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FROM PAGE TURNING TO DEEP LEARNING: A CASE HISTORY OF FOUR YEARS OF CONTINUAL DEVELOPMENT OF AN ICT COURSE

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Abstract

As online delivery becomes more widely adopted in higher education, a proliferation of courses have developed that represent transitions of print-based resources into Web-based delivery formats. In many cases, traditional linear and directive pedagogy is reproduced in the online medium. Such approaches to teaching and learning, and to curriculum inevitably lead to linear and directive online course structures. This paper describes an action research undertaking conducted over a four year period which transformed an online computer course aimed at pre-service teacher education students from a linear, directive format into a non-linear and self-directive format. Constructivism, as well as experiential and reflective learning informed the process.

Keywords
Online delivery, non-linear learning, teacher education, action research, constructivism, experiential learning, reflective learning.

Introduction

The development of computer skills and knowledge by teachers and trainee teachers has become a significant imperative in many countries. There are great expectations resting on teachers to incorporate computer technology into their teaching and to model positive attitudes to computers to their students. As Ramsey (2000, p.68) describes, Information and Communications Technology (ICT) is 'one of the most significant challenges now confronting teacher education, teachers and schools'. Universities have generally responded quickly to the need for their teacher education programs to prepare teachers for the use of computer technology in their classrooms, often, as in the state of NSW (Australia), prompted by the mandating of computer competencies by employing bodies (Ministerial Advisory Council on the Quality of Teaching, 1997). Such a response has generally entailed the implementation of compulsory computer studies courses in teacher education programs. However, as Lundin (2002) points out, despite years of concerted effort in all Australian states, it is unlikely that more than fifty percent of teachers have a basic standard of computer skills.

Southern Cross University, NSW Australia has, like most teacher education institutions in Australia, had a core course (the term 'unit' is utilised in Australia) in ICT in its primary and

secondary education programs since 1998. It is this course that is the focus of this paper. The course is offered both internally and externally and exists as a fully online resource, enabling students to study independently, in their own time and at their own pace. Optional and non-compulsory tutorials are provided for internal students and personal one-on-one support is available to external students.

Background to the Course

The course, originally called DP329: Technology in Learning and Teaching, had been developed in 1998 as an online resource and represented a significant investment in development time. The online content dealt in detail with a range of topics including the World Wide Web, e-mail, mailing lists and newsgroups, synchronous communications, file transferring and Web publishing, together with the application of IT in learning and teaching, including Internet based educational activities, educational software and ethical and legal issues. The Web site contained over 880 Web pages, many extremely lengthy. The course was divided into 26 topics, and navigation through the course materials was linear, each page leading to the following page and each topic leading to the following topic. This meant that students were prompted to travel through each of at least 600-700 pages, although a content-style navigation structure had also been produced. The content was, in places, highly technical, with transcripts of interviews with Web publishing 'experts' and students being required to learn HTML. Furthermore, students had been partially assessed through a final examination focusing on technical terms and requiring memorization of 'facts'.

Remembering that the intended student group undertaking this course were teacher education students without necessarily a strong computer background (or in many cases even an interest in computing), this highly directive teaching approach through a linear structure of technical content, and an assessment approach founded on regurgitation of technical 'knowledge', seemed problematic. A change in staff responsible for the course's delivery occurred in 1999 and provided an opportunity to re-evaluate and re-develop the course from a new pedagogical perspective and within a research-based framework.

Research Methodology

Action research was deemed to be an appropriate methodology to pursue both change (action) and understanding (research) (Dick, 2000). Action research has a strong theoretical and practical connection to educational research, and, more specifically, teacher professional development (Carr & Kemmis, 1990). The widespread uptake of action research in educational contexts seems to lie in its aim of 'solving pertinent problems in given contexts through democratic inquiry in which professional researchers collaborate with local stakeholders to seek and enact solutions to problems of major importance to the stakeholders' (Greenwood & Levin, 2000, p.96). The focus of educational action research is for practitioners to make sense of their practices and to improve them, and in so doing assist in the development of theory and knowledge (Hughes, Denley & Whitehead, 1998). Action research is participatory research: 'it is a process directed towards and directed by those who are actually taking the journey' (Grundy, 1995, p.9). As such it provided a valid approach to founding the course's development in the experiences of both students and teaching staff. Action research thus provided an opportunity to elicit a greater understanding of the factors impacting on students' learning in this particular computer education context: to gain a 'picture' of the learning experience as grounded in the experience of the students themselves.

The research consisted of three distinct research cycles over the period of 1999-2001, each consisting of phases of planning, acting, observing and reflecting. Each of the cycles progressed understanding of the learning experiences of students, and the influences impacting on their learning. Each cycle will also be shown to have lead progressively from a conceptualisation of the course as directive and linear, toward a pedagogy founded in non-linear, non-directive and reflective conceptualisation.

Data was collected in each cycle using multi-method approaches including survey instruments, observations and qualitative data drawn from reflective journals maintained by teachers and students over each teaching period. All students in the course were invited to be involved. In this respect the research approximates large-group action research where it is 'not the mass of people agreeing on one idea that is of value, but rather the number, complexity and quality of ideas that can be generated among a number of people' (Martin, 2001, p.201).

The Rationale for Non-directive Learning

Computer technology is evolving at such a rapid rate that, if an individual undertakes traditional, directive-style training in how to use a particular piece of software, that knowledge is likely to be inadequate or out-of-date in a very short period of time: months not years. This rate of change places immense strain on everyone involved with computers, including teachers, no matter what their skill levels and can lead to 'adverse cognitive, affective and motivational consequences' (Rozell & Gardner, 1995, p.126). Technology is too diverse and evolves too rapidly for teachers to be reliant on workshops and seminars (Melczarek, 2000). Relevant computer education thus requires more than skills training. It also involves changes in attitudes, values and beliefs that develop confidence for ongoing learning.

Research (Coffin & MacIntyre, 1999) emphasises that affective influences such as negative attitudes toward computers, anxiety and low computer self-efficacy are primary deterrents to computer use. Learning to use computers involves learning to adapt to change, to be flexible, intuitive and above all persistent. Teachers need to develop adaptive computer learning skills. They need to develop self-efficacious approaches to information technology, an ability to learn from colleagues, support personnel and students (Rea, Hoger & Rooney, 1999); in short, they need to engage in self-directed and lifelong computer learning.

These issues evidently indicate a need to move away from skill objectives to focus more on teachers' approaches to computer learning, their beliefs, attitudes and metacognitive understandings. Such an approach entails helping individuals come to terms with the nature of technological change and their own abilities to confront this change. In such a context, emphasis needs to be placed on teachers becoming more self-directed in identifying what they need to learn and in undertaking the actual learning required. Learning through independent hands-on experience and regular practice is vital and learners who know how to be self-directed and independent will be more successful than those dependent on structured routines or guidelines (Ropp, 1997; 1998). Melczarek (2000) emphasises the importance of self-directed learning and contrasts often adopted directive teaching approaches with proficient computer users' naturalistic learning approaches:

> Reliance on direct instruction will only lead to greater dependence on others and the need to continuously take technology courses and workshops… Only through self-directed learning will learners become dependent on themselves to solve their own problems, become life-long users and inherently learners of technology… This will hopefully lead to greater and more innovation in the use of technology… the future success of technology integration must be seen as being dependent on teachers developing their own ideas instead of simply implementing the ideas of others.

Of implicit importance here is a focus on learning strategies and empowering learners to continue to learn computer skills throughout life. As emphasised by Hiemstra, (1994, p.89) 'learners who have never been encouraged to take responsibility for their own learning can remain unaware of the power they possess as learners'.

Theoretical Underpinnings to the Redevelopment

Before describing the practical changes and developments to the course it is valuable to briefly outline the theoretical and pedagogical underpinnings to the redevelopment.

Firstly, the resultant online course can be seen as assuming a more **constructivist approach** to learning and teaching. If 'constructivism involves the active creation and modification of thoughts, ideas, and understandings as the result of experiences that occur within a socio-cultural context' (Lissack, 1999, p.2) then the resultant course certainly involves students in actively sharing their learning process. The reflective structures which enveloped the learning approach were consistent with constructivism (Twomey Fosnot, 1996) as reflection enabled individuals to make sense of their world by constructing their own representations or models of their experiences (Jonassen, Peck & Wilson, 1999). Unlike the previous instuctivist approach, represented by the linear design structure, the 'set' body of knowledge and the exam-based assessment process, the new course format emphasised the ability of students to raising their own questions and set their own learning goals. Problems and errors are perceived as inevitable and an important source of learning. In the new course format the online resources are not intended to impart knowledge but rather to facilitate and scaffold students' self-directed learning and construction of metacognitive knowledge.

The pedagogy of the redeveloped course is founded on **experiential learning** (Boud, 1989; Henry, 1989; Kolb, 1984; McGill & Weil, 1989; Packham, Roberts & Bawden, 1989; Weil & McGill, 1989) which was perceived as compatible with the goal of fostering self-directed and lifelong learning. As Henry (1989) explains, experiential learning methods are designed to foster self-motivated, assertive, adaptable and able situation improvers, who know how to find relevant information and apply it.

Key to the re-design of the course was the concept of **reflective learning**. In agreement with Candy, Crebert and O'Leary's (1994, p.100-101) premises, both students and staff consider the influences on their computer use to date, challenge their assumptions, beliefs, current learning and teaching approaches, and perceive appropriate paths for improvement in their teaching and learning practice. This reflection is scaffolded within a metacognitive framework, as reported elsewhere (Phelps, 2001; Phelps & Ellis, 2002a, 2002b, 2002c; Phelps, Ellis & Hase, 2001) with the aim or fostering computer capability. To this end, a major adjustment made to the educational design of the course was the replacement of the final examination with a reflective learning journal. As Holly (1987) states, a journal can be a tool for both analysis and introspection. It can be a chronicle of events, a dialogue with, and awareness of, facts and interpretations, as well as a dialogue with oneself over time: 'It is a learning process in which you are both the learner and the one who teaches' (Holly, 1987, p.4). Keeping a journal helps adults 'break through habitual modes of thinking and change life direction through reflective withdrawal and re-entry' (Lukinsky, 1991, p.213).

The Cycles of Development

The first semester of teaching (cycle one) involved a number of changes to the initial online resources and course structure including removing the final examination, conceptualising the course within a reflective framework, and therefore including a reflective journal as a major assessment item, removing and/or replacing some existing content considered irrelevant, technical or inappropriate for the target group, including a 'Skills Chart' that enabled students to self-assess their skills in a range of areas and to communicate the expected minimal level of skill development. The first semester of teaching (cycle one) was an opportunity to elicit a greater understanding of the factors impacting on students' learning in this particular computer education context.

Online learning presented a new experience for most if not all students. For many, the initial prospect of studying an online course was 'quite daunting' and some students' attitudes were coloured by discussions with students who had undertaken the course in previous years. Some

students explicitly stated that they would prefer print-based resources: 'It makes it much easier to flick back to something... highlighting your notes and reading over them in spare minutes is effective...'. The course was perceived by a significant number of students as presenting a very heavy workload. Many commented on the large amount of reading and some highlighted their difficulties with reading on-screen. This workload greatly impacted on students' motivation and concentration, particularly as the semester progressed: 'Sometimes it became very monotonous and could feel myself wanting to skip over some sections'. Other students, however, acknowledged the intrinsic appropriateness of online learning for computer skill development: 'You learn how to cook by cooking, how to play cricket by playing cricket and the best way of learning about the Web is learning on the Web'. Other issues identified in this first cycle included technical access (i.e. Web-access by students) and help-seeking strategies.

Many of the functional issues raised by students were associated with, or compounded by, the design and structure of the course resources, many aspects of which were still at odds with the objective of making the course a flexible and learner-centred learning resource. The huge volume of reading exacerbated access difficulties and feelings of isolation and lack of support, and the linear structure forced all students along an identical study pathway. Many of the more technical aspects of the course were little understood by students and, because the focus was on learning skills or the meaning of particular technical terms, many students had difficulty thinking laterally about applications of the technology in the classroom. Despite the large quantity of information in the resource, some aspects of the courses' objectives were not covered by the resource, limiting the ability to use the online resources as a 'stand alone' self-directed resource. Staff faced a considerable challenge in achieving the addition of more topics while decreasing the quantity of material.

A period of reflection following cycle one and further planning for cycle two led to engagement with a range of general and applied theory relating to social cognitive theory (Bandura, 1977,1981 & 1997) and attribution theory (Kent & Martinko, 1995a; 1995b; Martinko, 1995) and their application in computer learning contexts. During cycle two the course was re-developed to incorporate a metacognitive learning processes, in particular a focus on self-efficacy, attribution theory and learning styles. This learning approach is the focus of other papers (Phelps, 2001; Phelps & Ellis, 2002a, 2002b, 2002c; Phelps, Ellis & Hase, 2001). This metacognitive approach focused students more on the processes of computer learning, rather than simply the content (whether it be skills or knowledge). Although the materials still contained much of the same content, as well as additional information, students were presented with far more choice about how they engaged with the content. In terms of the structure of the online resources, the course was transformed from a structure of 26 essentially linear topics to a four-module structure: Thinking, Using, Applying and Creating. Within these four modules were a number of topics. The modules and topics were independent of each other and could to completed in any order or concurrently. At this stage, the content within each topic was still fairly linear. A further significant change was the provision of the course on CD-ROM rather than simply via the Web, a transition which was greatly appreciated by students given issues of accessibility in many rural areas.

Cycle three refined and added to the metacognitive approach such that it incorporated a comprehensive array of factors impacting on computer learning including playfulness, the role of memory, the importance of difficulty and effort in enhancing learning retention (Bjork, 1994) and the importance of balancing problem-solving and help-seeking. Students were also scaffolded by a multi-level skills chart that required them to set their own goals. Most importantly, students were prompted to consider the nature of learning online and, in particular, the authenticity of the non-linear learning environment. They were also encouraged to confront their (potential) expectations that teachers should 'tell you exactly what you have to learn, and how you should learn it', using an analogy of the learning which occurs when someone becomes a parent. In this way it was emphasised that there was no single body of information in the course that all students had to work through identically, since everyone would have different interests, existing knowledge and skills and therefore different needs. Rather, an emphasis was placed on students having fun in pursuing their learning goals.

Of most relevance to this paper, however, was the restructuring of the content in each topic, particularly the skills-based topics. Each topic within the Using module was re-presented according to five 'windows': Facts, Skills, Activities, Use in Schools and Reflection. These windows were accompanied by a bright, inviting and 'fun' graphic interface, one which encapsulated an approach of 'play' and exploration. These five windows were designed in response to the recognition that some students required or preferred foundational understandings (facts), or foundational skills, while others needed to be challenged to set and achieve ambitious learning goals, and to 'test out' their knowledge (activities). The structure embodied a recognition of the importance of perceived usefulness (classroom application) and maintained the emphasis on reflection. Students thus had to be more active in 'picking and choosing' their learning approaches. They had more choice about what they learnt, but more importantly, how they learnt it. No longer were they simply page turning, but rather they were actively engaged in selecting which content and which activities were most appropriate in achieving their goals, and in documenting through reflection the resultant, personally significant learning. The online unit itself will be 'showcased' to conference delegates in order to illustrate the resultant course structure and the underpinning learning and teaching approaches.

Progressively, over the course of cycles 1-3 students' reflections indicated decreasing emphasis on functional issues such as predominated in cycle 1, an outcome perhaps influenced not only by improvements in access to technology, and the production of the course CD-ROM, but also by the more pro-active role being played by students in their learning. There was less a culture of 'blame' (external attribution) and far more one of seeking solutions and strategies to enhance learning. With independence offered as an explicit goal, students seemed to have a greater appreciation and understanding of the teaching approach, with consequential increase in students' independence. Whereas, in cycle 1, only a minority seemed to thrive in the independent and flexible learning context, it now seemed to be accepted and embraced by the majority. The potential of reflection in assisting students to confront fear and deal with difficulty had been revealed in cycle 1; but, by cycle 3, the course was far more successful in evoking these changes in more students. The non-linear approach, moving away from pushing all students through the same content, had made a significant difference in this respect, producing a learning environment which was relevant and challenging for all students. By cycles 3b and 3c, students were more likely to be touched by a sense of 'fun' and 'excitement' in their computer use.

Conclusion

Informed by literature and theory, the progressive re-design of the course has encouraged students to engage in reflective practice to better understand their own learning approaches with regard to computers. It challenged students to adopt a metacognitive approach and to move form a simple 'page turning' approach to learning to one that involved 'deep learning'. Consistent with constructivist approaches (Kanuka & Anderson, 1999) the course has been progressively re-designed to actively and explicitly provid a variety of different experiences that do not expect all students to engage with it in the same manner. The course materials have evolved from a prescriptive set of linear resources to a collection of independently structured, stand alone modules and topics. Such a structure is relatively easy to update as new technologies and topics appear.

It is the comments of students themselves, however, that have led us to realise the broader implications of this research. The influence of the learning and teaching approaches developed throughout this research have not only changed our own teaching practice, but have had an impact on the learning of many students. Such an impact will extend beyond the context of this Unit.

> … I think that I have learnt more about the way I learn than I have about the computer, which I think will be a more beneficial way of learning to be flexible with the changing nature of IT.

Of even greater significance is the potential for the research to touch the lives of the young people in these future teachers' classrooms, as the following student reflections indicate:

> I think that by creating a caring environment that believes 'mistakes are our friends' and encouraging students to enjoy their own learning and to take some responsibility for their own learning I can foster the development of higher self-efficacy among my students and in turn influence performance positively.

> From my reading this semester I know that there is a massive push towards empowering all students to be self-directed learners... I feel that learners need to know how to own their own learning, but that this does not come automatically, and teachers themselves need a lot of help in altering how they teach to achieve this aim. That is, if teachers like me teach how they were taught then this aim will not be realised. However for me, Units such as this one are influencing my philosophy of teaching markedly, and I know that already my teaching will be different than it would have been if I had... not done this Unit.

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