactivity, and hence students’ motivation and participation, hyperlinks, audio and video clips, interactive activities and exercises with immediate feedback can be incorporated into the e-learning materials. Hannon and Atkins (2002) address three levels of learner-content interactivity. They are:

- low: a navigational ability to view, link and access information as fixed media;
- medium: a more functional ability to access content, choose from multiple paths through subject matter, search databases, locate and manage information, respond to tests and quizzes;
- high: an adaptive capability where the user can adapt the information space and the conditions of engagement, explore and respond to simulations and immersive environment. (section 6, para. 2)

The interaction with content, which represents subject knowledge, means that learners are involving in the learning process. Interaction is an internal dialogue of reflective thought that occurs between the learner and the material. As Pahl (2004) mentions, interaction is “triggered and supported by events in the learning environment, such as interaction with computer-based educational media” (p. 50). There is an underlying assumption that the interaction with

content with multimedia resources is beneficial to learning. However, not many studies mention how learner interacts with what is to be learned. What do learners expect to get when they involve in the process of learner-content interactivity? In fact, different people perceive the way of interactivity differently.

According to the study conducted by Moreno and Valdez (2005), multimedia environments have the potential of promoting meaningful learning. They address that “the major cognitive processes that lead to meaningful learning include selecting relevant information, organizing that information into coherent representations, and integrating these representations with existing knowledge” (p. 36). The importance of using multimedia resources as the means of learner-content interactivity is to facilitate the cognitive organization process during students’ meaning making.

The objectives of this study are to examine the role of dual code and interactivity in promoting deeper learning; to test the effectiveness of interactivity by means of a self-organization technique; and to examine the cognitive load effects of the interactive multimedia components. Three experiments were conducted with a set of questionnaires with multimedia presentations developed by Flash MX. There were 98 participants who were undergraduate students randomly assigned to different groups of experiments. In their findings, several important implications are addressed. The findings of Experiment 1 strongly supported the dual-code hypothesis, which predicted that students learn better when provided with visual and verbal knowledge representations rather than just visual or verbal representation alone. It ensures that using multimedia resources as the content presentation will enhance learning effectiveness. It also corroborates the findings of Park and Etgen (2000) which mention that “information presented in multiple forms is recalled better than that presented in a single form, and multiple-forms presentation seems especially advantageous when the information is presented within a meaningful context” (p. 200).

The results of Experiments 2 and 3 suggest that deep learning is not promoted unless careful consideration is given to the effects of different feedback strategies. It implies that interactivity is effective when students are asked to evaluate their answers before receiving corrective feedback from the system. Examining the studies above, two important issues are highlighted on the practical side of development of e-learning materials. Effective use of multimedia resources with sound combination of verbal explanation and visual presentations is beneficial to the learning process. Providing immediate

feedback for students to check their answers may not be the appropriate way to enhance their learning. As Park and Etgen suggest, it is essential to ask the learners to evaluate their own actions or comments before submitting their answers for feedback.

The focus in the study mentioned above is mainly to test the response of the participants who are viewing the multimedia e-learning components under experimental study. In macro-level of learner-content interactivity, what learners expect to get from this level of interaction is also critical and helpful to enhance the design and development of e-learning materials.

According to the survey of online learning conducted by the Open University of Hong Kong in 2004, over 73.3% students find the multimedia materials (i.e. video/audio streaming) helpful for their study. Over 79.4% students indicate that online activities make their learning interesting and enhance their learning motivation.

In the study of Sims (2003), the perception of learning experience on learner-content interactivity is investigated. Qualitative approach was used in this research which required the participants studying an undergraduate course in multimedia and interactive learning at an Australian regional university to provide written responses about the different aspects of interactivity. The focus of the study is mainly on three aspects including the benefits, characteristics and structure of interactivity. Each response can be categorized into the six major hierarchies – engagement, control, communication, design, individual and learning. The themes are based on five major aspects which bring the impact on the effectiveness of the interactive learning experience. They are educational psychology; theory and research of interactivity; technology of human-computer interactions; communication and collaboration; and design of learning environment.

Sims (2003) concludes that the construction of interactions can better match the expectations of the user if interactive learning environment is created. However, it greatly depends upon the characteristics of the individual learner. Different people interpret the information presented in different ways. The learner has to take on a more participatory role and becomes an active player in the learning process. Having clear and good presentation of e-learning materials is one important factor to enhance learner's motivation and participation.

Referring to the findings of the study conducted by Sims (2003), the major benefits of learner-content interactions which are expected from the learners during their learning process are engagement, control and learning. It implies that learners not only satisfy reading the learning content on the screen but also

expect any form of interaction which can involve them to participate in the learning process. In fact, to engage in learning explicitly means to control the learning pace. According to the findings, control is “a much more subtle aspect of the overall interactive process” (Sims 2003, p. 94).

The essence of e-learning is learner-centered which can have autonomy to control learner’s own pace of learning. Learners can be able to learn at their own pace and access a wide range of information to build their own knowledge and understanding. Therefore, providing interactive multimedia components is helpful for learners to select what information they want. It also prevents learning from becoming boring because the learner is the active player in the learning process. Sims illustrates that “the responses emphasize a notion of freedom, where the user is able to make choices or choose learning decisions depending on their particular requirements, especially those associated with access to content” (p. 97). Referring to the structure of learner-content interactivity, the findings reveal that more complex structures lead learners to have more choices to go through their learning process. The more engagement in learning, the more control in learning pace, the more individualized learning we have to provide. Therefore, instructional designers should be aware of individual differences and flexibility of choices when designing e-learning content.

How to Enhance Student’s Motivation and Participation in E-learning

Learners have greater flexibility and autonomy in selecting and participating in their own learning process. Hence, their learning experience can be more personalized and individualized. Using interactive-rich instructional design strategies to design the e-learning content allows learners to engage with the materials without following a linear flow of instructions. Unlike the most basic structure such as the turning pages through clicking on hyperlinks, learners will not necessarily go through the same experience in their learning process. The interactive-rich content that has highly engaging activity, thought provoking, and emotionally involving, will result in greater cognitive activity (Mayer, 2001).

According to Belanger and Jordan (2000), this high level of interactive materials is combined with video, sound, animation and high-resolution graphics to provide learners with a rich learning environment that can engage their psychomotor, cognitive and affective skills. The complex branching paths are based on learner selection and responses. The e-learning materials can be re-structured, chunked and reorganized so as to provide a task-based learning experience. Simulation and role-play can be included. Furthermore, learners can

interact with learning materials via the screen using various forms and interactive activities such as multiple choices with instant feedback, which can encourage learners to actively engage. Learners can also jot down some notes during reading materials online with the help of the programmed tools. It encourages learners to retrieve their notes concurrently and facilitate learners to do revision. Hot spots in graphic and JavaScript as pop up visual and auditory cues are commonly employed. More advanced activities including data entering to test the concepts through simulations, involving the games, decision-making scenarios and wikipedia blog interaction can be incorporated.

When engaged in highly motivating activities, learners experience immersion, reflection flow, collaboration, learner control, curiosity, fantasy and challenge (Iverson, 2005; Stoney and Oliver, 1997). In fact, the e-learning can support certain types of interaction like question asking and answering, problem solving, simulation control, and game playing. Providing such interactions in a smooth and rapid manner currently requires the use of newer web technologies like flash and Java programming.

The study conducted by Pahl (2004) is to investigate how learners interact with educational multimedia by means of their concrete behavior, their preferred learning style and their learning goal in the e-learning environment which can enhance their learning. The study mainly focuses on three aspects of interactions including (1) interaction and learning; (2) human-computer interaction; and (3) interaction educational multimedia. A web-based course for third level computing student is used for a case study in his study. There are various types of media using web technologies with the course content. Audio-visual materials are also incorporated and streamed online. Lab features facilitate interaction with software tools.

This type of interactive-rich content comprises a variety of interaction styles and media and integrates different kinds of educational services. It brings a number of learning strategies and activities for the learners. The study indicates that student's learning behavior based on the actual course usage is of paramount importance. It also supports providing quality e-learning materials can help to achieve a better learning experience for learners.

The strategies discussed above are related to several aspects of the learning process. The underlying design principle is learner-centered approach. Learning takes place in an interactive learning environment is far more important because learners experience their learning process differently. Learners are autonomous to control their learning pace, such as clicking the hyperlinks they are interested in; jotting down what they think in the comment box; viewing download video

or audio clips and so forth. Interactive-rich online materials keep learning from boring and motivate learners' interest. It also promotes learners constructive learning. As Jonassen, Hernandez-Serrano and Choi (2000) mention, multimedia components can help learners "build new understanding by providing them affordances to represent what they are learning" and "focus their intentions by critically valuating the underlying structure of the collected information, generate model cases from it and develop arguments to justify the hypermedia design used to represent what they have learned" (p. 121). Learners need to construct relationships among the topics by linking them. This learning process is not a simple linear process but with multiple paths emerged and pursued until the dynamics of learners' intentions and motivation are attained.

All these actions are based on learners' participation which the learners have their choice of control. Providing a sense of control is a significant level of influence for the learner through the interactive experience. As the learners play the participatory role in their learning, different types and levels of interactions appear in various situations. They will engage in the social conversation, or interact with the learning content with responsive actions. These kinds of participation become learners' engagement in meaningful activities which have a level of adaptive response in their learning experience.

Recently, the Open University of Hong Kong has just offered 'Master of Laws in Chinese Business Law' in October 2007 which is a fully e-learning programme. In this mode, students interact with the e-learning materials via e-learning platform, so they can study at their own pace and according to their own schedules. Students learn through real-time online lectures and take part in discussion forums and video conferencing, which let them enjoy the direct interaction typical of face-to-face study. This approach makes learning more interesting and facilitates communication between teachers and learners. E-learning materials are structured in the way the information presented, based on detailed learning objectives, and that they will be required to complete study units with different levels of core content navigation and go through various exercises and assessments. Their learning activities are tracked for record.

According to the survey of this e-learning programme offered in 2007, about 91% students find e-learning interactive activities very helpful to their study. About 86% students find the features of saving their feedback with suggested comments very useful for their revision. About 82% students find the features of key links and optional links which provide useful websites and information to enhance their learning. These features can help them to distinguish the important learning concepts and information from all various types of learning materials.

Their learning pace can be controlled by the students and the students can easily track back their learning progress during interacting with e-learning materials. In addition, about 80% of students find the real-time lectures and tutorials are useful for learning. Overall, about 86% students are satisfied with e-learning and find e-learning flexible.

With modification of the e-learning materials and the mode of learning changed from printed based distance learning mode to web-based, teaching will be shifted to a more collaborative learning approach which is about learning from others and with others, sharing information, ideas and experiences and working towards a common goal. It makes extensive use of e-learning technologies such as web-conferencing, discussion forums and virtual classrooms. Instructional designers have to focus as much on what learners do in the learning process. The following instructional design strategies could be considered before starting the development of e-learning materials.

1. Modularity

The core content for e-learning materials should be shorter in extent so that they are more appropriate for online study. The amount of text is reduced to a minimum. The small and modularized units of content will be emphasized and presented in various formats including key links, optional links, multimedia components, video lectures and so forth.

2. Learnability

With the help of multimedia learning components, a small chunk of information should be helpful to illustrate and demonstrate the process and some abstract content. It also encourages learners to have self-reflection and promotes their collaboration and problem solving skills through written messages posting in the discussion forums. Due to varieties of learning styles needed, it suits different types of learners.

3. Interactivity

Interactivity is the key to a quality e-learning experience. Four types of interactions including learner-content, learner-instructor, learner-learner, and learner-interface need to be critically considered in the development of e-learning.

4. Collaboration

Learning process involves collaboration and a social context, with learners working together. The use of sharing ideas in groups, collaborative learning and discussion of assignments should be employed when designing e-learning materials.

Conclusion

To develop e-learning materials, in fact, takes time and resources. What do learners expect to get when they are involved in the process of learner-content interactivity? Among the levels of learner-content interactivity, the instructional design strategies should be adopted differently, hence enhancing learners' motivation and participation. In order to improve the effectiveness of e-learning, the appropriate e-learning content presentation and approaches discussed above should be developed to strengthen the learner-content interactivity. In the long run, the development strategies of e-learning materials are the potential area to be explored.

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THE USE OF MULTIPLE CHOICE TESTS IN LAW

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Abstract

The Chapter evaluates the success in using multiple choice tests (MCT) to support student learning on the law degree at the University of Westminster. Law is a subject which does not encourage the use of MCTs as a type of summative assessment as it is difficult to set up questions that test the application of the law. However, MCTs are very useful for testing knowledge on a formative basis.

The numbers entering higher education in the UK have grown dramatically over the last few years. The numbers of students studying the law of contract, a foundation subject, have grown from a cohort of about 200 students in 2000/2001 to a cohort of 450 students in 2005/2006. The summative assessment regime has remained constant in that it is composed of an essay worth 30% of the final mark and a closed book examination worth 70%. It has been noted that students were failing in the exam usually because although they absorbed the basic rules of law, they had not learnt or understood enough basic case law. Formative assessment has been embedded in the module to endeavour to remedy the fall in pass rates. In addition to a 'mock exam', a formative test was introduced midway through the first semester (the midsessional) in order to identify those students whose understanding of the topic was questionable. Initially this was taken as a paper MCT, but with the introduction of the Blackboard learning system, the test was moved to an on line format. This was done to ease the marking burden on staff and also to ensure that tutorial time was not lost. The informal feedback on the midsessional tests suggested that the students wanted further tests to use in their revision. In 2005 three more short MCTs were introduced on popular exam topics. There was a correlation between those students who attempted the tests and those students who were successful in the exam. The average mark obtained on the module improved by over 2% and the numbers of failures decreased.

The tests were repeated again in 2006 and the data was analysed to ascertain whether the pass rates were being affected by the use of the tests. All students were emailed a short questionnaire regarding their use of the tests. The feedback from those questionnaires was analysed and some conclusions drawn as to the future role that MCTs will have on the module.

The Background

The aim of the paper is to evaluate the success in using multiple choice tests (MCTs) to support student learning on the law degree at the University of Westminster. The numbers entering higher education in the UK have grown dramatically over the past few years. The area of law has shown an increase in admissions in the UK from 41,750 in 2000/1 to 62,730 in 2004/5 (HESA). This

can be underlined by reference to the growth in the size of cohort entering the undergraduate law degree programme at the University of Westminster and studying contract at Westminster. This cohort has risen from 247 students registered on the module in 2000/2001 to a cohort of 454 students in 2005/2006.

Contract is a 'foundation' (compulsory) subject on any degree which is intended to be a qualifying law degree and thus it exempts students from further study of that subject prior to taking their chosen professional course and training. It is also a subject that is vital to understand in order to facilitate the study of other areas such as employment law, company law or even family law. It is, therefore, essential that students pass contract as it is an integral part of their studies.

Contract is a first year module at Westminster. It was revalidated in 2001. The summative assessment regime that was put in place is composed of an assignment worth 30% of the final mark and a closed book examination at the end of the year worth 70%. To comply with the demands of the professional bodies in England and Wales, there is the additional requirement that a student must achieve a minimum of 35% in each element of assessment. An analysis of the results from 2000 to 2005 revealed that although many students were doing well in the written work (The average mark for the assignment submitted in 2006 for all students was 54%), they were failing, sometimes extremely badly, in the exam. Marks in single figures were being recorded. The exam consists of a mixture of essays and problems on topics studied throughout the year. Contract does require more problem based questions to be answered than comparable first year subjects. The usual pattern was that although most students had absorbed some basic rules of law, they had not learnt or understood enough basic 'case law'. Case law is applied by analogy to the problem based questions and is cited as examples to support arguments in the essay questions. Among the learning outcomes for the contract module students are expected to be able to analyse complex factual problems and identify legal issues in areas of contract law and apply their knowledge in a variety of formal and informal assessment formats. Therefore, for a student to achieve a good grade in law, it is not sufficient for that student simply to 'know' the relevant law, the students is required to demonstrate that they can apply the law correctly. However, if a student is lacking in the basic knowledge of law, then it proves difficult to apply. MCTs are criticised because they fail to promote higher level learning but they are recognised for the benefits in supporting memorisation and fact retention (Nicol, 2007) and it was because of the latter that MCTs were utilised on the contract module.

A further consequence of revalidation was the embedding of formative assessment in the contract module, as in all year long first year modules. Initially, a mock exam was offered in the inter semester break. The formative assessment was then extended to include a test mid-way through the first semester (the midsessional). The midsessional is a diagnostic tool which is used to identify those students whose understanding of the topic is questionable. It has also proved useful in highlighting students who are not attending. Despite these opportunities for students to reinforce their learning, the pass rates and average marks on contract were disappointing, hitting a low in 2003/4 of an average final mark of 38.5%. To counter this, and restore pass rates in contract to parity with the other first year year-long modules, the formative assessment was restructured and extended. The midsessional test had originally been a paper based MCT, but with the introduction of the Blackboard learning system, the test was moved to an on line format. This was done to facilitate access to the test, ease the marking burden on staff and also to ensure that tutorial time was not lost. The informal feedback on the midsessional tests from the students via the Blackboard discussion board indicated that they wanted further tests to use in their revision. In response to this in the Spring of 2005 three more short MCTs were introduced on popular exam topics.

The Use of Multiple Choice Tests in Law

Law is a subject which does not generally encourage the use of MCTs as a type of summative assessment as it is difficult to set up questions that test the application of the law. However, MCTs are employed in some summative assessments as an element of assessment. For example, at the University of Westminster the Legal Skills and Process 1 module was part assessed by an MCT. However, this was a paper based 'fact learning' test on the workings of the legal system done under exam conditions. Work has been done in a variety of institutions to promote the use of MCTs as a summative assessment tool but these have tended to be in the context of the professional courses, for example, Peter Alldridge at Cardiff Law School or Colin Bobb-Semple at the Inns of Court School of Law. At undergraduate level there is little literature available on the use of MCTs to support learning in law in England and Wales. There is some guidance on the development and use of MCTs on a formative basis by Higgins and Tatham available on the United Kingdom Centre for Legal Education (UKCLE) website. Also contained within the UKCLE website are resources on the use of ICT generally in learning law, some of which contain MCTs. However, this lack of use of MCTs in the sphere of legal education is

disappointing, but not surprising, given the innate conservatism of those who teach law and the lack of interest in utilising technology.

MCTs on the Contract Module

It has been noted by Brown and Knight that

seen as part of an overall strategy of assessment, MCQs have a great deal to commend them. Alone, they are limited and time-consuming, although still especially worthwhile in some disciplines. Taken in conjunction with other methods used for other purposes, they have great power (Brown and Knight 1994).

This is the basis on which MCTs have been utilised within the contract module. They have been used on a formative basis as a system of supporting and reinforcing the traditional lecture/tutorial learning method.

Given the numbers of students on the module and the increasing pressures on teaching staff, it was decided to put as much of the formative assessment on line as possible to enable the assessment to be carried out, but not increase the overall marking burden on staff (Bull & McKenna, 2004). The contract module employs the use of MCTs extensively comparatively to other Law School modules. In 2005/6 a practice test consisting of ten questions on material covered in the first half of the semester was offered to ensure that the system worked and also to give students the chance to prove that they could read and follow instructions. It had the additional benefit of flushing out the AOL users whose system is incompatible with blackboard. These students were then advised to use a computer lab on campus instead or entreated to change their ISP. The midsessional test was available about a week later during Preparation Week. This test consisted of 30 questions selected at random from a central question bank for each student so that every test was unique. This prevented students taking the tests en masse and sharing the answers. The questions were on everything studied up to the midsessional break. For those students who 'forgot' to take the test over the break, a reminder email was sent to them and a further test on the same basis was offered a week or so later. The midsessional was offered on a one attempt basis, unless the system failed. If this happened, the test was reset by the module leader. The 'subject specific' tests were posted to Blackboard at the start of the Easter vacation and remained live until the exam started. These tests are analysed further below. Thus students were given many opportunities to use the system and become familiar with it.

The Style of the MCTs

The MCTs are in the traditional style of ‘stem’ plus four options. The options contain the ‘key’, the correct answer, and three ‘distractors’. Students are expected to choose one answer from the list.

An example of an MCQ used in the ‘terms of the contract’ test:

Question:	Which of the following cases demonstrated the ratio that local custom resulted in a reference to ‘1,000 rabbits’ meant ‘1,200 rabbits’?
Answer:	A Smith v Wilson B Hutton v Warren C Allen v Pink D Warren v Mendy
Correct Feedback	Smith v Wilson is the correct name for the case
Incorrect Feedback	Hutton v Warren is a case on custom but refers to allowances for seeds and labour in a tenancy. Allen v Pink concerns the importance of a written document. Warren v Mendy is a case about injunctions

This style of ‘stem plus four’ was chosen to reduce the guesswork element that can arise with ‘stem plus three’ options. Writing ‘stem plus five’ options seemed to be excessive bearing mind the aim of the test was to support learning, and it would take longer for the students to assimilate the information thus extending the time required for the tests.

The questions were presented one at a time and students were not allowed to backtrack. Once the test was completed, students were presented with their result and feedback on the questions. The feedback given on all questions is similar to the example given above. The tests were trialled in 2004/5 and some minor amendments were made following comments to the discussion board about typos and the comprehensibility of some of the questions. Most of the questions set are straightforward. However, some of them had stems or options which were deliberately phrased slightly ambiguously in order to make the students realise that case facts and ‘ratios’ (reasons for the decision) are not always clear-cut. In the example above given that the questions concerned rabbits, suitable distractors were cases with ‘rabbit-related’ references such as ‘warren’. Other examples of difficult distractors were questions where the four options were all real cases but the first named party in each option had the same

name to make the students think about which the correct case, i.e. *Williams v Williams*, *Williams v Roffey*, *Williams v Cawardine*, *Williams v Bayley*.

The tests that were being looked at for correlation with final module results were the 'subject specific' tests available in the weeks prior to the final exam. In the final exam students are required to answer 3 questions in 21/2 hours. The contract exam is divided into three sections. One question should be answered from each section. Part A contains three questions on the formation of a contract. Part B contains questions on topics relating to the content of the contract. Part C contains questions on vitiating factors and remedies. There are three subject specific tests offered. These are on exclusions clauses, terms of the contract, which are Part B topics, and misrepresentation, which is a Part C topic. These areas were selected as they tend to be the popular ones with the students in the exams. Areas such as the formation of a contract have already been covered in the midsessional tests. The subject specific tests are set up to require that a student answer 10 questions drawn at random from a question bank in a nominal time of 15 minutes. The time is nominal so as to not disadvantage the large number of students on the module with declared disabilities such as dyslexia and also to take account of the somewhat flaky nature of Blackboard, which can lock up at inopportune moments. Some students have taken the flexibility in timing beyond its limits and spent several hours in completing the test. For 2005/6 the options on the MCTS were changed to enable students to reattempt the tests in order to gauge if their learning was improving. Students were also permitted to save the test and return to it later. Most students took the test within the time frame. However, the longest time taken in 2005/6 to complete a test was recorded at over 96 hours!

The main problem with the tests, and the principle reason why they remain formative, is the reliability factor of the Blackboard system. It is impossible to guarantee that all students will be able to take the test online without a large percentage of screens 'freezing'. This is an issue that has been raised with the on line learning team at Westminster, who maintain that this is a Blackboard problem and has to be resolved by the designers of the software.

The Results — Caveats

In examining the results, only those students who sat the final exam in May/June have been taken into consideration. There are a small number of students (2) who did attempt one or more of the tests but were unable to take the exam owing to extenuating circumstances. There are also a number of students who did attempt the tests but the test locked for some reason. For some of these students

it was possible to manually award a mark for the part of the test completed. However, for most of these students, the tests tended to fall over at the start and no questions were attempted. In this case the test was simply reset. Although there is within Blackboard the performance dashboard which indicates who has used generally Blackboard and how often, there is no simple record of who took which tests and when. Thus it is not possible to state accurately exactly who is using the tests.

2004/5 Results

The overall results for the 2004/5 June exam were that 382 candidates took the contract exam achieving an average mark of 40% overall for the module. Compared to the previous year when there were no subject specific tests available the average overall mark obtained on the module improved by 2% and the numbers of failures decreased.

298 students did not attempt the MCTs. The average exam mark for this group was 38.8%. There was a notable correlation between those students who attempted the tests and those students who were successful in the exam. 84 students did attempt the tests and they averaged 45.1% in the exam. This represents an average uplift of 6.3% in the exam. The overall grades for the respective groups were non test takers achieved an average of 42%. Those students who took the tests achieved an average of 47%.

2005/6 Results

The overall results for the 2005/6 May exams were that 393 students took the exam achieving an average grade of 43.8%. 292 students did not attempt the tests and averaged 41.9 in the exam. 101 students did attempt the tests and averaged 49.8. This represents an average uplift of 8.1% in the exam. The overall marks for the module can be broken down as follows. The non-test takers averaged 42%. The average for the test takers was 51%.

However, it should be noted that the students who used the tests tend to have a slightly higher average for the coursework than those who do not use the tests. In both 2004/5 and 2005/6 the difference between the two groups was 2%.

Does Mode of Study Make a Difference?

Students can study law in three different modes at Westminster. The majority of students attend on a full-time basis. They are joined by about 26 students who are attending on a part-time basis two days a week (PTD). There are also about

50 students who attend on a part-time basis two evenings a week (PTE). It is difficult to see any clear correlation between mode of study and use of tests for the day time students. It may have been expected that the students who would make greater use of the tests would be those who are attending on a part time basis as they have less access to facilities. However, the PTD students appear to be equally divided between those who used the tests and those who didn't. Use of tests for this group did not appear to have any bearing on whether a student passed or failed. For the PTE it was notable that less than a quarter of the students used the tests. This may be related to fact that there is a different teaching team for the evenings, one of whom refuses to have anything to do with the use of Blackboard. However, for those PTE students who did use the tests only one of them failed to achieve a mark of at least 50%.

Student Feedback

All students registered on the module were emailed to ascertain how and why they used the tests and additionally to ascertain why the majority did not. This took the form of a short questionnaire (Appendix A). As there were a proportion of emails that were undelivered the questionnaire was also posted on the contract Blackboard site to ensure that all students who wished to respond to the questionnaire could do so. About 30 responses were received. Initially students were asked whether they took the tests on exclusion clauses, terms or misrepresentation prior to the exams. Student responses to this question fell into four distinct categories:

- a) those who didn't take the tests owing to extenuating circumstances;
- b) those who didn't take the tests because they were 'less organised';
- c) those who took the test because they were desperate; and
- d) those who had an organised and systematic approach to revision.

Those students who didn't take the tests were invited to give reasons why they did not use the MCTs. As identified above, there were two distinct groups of non users. The first group were those students who had suffered from some type of extenuating circumstance in the run up to the exams, which had resulted in them not taking the exam or underperforming. Most of these students stated that they simply forgot about the option of the tests. The second group were those students whose academic performance tended to be weaker, or whose attendance at class was sporadic or generally were less organised. A typical comment was "I got behind and needed the time to revise. I didn't have time to do the tests."

A more worrying response from several non taking students was that they “had no idea that there were tests online.” Given that the tests are mentioned in the module handbook and frequent messages were sent out via the Blackboard system notifying students of when the tests are available, it suggests that there are some students who need to pay more attention to the information provided. A further issue identified in the any further comments section was the accessibility of the tests, but the in light of earlier comments, the students’ responses suggested that they would not have chosen to use the tests even if they had been accessible.

When looking at those students who did use the MCTs again there appeared to be two distinct groupings. One group were the desperate, or more kindly, the less prepared. It would be unfair to categorise all of these students as less able or less focused because of the author’s personal knowledge of many students’ attendance and preparation. However, many of this group had not fully assimilated the demands of undergraduate study and their use of the MCTs was limited. These students reported that they had tended to take the test in close proximity to the exam i.e. the day or night before. There are instances of students taking the tests in the early hours of the morning of the exam and one extreme case where a student was logged into a test less than half an hour prior to the exam. The results for this group of students were poor, i.e. scoring between 1 and 5 out of ten. Typically only one of the tests was used by this group. Comments reflected more on the individual student’s lack of organisation in preparation for the exam, rather than the usefulness of the tests.

The feedback from the second group of the MCTs users was somewhat surprising to a rather jaded, and occasionally highly cynical, module leader. Most of this group had used the MCTs as they had been intended – as part of a structured programme of revision. A typical comment was that the tests

“definitely they made me realise that my revision wasnt going as badly as i thought and highlighted what i didnt know and had to work on more. (sic)”

Many of the students had taken all three tests several times. One student reported that the tests had been taken initially during the vacation after a little revision had been done to gauge how successful that revision had been. The tests were then repeated two weeks later and then finally about a week prior to the exam. Most students stated that they did have to guess on their first attempt but were categorical in stating that they took the tests seriously and did not have any

books to hand during any of the attempts. Examples of the comments on preparedness for the tests were as follows:

“Very seriously because I wanted to prepare my self well, as a result I took time to read the subject areas, then close the book and take the test.”

And

“I thought they were very useful and gave me motivation to study more as I did not want to attempt them unprepared.”

Bearing in mind the aim of the test was simply to assess knowledge, then the responses to the questions regarding the ease of taking the tests and completing it within the time limit resulted in comments such as:

“I THINK TESTS SUCH AS THOSE ARE EXTREMELY HELPFUL IN UNDERSTANDING ANY TOPIC FULLY. PLUS IT HELPS YOU TO COMMIT THE KNOWLEDGE TO MEMORY. DEFINITELY A PLUS IN UNDERSTANDING ANY TOPIC ON THE LAW COURSE. THE SIMPLICITY OF THE QUESTIONS WAS EXTREMELY HELPFUL IN PINPOINTING THE RATIO OF CASES AND THE REASONS FOR SUCH (sic).”

Only one respondent stated that they had taken the tests while at university, but had also taken them at home. This may suggest that for those students who have more problems in accessing a computer that an increase in ‘quiet’ labs may be helpful in enabling more students to participate in the tests. A surprising feature was how few students reported problems with accessing the tests, either from home or from university. Given the number of tests that had had to be reset during the revision period, this was not the feedback expected. This suggests that closer monitoring of which students experience difficulties in future is needed. The problem may be less the unreliability of Blackboard and more pure operator error on the part of the students. More training on the use of the system during induction and greater support during the year may help in increasing the number of tests successfully completed at the initial attempt. Accessibility may also be a feature of why the tests were used and how they were utilised. It has been recognised that the increased financial demands on students in higher education in the UK has led to many students having to balance the demands of study with the need to earn. The ability to access the tests remotely may be a feature of their use.

The responses to whether the instructions were clear and the questions were understandable were generally positive. When asked if they felt that the test had helped their revision, the vast majority said that it did by increasing their confidence about their knowledge of the subject. Most respondents stated that they would like further MCTs, but not only in contract. There was a clear request for the use of MCTs to be extended into other modules at all levels as a revision tool.

“Thank you for the tests, they were a great help and I hope that they continue next year.”

This request was communicated to the other core module leaders and largely ignored. Finally, it was also notable that a large number of students appreciated the opportunity to take the tests and expressed their gratitude to the team for making them available.

“The tests were fantastic! really useful and I would recommend every subject provided them with students. I actually hoped they were more because they really helped identify strengths/weakness and what needed more revision (sic)”

8. Conclusions

With regard to meeting the stated aim of creating the tests – improving the pass rates on contract, the results to date show that using the tests to support learning is making a difference to a student’s mark for the module if that student uses the tests as part of a revision strategy (Nicol, 2007). However, it is also clear that the vast majority of students are still not using the tests nor do they appear to have clear revision strategies in place.

It is accepted that not every student needs to use the MCTs. Many students achieved good marks without them. The proportion of first class marks was evenly split between MCT users and non users – 2 in each group. However, of the 75% who did not use the MCTs the problem in the exam remained the same – a lack of basic knowledge which inevitably resulted in a fail. These failures tended to be more extreme with exam marks in single figures. Nevertheless, it is admitted that MCTs are not a cure all. There were 3 MCT users who scored less than 20 in the exam. The common factor was that they only took one test scoring less than 5 on it. One of that group is recorded as scoring 1 at 6.30 on the morning of the exam so it understandable if that student was not overconfident going into the exam.

It appears that a targeted use of MCTs may be an appropriate strategy. Looking at the marks achieved by the better students, the exam grades tended to be consistent. However, it was notable that the weaker students appeared to obtain greater benefit in uplift in results. This outcome is consistent with the findings of Cartwright and Migdal who ran some small scale research into the use of electronic delivery in law at the University of Wolverhampton in the 1990s they found that

“weaker students (those who might ordinarily fail or scrape a bare pass) were achieving a mark some 10% higher than that achieved in the conventionally delivered modules.” (Cartwright and Migdal 2001)

Taking into account the final results and the feedback received the following steps will be taken for future cohorts;

1. More tests will be created to cover a greater range of topics. Nicol & MacFarlane-Dick report that providing more formative assessment opportunities promotes ‘autonomy in learning’ and thus supports learning across the course. Further finance has been applied for in order to do this.
2. The midsessional test question banks will be revised and reordered to enable the questions to be used for exam revision purposes.
3. The existing question banks will be extended to permit greater variation in the tests.
4. All staff involved in teaching on the modules will be required to undertake training on Blackboard in order to provide better support to the students.
5. The tests will be promoted more to all students on the basis of encourage students to use them in revision and prepare early for the exam. Nicol suggests that repeated opportunities to take formative assessment lead to greater motivation. (Nicol, 2007)
6. Students will be given more advice regarding preparation for the exams.
7. The short tests will be kept as repeatable so that students can gauge any improvement in their knowledge. ‘Closing the gap’ has been demonstrated in the work of Boyle & Nicol(2003).

The upward trend in marks on the module is continuing. The MCTs may be not responsible for the whole improvement but do account for a substantial part of it. The results suggested that the ‘blended learning’ approach which is being employed on contract is the right one and this will be further developed over the next academic session.

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Appendix A

Contract Multiple Choice Tests Feedback Questionnaire

1. Did you use the tests on exclusion clauses, terms or misrepresentation prior to the exams?
2. If you answered yes, please go to question 3. If you answered no, why didn't you use the tests?

Thank you for your reply. If you have any further comments, please note them below at 16.

Only answer questions 3–15 if you took the tests

3. Why did you use the tests?
4. When did you take the tests? E.g. over the vacation, at the start of the summer term, the night before the exam, the morning of the exam.
5. How many attempts at each test did you have?
 - 5.1. Exclusion clauses
 - 5.2. Terms
 - 5.3. Misrepresentation
6. How seriously did you take the tests? E.g. did you have books to hand? Did you guess?
7. How easy was the test to do?
8. Did you complete the test within the time limit?
9. Where did you access the tests from – Home or university?
10. Did the tests lock up or freeze at all? Did you have any access problems?
11. Were the instructions about the tests clear?
12. Were the questions clear?
13. Did you do as well as you expected on the tests?
14. Do you think that they helped your revision?
15. Would you have benefited from a greater range of subjects being available?
16. Any further comments?

Thank you for your reply. If you have any further comments on the tests, please add them below. All comments will be anonymised. Please note that this email has been sent to everyone registered on the contract module for 2005/6. Receipt of this email has nothing to do with your exam performance.

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