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Mapping the complexity of computer learning: journeying beyond teaching for computer competency to facilitating computer

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Mapping the Complexity of Computer Learning:

Journeying beyond Teaching for Computer Competency to Facilitating Computer Capability

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BA, MDEd, DipEd

Thesis submitted to fulfil the requirements of Doctor of Philosophy
Southern Cross University

November, 2002
I, Renata Phelps, declare that the work presented in this thesis is, to the best of my knowledge and belief, original, except as acknowledged in the text, and that the material has not been submitted, either in whole or in part, for a degree at this or any other university.

Signed .................................................    Date ......................................
Abstract

For future generations to maximise their capability to operate within technologically driven economies, it is critical to foster computer abilities at every level of the schooling process. Teachers are central to this process. Yet, for many teachers, the need to integrate computer use in their teaching is threatening and overwhelming. This thesis argues that, given the rapid rate of technological change, skills-based approaches to computer education inadequately prepare teachers for a career of continued technological change. Effective computer education for teachers requires more than skills training. It involves changes in attitudes, values and beliefs that provide confidence for ongoing learning. Furthermore, it involves learning to adapt to change, to be flexible, intuitive and above all persistent. It requires the fostering of teachers who know how to be self-directed and independent in their computer learning, rather than those dependent on structured routines or guidelines.

This thesis is the ‘story’ of an action research initiative underpinned by a belief in the importance of approaches to computer education which foster lifelong computer learning. It traces the journey of a reflexive process of change and iterative development in the teaching of an educational information technology (computer) unit to pre-service teacher education students. Over a period of three years (1999-2001) I pursued a central research question, namely: How can I develop my teaching practice to better facilitate the development of capable computer users? The research explores the distinction between a ‘competent’ and a ‘capable’ computer user and trials a range of teaching and learning approaches that aim to facilitate the development of capable computer users.

From this constructivist research and teaching process a multidimensional approach to computer education emerged, founded on metacognition and reflection. This approach is demonstrated to offer many advantages over a skills-focused approach. This thesis maps the complexity of the computer learning and teaching context, arguing that simplistic approaches to teaching will produce narrow and limited learning outcomes. Rather, a holistic approach is proposed, one that moves beyond the development of computer competency toward a longer term vision of facilitating computer capability. It is argued that the role of the computer ‘teacher’ is to foster reflective awareness and develop a learning environment that can assist computer learners to become comfortable existing on the ‘edge of chaos’.

This research supports previous studies which indicate the important role of computer self-efficacy and the influence of factors such as perceived usefulness, anxiety, support and frequency and duration of use. However, the research also documents the unpredictable influence of these factors on individuals’ resultant approach to computers and challenges dichotomous interpretations of such factors. Appropriate attribution is also shown to be a major influence on computer capability, as are factors such as help-seeking, motivation and goal-setting, although again, these influences are non-linear. It is argued that computer capability cannot be ‘taught’ but, rather, computer educators should look to creating environments where its emergence can be facilitated. The metacognitive computer learning context developed and explored through this research is one such approach.
Acknowledgments

A thesis is never the undertaking of a single person and there are many people who have travelled this research journey with me. I would like to take the opportunity to thank them.

The decision to commence a PhD cannot be made without the commitment of one’s entire family, and it is my partner Don Metcalfe and his children Wanda and Julius who have experienced the day-to-day trials and tribulations of this undertaking. Their support has been far more than emotional. Together they have offered administrative assistance as well as domestic support, without which this endeavour would have been extremely difficult. My wider family, in particular my parents, Lionel and Lenore, have also borne the brunt of this extended undertaking. It is because of their commitment to education and their fostering (in me) of a passion and dedication for lifelong learning that the impetus for this research arose. I can only hope that my father’s dedication to education is reflected in my work.

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Publications Arising from this Research

(at time of submission)


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The reader might note that appendix 1 provides notes regarding editorial and stylistic conventions utilised throughout this research, including key definitions and abbreviations. Particular note might be made of the conventions employed throughout this thesis for the numbering of pages from electronic publications (e.p.).
“One of the most difficult tasks any undergraduate teacher preparation program can face is trying to help educators become comfortable with computers while still preparing them for the ever changing and flexible technologies of the 21st century... Time and time again I am presented with training programs that show teachers how to memorize steps in order to become experts in particular software. The problem is that with the speed of changing technologies, expertise turns into frustration as memorized steps become chaff in the wind. This is readily apparent in undergraduate pre-service programs where students learn technology skills but find that they can't integrate the skills (or can't remember the steps) upon graduation and placement. There are cases where teaching specific skills inspires some teacher education students to adopt a technology mindset to approaching curriculum planning. However, for the most part, this transmission model of technology adoption fails”.

(Ferdig, 1998)
Chapter 1 - Charting the Context of Research and Practice

Within many vocations, technology is changing at such a rate that one’s occupational preparation can become obsolete in a matter of years. One of the specific implications of such rapid technological developments is the heightening of the need for learning throughout life (Candy, Crebert & O'Leary, 1994).

1.1 Introduction

Computer technology plays an integral role in our personal, professional and educational lives. The ability to utilise this technology has become the new literacy for the 21st century and is of critical importance in enabling Australia to compete successfully in the global community. For future generations to maximise their capability to operate within competitive and technologically driven economies, it is critical to foster computer abilities at every level of the schooling process, and teachers are central to this process. Just as literacy and numeracy have become imperatives in school education, so too now has ‘technacy’. In an initiative paralleling past and current approaches to literacy and numeracy education, New South Wales (NSW) will, in 2004, implement state-wide computer skills assessments for all Year 10 students, with plans for the later introduction of testing for Year 6 students (NSW Board of Studies, 2001). Such an initiative reflects the emphasis on computer skills not only at the state level, but nationally and internationally, and highlights the critical importance of all teachers assuming responsibility for the integration of computer technology across Key Learning Areas (KLAs). Two key reports (Esson, Johnson & Vinson, 2002; Ramsey, 2000) have emphasised that, given the aging population of teachers in Australia, and the issue that few received pre-service training in computer use, both professional development and pre-service training in computer technology is critical. While some beginning teachers now entering the profession have sound computer abilities, many have themselves missed out on computer education throughout their own schooling. Therein lies the challenge. There are great expectations resting on teachers to incorporate computer technology into their teaching and to model positive attitudes to computers to their students. Many, however, neither have the skills nor the confidence to do so. Ramsey (2000, p.68) describes information and communications technology (ICT) as ‘one of the most significant challenges now confronting teacher education, teachers and schools’.

Universities have generally responded quickly to the need for their teacher preparation programs to incorporate computer skill development, often, as in NSW, prompted by the mandating of computer competencies by employing bodies. Such a response has generally entailed the implementation of compulsory computer studies units. Similarly, professional development initiatives have been implemented by employers, prompted by the imperative that all practising teachers reach base levels of computer competency. In this thesis it will be argued that, given the rapid rate of technological change, it is questionable whether a skills-based approach to computer education adequately prepares teachers for a career of continued technological change. As Dugan (2000) has emphasised, simply increasing training will not increase integration. Computer learning, particularly for teachers, cannot be so oversimplified. Effective computer education for teachers requires more than skills...
training. It involves changes in attitudes, values and beliefs that develop confidence for ongoing learning. It involves learning to adapt to change, to be flexible, intuitive and above all persistent. In short, it requires the fostering of teachers who know how to be self-directed and independent in their computer learning, rather than those dependent on structured routines or guidelines.

This thesis represents a journey: both personal and professional. It is the ‘story’ of an action research initiative underpinned by a belief in the importance of approaches to computer education which foster lifelong computer learning. This thesis documents a reflexive process of change and iterative development in the teaching of an educational information technology (computer) unit to pre-service teacher education students. Through an action research project over a period of three years (1999-2001) the researcher pursued a central research question, namely: **How can I develop my teaching practice to better facilitate the development of ‘capable’ computer users?** The research explores the distinction between a competent computer user and a capable computer user and trials a range of teaching and learning approaches that aim to facilitate the development of capable computer users. A metacognitive and reflective approach to computer education is refined and presented as an alternative to a skills-focused approach.

This introductory chapter charts the context of computer use within the teaching profession and the challenges this presents for teacher educators. From this exploration the context of the research is described, including some background to the Unit which is the focus of this research. A summary of the three action research cycles that form the foundation of this research is provided, before the limitations, delimitations and ethical considerations underpinning the study are defined. Finally, the chapter provides an overview of the structure of the thesis, including a justification for its somewhat non-typical presentation.

### 1.2 The Issues Surrounding Computer Skill Development

While recent studies (for instance, Knezek & Christensen, 2000; Warner, 2000) document growing levels of computer competency among school students, there are still many mature-aged individuals, as well as school leavers, who are insecure in their computer use and this is likely to be the case for some time yet (Watson, 1997). Organised training or education programs such as those provided through adult education programs or Technical and Further Education (TAFE) are an obvious choice for many individuals. Organisations, too, have tended to react to the professional development and retraining needs of their staff by conducting workshops and training: a ‘visible’ solution in contexts where organisations need to be seen to be supporting the re-skilling of staff. End-user training in the use of computer software and hardware has thus become a significant area of professional development and adult education in a range of educational and organisational contexts.

There is little research or documentation that discusses the teaching strategies employed in computer skills ‘training’ or the approaches which individuals take in their own learning of such skills. Many computer training programs are directive in nature, guiding participants through a series of step-by-step instructions and focusing on one particular program or computer function. Certainly, educational contexts such as vocational education and training, which draw on competency-based approaches to learning, tend to be highly structured and directive. Such systemic solutions to particular problems are indicative of wider trends in management which, more often than not, have a ‘poor rate of return’ (Hase
Chapter 1: Charting the Context of Research and Practice

However, experienced and confident computer users adopt quite different learning approaches from those of novices. Firstly, many individuals who become adept at using computer technology learn experientially, predominantly through self-directed exploration, rather than turning to short courses or training sessions (Davis, 1999). If they do attend structured training then they are likely to be less concerned with step-by-step instructions than deriving broad conceptual understandings of the capacity and features of the software or hardware.

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, no matter what their skill levels. ‘For many workers the pressures created by rapidly changing computer technologies have produced adverse cognitive, affective and motivational consequences… Ultimately, computing problems can contribute to employee alienation and apathy’ (Rozell & Gardner, 1995, p.126). Computer training thus presents significant challenges at the individual and organisational level because a relevant professional development program requires more than skills training. It also involves changes in attitudes, values and beliefs that develop confidence for ongoing learning. Recent 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. 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). In this thesis I will be focusing specifically on how these issues surrounding computer skill development impact on one particular professional group, namely school teachers.

1.2.1 Computer Skills and the Teaching Profession

Numerous studies point to limitations in pre-service teacher education in terms of computing (Blake, Holcombe & Foster, 1998; Dogger & Dickson, 1991; Handler & Pigott, 1995; Higdon, 1995; Strudler, McKinney & Jones, 1999; Wild & Oliver, 1995). Similar critiques have been made of professional development programs offered to practising teachers (Downes et al., 2001; Niederhauser, 2001; Russell & Bradley, 1997; Williams, 1998) and various alternative models are beginning to be proposed and trialed (Bell & Coultas, 1996; Holtzberg, 1997; Strudler, McKinney & Jones, 1999; Williams, 1998). It has been stated that teachers, in general, are not confident in their use of computers (Russell & Bradley, 1997) and that there is historical resistance surrounding their use (Albaugh, 1997). 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.

For many teachers, the gap between perceived technological competence and learning to use computers in their teaching is often threatening and overwhelming (Ropp, 1998). Many have high computer anxiety and low computer self-efficacy, which is further exacerbated by the high level of computer confidence of their students. Furthermore, given the isolated
and independent nature of their work, if teachers encounter difficulties there is often very little assistance or support available to them (Becker, 1994).

Computer ‘literacy’ is a frequently discussed concept but one that has continued to change in definition over time. Russell (1995) has noted how early literature emphasised the need for understanding hardware, software and basic programming such as Logo and that the emphasis then shifted to an applications-orientation, stressing skill development and competency in using particular programs. While such a definition is still used by many researchers and writers (for instance, Goldweber, 1993; Sheffield, 1998) a further evolution is emphasising a more values-based approach, which requires teachers to view their role in the classroom as ‘facilitator of knowledge rather than the fountain of all wisdom’ (Higdon, 1995). The teacher preparation and professional development literature is now emphasising integration of computer technology into teaching practice (Fisher, 1997; Lai, 1999; Orwig, 1997; Strudler, McKinney & Jones, 1999; Stuhlmann, 1998; Thomas & Cooper, 2000; Williams, 1998). Similarly, the Australian Council for Computers in Education (1999) recently described IT literacy as embracing thinking skills, analysis skills, communication skills, team work skills, problem-solving skills and creative processes. Such a definition emphasises the holistic nature of computer literacy.

In the New South Wales (NSW) Education system a significant initiative, the Technology in Learning and Teaching (TiLT) Program, (NSW Department of Education and Training (DET) 1998a; 1998b) has been in place since 1997. This program has provided self-instruction material and workshop-based training to thousands of practicing NSW teachers. However, as Melczarek (2000) asserts, technology is too diverse and evolves too rapidly for teachers to be reliant on workshops and seminars. 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. 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.

1.2.2 Challenges for Teacher Education

Like many education systems, the NSW DET requires all pre-service teachers to gain a basic level of technological proficiency prior to employment. However, as Ropp (1997) points out, ‘proficiency’ or ‘competency’ is a construct that is demonstrated at a particular point in time and, as such, the notion of ‘proficiency’ is insufficient to ensure sound continued integration of technology into teaching practice, or to support notions of lifelong learning. The majority of practising teachers who successfully integrate technology into their teaching were not taught how to do this in teaching preparation programs but learnt about new technologies, and adapted them for use in their classroom, after entering the workforce, a process usually requiring extensive individual work of an independent nature (Ropp, 1998). These claims are supported by the findings of Chandler’s (2000) study of self-taught computer users. In addition, research such as that by Zhao et al. (2001) emphasises the importance of factors such as a positive attitude to integration, enthusiasm, lack of anxiety and approach to learning as key factors in adoption of technology by teachers.
The problems with many pre-service computer education programs are highlighted by Ferdig (1998) who points to instances where students learn technology skills but can't integrate the skills, or remember the steps, on graduation and placement. Ferdig states that ‘there are cases where teaching specific skills inspires some teacher education students to adopt a technology mindset to approaching curriculum planning. However, for the most part, this transmission model of technology adoption fails’ (Ferdig, 1998, e.p.). In fact, in the area of educational IT training, the criticism of teacher professional development which was made by Barth (1986) is particularly relevant: that most forms of teacher development activity leave untouched the incompetent, insult the capable and at best, are ineffectual.

A clue to the ineffectiveness of many training programs is provided by Loveless (1995, p.xii): ‘It is not possible to consider the use of IT in classrooms without reflecting upon one's beliefs about learning and teaching. IT capability can be seen as much more to do with an approach to ways of learning and working than as the development of a set of skills’. Similarly, Melczarek (2000, e.p.) 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.

These issues evidently present challenges to teacher preparation and professional development. They 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. 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’. Continuing to teach computer skills by employing teacher-directed approaches may well be easier than challenging the power base of the teacher as the ‘source’ of knowledge (Long, 1990). These are issues that are addressed throughout this thesis.

The challenge addressed in this thesis is the need to understand end-user computer education in a broader context than simply skill development. Underpinning this exploration is a distinction between computer competence and capability, concepts further explored in chapter 2. The following quotation provides the philosophical and conceptual impetus for this research:

Any society in which progress and change are common features requires its people to be independently capable. It should be a distinctive role of higher education, as opposed to intensive training, to prepare people with real capacity for managing and
coping with change and uncertainty. The speed of technological, economic and social change means our jobs and circumstances change more frequently and less predictably than before... (It) puts a premium on giving people confidence in their own ability to learn and shows how futile it is to try to sustain the formal transmission of knowledge model of higher education (Stephenson, 1993, p.20-21).

This challenge is the focus of the research outlined in this thesis.

1.3 **Action Research: The Central Tenet**

While somewhat unconventional, it is critical at this point to provide a discussion of the methodology employed in this research and its influence on the presentation of the thesis. The overarching framework for this study was action research. As the name implies, action research is intended to produce both change (action) and understanding (research) (Dick, 2000). 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). This notion of participation is further explained by Kemmis and McTaggart (1988, p.5):

> Action research is a form of collective self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own social or educational practices, as well as their understanding of these practices and the situations in which these practices are carried out.

Action research was, for me, more than a methodological choice, a distinction also made by Lau (1999, p.2) who describes it as a ‘commitment to an underlying philosophy of social science’. Similarly, Sumara and Carson (1997) perceive action research as a ‘living practice’ that requires the researcher to not only investigate the subject at hand, but also to account for the way in which the research both shapes and is shaped by the researcher. As will be revealed throughout this thesis, action research formed the foundation upon which the formulation, design, conduct and presentation of the study was based. The importance of this cannot be overstated. Action research was selected as the most methodologically appropriate approach given the nature of the research focus. My intentions were at no stage limited to knowledge generation but instead I wished to improve practice, both my own and that of my students. From a philosophical and ethical point of view it was important to me that the participants in the research should benefit from the research in terms of their own learning and future teaching practice.

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). To reiterate, my research focus was to explore how I could develop my teaching practice to better facilitate the development of capable computer users. Action research was, thus, an appropriate and justifiable methodological choice.
While action research is recognised as a valid form of enquiry, the paradigmatic positioning of many disciplines may still bring healthy (or perhaps unhealthy) scepticism towards this methodology (Dick, 1993; 1997; 2000; Hughes, Denley & Whitehead, 1998). Chapter 2 of this thesis further explores the epistemological and methodological justifications for my approach to the study, in particular the notion of participation and issues of generalisation, validity and rigour.

### 1.4 Explicating my Values, Beliefs and Assumptions

It is critical for any researcher to explicate their value and belief systems and their personal assumptions - to define themselves as a researcher (Hall, 1996; Rossman & Rallis, 1998). Each of us perceives the world differently, filtered through our senses, frameworks and assumptions (Dick, 1997). The act of reflexivity represents a conscious effort by the researcher to ‘tell the truth’ about the research account (Gergen & Gergen, 2000). As an educator this explication is doubly important because, as Tripp (1998) has highlighted, our values are valuable to us and very naturally we want those who we teach to make our values their own. Reflexivity forms a central role in my research, as I acknowledge the effect of my presence as a researcher on what is being investigated and the influences of my beliefs, values and assumptions on the way that I teach. For this reason, I have chosen to define my position as a researcher and teacher ‘up front’, albeit briefly, and will continue to discuss and challenge these positions throughout the thesis.

In my approach to both my research and my teaching I firmly identify as a constructivist. I believe that we can only ‘know’ through interaction with the world and that, at best, research should seek to ‘uncover, interpret and illuminate meanings of what is happening, being done, being understood or being interpreted by those involved in the activity under investigation’ (Nunan, 1991, p.26). In my approach to education I believe that teaching is not about imparting knowledge but, rather, is about facilitating learning. In my role as an academic I see myself as both a learner and as a teacher. My approach to research is similar to that expressed by Morgan (1991), which is to attempt to make sense of the multiple realities of complex phenomena. I view people as self-determining and, from this, I perceive my research as shaped, to a significant degree, by those who participate in it, a point emphasised by Reason (1994). My approach might be paralleled to that of Carr and Kemmis (1990): to reveal the meaning of particular forms of social life by systematically articulating the subjective meaning structures governing the ways in which typical individuals act in typical situation. I acknowledge a relativist position: that knowledge and observation cannot be theory-free (Smith & Deemer, 2000) and that the approach which I have taken to my research is a reflection of both my prior and current theoretical engagements. This relativist position, and my constructivist beliefs, underpin my emphasis throughout this thesis on reflexivity and personal narrative.

I have a strong passion for learning and change. I tend to challenge existing practices and to strive constantly towards improvement. Central to this is the notion that I want my research to ‘inspire’ rather than ‘convince’ (Wadsworth, 1998). As a constructivist I am a strong advocate of experiential learning, believing that we learn from our experiences through cycles of reflection and action. As noted by Brooks and Watkins (1994) and Miller (1994), action technologies systematise experiential learning into a process of knowledge construction useable by practitioners. Action research is therefore congruent with my values and beliefs.
I view our social existence in the world as highly complex and, like Brooks and Watkins (1994), challenge the capacity of traditional research to adequately address many social problems. My research reflects my acknowledgment of complexity both explicitly and implicitly; and, in later chapters, I draw from complexity theory (for example, Waldrop, 1992) to reach new understandings of the computer learning and teaching context. Throughout my thesis there is minimal emphasis on control of variables or artificial reduction in focus. Some readers might interpret this as a lack of clear research focus. However, it will be argued and demonstrated that this more pragmatic and naturalistic approach is consistent with contemporary theories of complexity, and that such an approach comes closer to providing ‘real’ and workable knowledge, than that which is founded upon simplification and reductionism. I also bring to this research endeavour a strong focus on ethical issues. I firmly believe in the concept of ‘research with’ rather than ‘research on’ (Carr & Kemmis, 1990). Such a foundation in ethical considerations is intrinsic to constructivism because of the inclusion of the participants’ values in the inquiry (Guba & Lincoln, 1994). The collaborative and participative nature of action research thus holds significant appeal.

Finally, I see myself as a pragmatist and, as such, I see theory and praxis as integrated and unified aspects of knowledge construction (as described by Greenwood & Levin, 2000; Levin & Greenwood, 2001). My position might be paralleled to that of Bennett-Levy (2002) in that, while I identify as a constructivist, I also regard it as pragmatic to work on the basis that there is a ‘constructed’ reality which we can understand, albeit imperfectly, and coloured through our individual perspectives, ideas and ideologies. ‘Truth may be relative, but some truths are more relative than others’ (Bennett-Levy, 2002). In both the conduct and presentation of this research I have been concerned with tangible and valuable outcomes. It has been critical that my research be accessible to those who might benefit from it and responsive to the demands of my professional context. While expressed quite briefly here these underlying values are embedded throughout this thesis as I, again as a constructivist and reflective practitioner, believe that it is not possible to separate the discussion of my research from the values and beliefs which I hold. Throughout this research I clearly identify my own values, beliefs and assumptions, explicitly acknowledging how these both differ from, and resonate with, those expressed by the students participating in the research.

1.5 Overview of the Research Context and Processes

In the previous sections action research was identified as the foundational methodological framework for this research. In this section an overview is provided of the research and, in particular, of the action research cycles, including a broad outline of the focus underpinning each cycle and the various data collection and analysis methods employed.

1.5.1 ‘The Unit’ as Research Context

Consistent with the expectation that pre-service teacher education programs prepare teachers for the use of computer technology in their classrooms, Southern Cross University incorporates a compulsory unit of study for students in both the Bachelor of Education (Primary) (BEd), a four year undergraduate degree, and the Diploma of Education (Secondary) (DipEd), a one year course for students already holding an undergraduate degree. In Australian higher education a ‘unit’ is a single program of study of
approximately 150 hours duration and usually undertaken over a 14 week period. The Unit is also undertaken as an elective by numerous students in other degree programs. In 2001 this Unit also became a core in a series of new combined degree programs and in the Bachelor of Technology Education (all four year, secondary education preparation programs). This thesis documents a process of change in the teaching of this unit between 1999 and 2001. The Unit in question underwent a name and unit code change during the research period (as indicated in Table 1) and to minimise confusion is referred to throughout this thesis as ‘the Unit’.

<table>
<thead>
<tr>
<th>YEAR AND SEMESTER</th>
<th>UNIT NAME</th>
<th>UNIT CODE</th>
<th>NUMBER OF STUDENTS ENROLLED</th>
<th>PRIMARY</th>
<th>SECONDARY</th>
<th>OTHER</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sem.2, 1999</td>
<td>Technology in Learning and Teaching</td>
<td>DP329</td>
<td>65</td>
<td>68</td>
<td>3</td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>Sem.2, 2000</td>
<td>Technology in Learning and Teaching</td>
<td>DP329</td>
<td>86</td>
<td>87</td>
<td>6</td>
<td>179</td>
<td></td>
</tr>
<tr>
<td>Sem.1, 2001</td>
<td>Educational Information Technology</td>
<td>EDU10003</td>
<td>79</td>
<td>4</td>
<td>9</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>Sem.2, 2001</td>
<td>Educational Information Technology</td>
<td>EDU10003</td>
<td>16</td>
<td>147</td>
<td>7</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Christmas, 2001/2002</td>
<td>Educational Information Technology</td>
<td>EDU10003</td>
<td>77</td>
<td>1</td>
<td>1</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TOTAL</td>
<td>656</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As will be further discussed, I was solely responsible for the design, development and delivery of the Unit over this period, and it is this iterative process of development that is the focus of this research. Driving the development and delivery process was a desire to refine learning and teaching processes with a view to improving learning outcomes for students. Informed by literature and theory, students were encouraged to engage in reflective practice to better understand their own learning approaches with regard to computers. This metacognitive approach is the focus of this research.

The Unit incorporated topics such as basic computer skills, Internet technologies such as the World Wide Web, e-mail, mailing lists and newsgroups, synchronous communications and file transferring, word processing, spreadsheets, databases and Web publishing. It also dealt with the application of IT in learning and teaching, including pedagogical considerations, Internet based educational activities, educational software, classroom management and ethical and legal issues. All students in the Unit learn to Web-publish and produce a Web-based teaching and learning resource for use in a classroom as their final assignment. The Unit 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. Consistent with constructivist approaches (Kanuka & Anderson, 1999) the Unit actively and explicitly provides a variety of different experiences and does not expect all students to engage with it in the same manner. The nature of the online materials, and how they developed throughout the research process, are of interest in this research.
1.5.2 Macro and Micro Levels of the Research

The learning and teaching of this Unit can be conceived of, and discussed, as action research undertaken at two levels: the macro level and the micro level. At the macro level, the purpose of the research was to improve my own teaching practice and to advance and document knowledge regarding the development of capable computer users. At this level, students enrolled in the Unit in any one semester can be understood as being involved in one action learning cycle and it is the principal researcher who progresses the study (and consequently transfers learning) between each of the research cycles.

At the micro level, students enrolled in the Unit in any one semester can be seen as engaging in their own action learning processes. The Unit is presented within a reflective framework with students being encouraged to reflect on the learning and teaching processes which they encounter, and to challenge their assumptions regarding effective computer learning and teaching. In each of the semesters students were provided with a range of theory and invited to participate in activities designed to prompt them to plan, act, observe and reflect on their own learning. Students were required to keep a reflective journal documenting their learning processes and their growing understanding of the issues surrounding computer learning and teaching. For students who consented to contribute to the macro research study, these experiences were utilised as data by the principal researcher to inform the progress of the macro research project.

1.5.3 The Research Cycles and their Respective Focuses

The research consists of three distinct research cycles over the period of 1999-2001. Each of the cycles of the research can be seen to have progressed my understanding of the distinction between a competent computer user and a capable computer user and the learning and teaching approaches that might facilitate the development of capable computer users. Cycle 1 occurred in semester 2, 1999. As this represented my first involvement in this teaching context a grounded approach was taken to the research. Cycle 2 occurred in semester 2, 2000, following six months of planning and re-development of the Unit based on the experiences in cycle 1. In this cycle a metacognitive approach was trialed. Cycle 3 occurred in 2001 and represented three intakes to the Unit, referred to as cycles 3a, 3b and 3c. In these cycles the metacognitive approach was refined. Figure 1 provides a visual representation of the action research process and table 2 provides a succinct summary of the three cycles, their principal foci, the theory informing them and the data collection techniques employed.
Figure 1  The three action research cycles

This figure illustrates the three research cycles, the period of time when they occurred and the corresponding chapters of the thesis addressing these cycles.
Table 2  Summary of the research cycles

<table>
<thead>
<tr>
<th></th>
<th>RETROSPECTIVE REFLECTIONS</th>
<th>CYCLE ONE</th>
<th>CYCLE TWO</th>
<th>CYCLE THREE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHRONOLOGY</strong></td>
<td>Prior to commencement of the research (1989-1999)</td>
<td>Semester 2, 1999</td>
<td>Semester 2, 2000</td>
<td>2001 (Semester 1, 2 and Christmas Intake)</td>
</tr>
<tr>
<td><strong>PRINCIPAL RESEARCH FOCUS</strong></td>
<td>Reflexivity on the theory and experiences which brought me to the research</td>
<td>A grounded understanding of the factors impacting on student learning in the computer education context</td>
<td>Exploring the value of a metacognitive approach to computer learning and teaching</td>
<td>Refining the metacognitive approach with a focus on learning strategies</td>
</tr>
<tr>
<td><strong>THEORY UNDERPINNING AND INFORMING THE CYCLE</strong></td>
<td>• Adult Learning Theory • Self-directed and lifelong learning • Capability and Competency • Learning Organisation • Constructivism</td>
<td>• Reflective Learning</td>
<td>• Social Cognitive Theory and Self-Efficacy • Attribution Theory • Learning Styles • Computer Anxiety • Experiential Learning Theory • Cognitive Modelling • Complexity</td>
<td>• Cognitive Playfulness • Self-regulated Learning • Motivation • Learned Helplessness • Complexity</td>
</tr>
<tr>
<td><strong>DATA COLLECTION METHODS</strong></td>
<td>• Reflection • Analysis of past writing and reading</td>
<td>• Reflective journals of students and principal researcher • Teaching Evaluation Survey • Observation</td>
<td>• Reflective journals of students and principal researcher • Evaluative surveys of teaching methods • Observation</td>
<td>• Small Group Discussion • Reflective journals of students and principal researcher • Observation • Observation</td>
</tr>
<tr>
<td><strong>PRAGMATIC LIMITATIONS</strong></td>
<td>• Retrospective</td>
<td>• Unfamiliar teaching context with minimal initial opportunity for planning and preparation</td>
<td>• Necessary period of leave • Impact of year-round teaching</td>
<td></td>
</tr>
<tr>
<td><strong>ANALYSIS METHODS</strong></td>
<td>• Personal Narrative • Reflexivity, identifying assumptions and beliefs</td>
<td>• Grounded Theory</td>
<td>• Statistical analysis of survey data • Qualitative analysis of reflective data • Case Study analysis</td>
<td>• Case Study analysis • Qualitative analysis of reflective data</td>
</tr>
</tbody>
</table>
1.5.4 Ethical Issues at the Macro Level

Ethical considerations such as voluntary participation, confidentiality, anonymity and mutual benefit for participants were central to the design and conduct of my research. Approval to conduct the research was obtained from the Southern Cross University Ethics Committee (approval number ECN-00-21), as well as the Executive Director of Administration.

The notion of mutual benefit significantly influenced the research design, in particular decisions regarding the sample of students with whom I worked. In the early stages of my research I gave lengthy consideration to whether I should focus on working with a small group of students or involve the full student cohort. Both ethical and pragmatic considerations influenced my decision to invite all students undertaking the Unit to engage in the learning process with me. It was impractical to isolate my evolving teaching practice from one student group to another. Furthermore, given the focus on enhancing learning outcomes for students it was, I felt, unethical to exclude students from that process. The theoretical, epistemological and methodological foundations of my research, provide clear justification for this approach, as will be emphasised throughout this thesis.

All students undertaking the Unit were informed, in the first week of semester, of the purpose of the research and its connection to the teaching and learning in the Unit. This information was provided both through oral presentation (for internal students) and in written form (for both internal and external students). This invitation to participate (appendix 2) included a brief explanation of action research, and in particular its emphasis on collaborative participation and reflective practice. The writing of Kemmis and McTaggart (1988) was cited in providing a concise overview of the research approach. Care was taken to explicitly outline what participation would require of students, and what the students could expect to gain. Participation in the research was thus fully informed and voluntary. I was, however, conscious that the Unit was inherently shaped by my research, just as my research was shaped by the pragmatics of the teaching context. In this respect all students undertaking the Unit were part of the research context although data from students were not utilised without their consent. Ultimately, these considerations were justified for me through my pursuit of improved teaching practice which, I felt, could only be interpreted as an attempt to improve learning for all students.

1.5.5 Limitations and Delimitations of the Research

In providing this overview to the research context it is important to define the research’s limitations and delimitations: to outline what I understand as the key boundaries of my undertaking, thus ‘building a fence’ around the research and its findings (Perry, 1994). Limitations are defined as constraints that are beyond the control of the researcher but are known to influence the inquiry whereas delimitations are the controls on scope which are actively established by the researcher (Murray & Lawrence, 2000). In particular I wish to highlight issues concerning both methodology and content.

Participation is an ‘ideal’ implicit in action research. As a researcher, I was concerned to maximise the level of participation by students and tutors in the design and progress of the macro research. However, I was also constantly conscious of the inability to place
additional demands on students and tutors beyond those that could be reasonably expected from involvement in the Unit. I acknowledge that the nature and extent of this participation was limited by my research focus and the pragmatic context of my research. This research is essentially a study of my own professional practice as an end-user computer teacher, and my efforts to facilitate the development of teaching approaches which foster the development of ‘capable’ computer users. These issues concerning participation are explored in greater depth in section 2.4.3.

In researching my own teaching practice I do, of course, focus considerably on understanding the learning of the students with whom I work. The research was both formed and constrained by the context of the Unit. The Unit was, until 2002, offered in the final year of the BEd program, and in the only year of the DipEd Program. There was no opportunity to follow-up with the students after the semester end, as most left the University and the region. It was not pragmatically possible to seek longitudinal data, nor would such an approach have been methodologically feasible within the constraints of a three-year research undertaking. My research thus had limitations similar to those identified by Ropp (1997), in that the theoretical perspectives under investigation, namely lifelong and self-directed learning and computer capability, take years to develop. While it is acknowledged that learning cannot be considered to have taken place unless that learning exhibits itself in behaviour (Long, 1990), my research was limited to a reliance on observed and self-reported data from within the constraints of students’ behaviour within a single semester.

The research, particularly in the early stages, was not focused specifically on computer use in classroom or teaching contexts but, rather, I was interested in the notion of ‘capability’ across any end-user computing context. As the research progressed, I realised the importance of a closer focus on ‘usefulness’ and, given the student group I was working with, pre-service teacher education became a delimiting focus.

Action research is frequently criticised in regard to its non-generalisability. This is because most action research projects involve small organisationally specific samples and in-depth and often longitudinal studies (Onn, 1998). This research is consistent with these delimitations, being essentially an intrinsic case study (Stake, 1994) of one particular teaching context, undertaken to achieve a better understanding of the particular case. No attempt is made to generalise the findings to other contexts. This thesis presents the rich data of this action research ‘case’, as seen and interpreted through my own experience and voice. I provide ample opportunity for the voices and interpretations of my co-researchers, the students, to be expressed and heard. However, I also explicitly acknowledge that this research can only be viewed by the reader through their own interpretative framework (Ellis & Bochner, 2000; Stake, 1994) and that its value to others lies in their own interpretation of its applicability and adaptability to their own context. In the words of Stake (1994, p.242), ‘local meanings are important; foreshadowed meanings are important; and readers’ consequential meanings are important’. Issues of generalisability, validity and rigour are taken up again in chapter 2.

Delimitation also needs to be placed upon the particular ‘school’ of action research embraced in this research. This research does not claim to be ‘critical’ or ‘emancipatory’ (Grundy, 1982; Jennings, 1995; Kemmis, 2001), although aspects of these traditions are
certainly embraced. While I actively engage in both reflection and reflexivity, and prompt
the students to do the same, we do not set out to focus on problematising or, in a
postmodern sense, de-constructing our learning and teaching context. This research might
more accurately be perceived as practical action research, having technical aspirations for
change but aiming to inform the practical decisions of practitioners (Kemmis, 2001). Other
limitations to the conduct of particular cycles of the action research are identified
throughout this research.

1.6 Thesis Structure and Presentation: Charting the Terrain

In this section I map the terrain of my research presentation. As described below, my thesis
is structured in a non-typical fashion but, I argue, justifiably so. I firstly provide some
grounding for my use of metaphor throughout the thesis and then justify my choice of a
sequential and chronological approach to the presentation of the thesis. Finally, I provide a
brief outline of the structure and content of each chapter.

1.6.1 Research as Journey: The Use of Metaphor

Various writers have explored the use of metaphor and its integral connection to our
construction of meaning (Hovelynck, 1998; Lakoff & Johnson, 1980; Mignot, 2000;
Ortony, 1979; Taylor, 1984). Metaphors are among our principal vehicles for
understanding and they play a central role in the construction of social and political reality
(Lakoff & Johnson, 1980). Their use is consistent with constructivism and my epistemic
understanding of the connection between language and meaning. Metaphor permeates
communication and perception, both representational and transformational, not only at
individual, but at cultural and societal levels (Mignot, 2000). Metaphors can assist not only
in communicating meaning but generating it. As will be explored later in this thesis,
metaphors can encourage us to develop new forms of social imagination, new language to
describe our observations and can challenge our very conceptual systems. In this thesis I
argue the importance of actively using metaphors rather than allowing them to use us, and
embrace this understanding in my own writing.

My research represents a personal and professional journey through both familiar and
unfamiliar terrain. Throughout my thesis I draw on the metaphor of ‘journey’ to depict the
research process. Although my choice of ‘journey’ as metaphor is by no means unusual or
original, for many academics, perceiving research as ‘journey’ may seem controversial.
Research, and theses in particular, are more frequently perceived as ‘argument’. This
‘frame conflict’ (Reddy, 1979; Schön, 1979; Sternberg, Tourangeau & Nigro, 1979)
derlies a potential and actual dismissing of metaphor as ‘unscientific, untrustworthy, a
linguistic embellishment’, positivist arguments which Mignot (2000) claims have more
recently been challenged. Yet, to echo the above comments of Mignot, a constructivist
perspective on knowledge and knowledge generation re-emphasises the criticality of
language and metaphor in establishing meaning. This research has involved me challenging
my expectations and re-designing the maps, which I included with my initially envisaged
itinerary. Like Richardson (1994), I view writing as a process of discovery. My thesis
charts my ‘discoveries’ and individual and cultural encounters. It provides a ‘diary’ of my
changes in direction and the influence of my travels on my own assumptions. I return to a
discussion of metaphor, and the ‘myths of objectivism and subjectivism’ (Lakoff &
Johnson, 1980) in chapter 8. However, at this stage, it is sufficient to note that
conceptualising the research as ‘journey’ re-emphasised the experiential, personal and
transitional dimensions of the research and brought with it a challenge to the conventional thesis presentation.

1.6.2 Challenging the Conventions of Thesis Presentation

The reader of this thesis will no doubt bring with them expectations and pre-conceptions regarding the notion of a ‘thesis’. Winter (1996) points out that the ‘academic norm’ for research presentation is only one possible format and that conventions and expectations regarding writing structure have been, and are, continually changing. Since action research emerges from a different context and different relationships, he concludes that there is good cause for reports from action research to also differ. In this thesis a chronological approach is taken to presenting the ‘story’ of my research ‘journey’. This approach is unconventional when compared to approaches advocated by authors such as Perry (1994) and Murray and Lawrence (2000). However, as an action research thesis, this approach is both epistemologically and methodologically justifiable. House (1994) notes that all research is a form of story telling; although we do not tend to call it such, given the unreliability suggested by the term ‘story’. Yet I would argue that an action research report is the story of individual and/or group change: change in practices, beliefs and assumptions. From a constructivist perspective, I support Stake’s (1994, p.240) comment that researchers can only ‘assist readers in the construction of knowledge’. The reader of research will bring their own personal meanings to the data and theory and will ‘add and subtract, invent and shape – reconstructing the knowledge in ways that leave it differently connected and more likely to be personally useful’ (Stake, 1994, p.241). Personal narrative, and the notion of research as ‘story’, repositions the reader as a co-participant in dialogue and rejects the orthodox view of the reader as a passive receiver of knowledge. It provides opportunities for the reader to have ‘vicarious experiences of the things told’ (Ellis & Bochner, 2000, p.751).

The methodological literature supporting the role of personal narrative in research (Clandinin & Connelly, 1994) informed the presentation of the research, as did the writing of Charmaz (2000) in relation to grounded theory and the more recent discussion of self-study research (Bullough & Pinnegar, 2001; Feldman, 2002; Smith, 2002; Zeichner, 2001). While this action research represents a study of a single context, personal narrative enhances the relevance and impact of the research, allowing readers ‘to feel the moral dilemmas, think with our story instead of about it, join actively in the decision points... and consider how their own lives can be made a story worth telling’ (Ellis & Bochner, 2000, p.735). Peshkin (1988, p.18) notes that ‘subjectivity can be seen as virtuous, for it is the basis of researchers’ making a distinctive contribution, one that results from the unique configuration of their personal qualities joined to the data they have collected’.

The chapters of the thesis proceed, as did the research itself, through a series of cycles of planning, acting, observing and reflecting, with each of these activities being systematically and self-critically implemented and interrelated (Grundy, 1982). Each turn of the ‘hermeneutic spiral’ (Gummersson, 1991, cited in Dick, 1993) builds on the understanding at the previous turn. The reader of this thesis will not find a single or separate chapter presenting either a literature review, outline of methodology or data analysis. Instead the research will ‘unfold’ for the reader, reinforcing the notion of research as a personal, professional, methodological and theoretical ‘journey’. 
Such an approach consciously works against ‘camouflaging’ or failing to acknowledge pragmatic realities, iterative learning and ‘discoveries’ and the inevitable ‘weaknesses’ that often remain unacknowledged in traditional research presentation. Action research represents a journey down many roads, and inevitably, some of those roads are revealed to be dead ends. Sometimes these mistaken paths have been taken for justifiable reasons, while others were traversed through simple error or mistaken assumptions and beliefs. In conventional research there is a culture of leaving these dead ends unacknowledged. In action research, however, these dead ends are a critical part of the learning, change and theory development process. Reflexivity is an important tool, exposing such weaknesses or ‘untruths’ and requiring us to ‘own up’ to our constitutiveness in the knowledge construction process (Hall, 1996). In adopting a reflexive approach and depicting the researcher’s personal involvement in the research, temporal factors can be of critical importance. A chronological approach to thesis presentation supports the researcher’s acknowledgment of this iterative ‘learning’ and, hence, represents a more rigorous presentation of the research. This is not to say that, in my own thesis, these erroneous paths have all been explicated in great detail. The necessities of readability and pragmatic concern for word length mean that economies of presentation need to be made. Minor ‘dirt tracks’ have been mentioned in passing while other trails have been considered more central to the depiction of the research.

Particular note needs to be made concerning the presentation of literature and theory. In conventional research the literature review builds a theoretical foundation upon which research is based and upon which issues are identified which are worth researching (Perry, 1994). In action research the issues which are pursued are those which arise from a cluster of problems of mutual concern and consequence to the researcher(s) (Kemmis & McTaggart, 1988). Thus the explanation of the origin of the research, and the justification for its need, do not necessarily lie in the literature but rather in the personal narrative of the participant researchers. Literature inevitably plays an important role in shaping the development of the research. Traditionally, the literature review is presented ‘up front’ in its entirety, implying that all the literature was familiar to the researcher at the beginning of the research process. This is, of course, a falsehood. The requirement to present an up-to-date literature review at the time of thesis submission necessitates that the literature review is constantly being added to until submission. Even aside from this, it is not humanly possible for a researcher, no matter how au fait they are with their disciplinary context, to be familiar with all relevant literature before beginning their research. In action research, the process of engagement with theory is an important part of the research process itself. Action researchers seek literature to partially answer their questions, to challenge their assumptions, to widen their perspectives and to inform their practice. Engagement with theory and literature is situated temporally in the action research cycles themselves. It is from this basis that I have chosen to present my engagement with the literature as part of the cyclical structure of the research and thesis. Such an approach was also adopted by Green (1999) who notes the value of sharing with the reader the excitement experienced by the researcher in encountering new and challenging literature.

A further, and perhaps more unconventional, point can be made in relation to the presentation of literature and theory in an action research thesis. If it is accepted that the researcher cannot be aware of all relevant and related literature before beginning the research, then they will inevitably encounter literature throughout their research, which
either supports their current actions or challenges their perspectives, assumptions or approaches. As Brewer and Hunter (1989, p.18) highlight, ‘evidence from two sources is intuitively more persuasive than evidence from one’. If ‘evidence’ is interpreted as encompassing prior research, then the discovery of research which supports your own findings might be seen as ‘triangulating’ your own data, but only where such research was not known to the researcher beforehand. Hence the timeliness of encountering such literature is important, and temporal and subliminal aspects need to be acknowledged and taken into account. That is, it is important for the researcher to note when, in the process of their action research, literature or theory is encountered. It is also important to acknowledge the inter-connectiveness of the theory with which they engage through citation analysis.

Any reading of this thesis must thus take account of the temporal aspects of the presentation of literature. The literature which informed my research is presented (approximately) chronologically as it was ‘encountered’ so as to best indicate how this theory impacted on my research. Again, pragmatic and logical considerations necessitated some minor divergences from this, however where such divergences influence the ‘telling’ of the research story these divergences are acknowledged as such.

On a final note, most of the thesis is presented in the first person. Consistent with action research I, as a researcher, am also ‘the researched’, and it is thus artificial to separate the voice of the writer and researcher (who is a key participant) from the process and findings. The centrality of reflection alone makes this impossible. Epistemologically, I support Lincoln and Denzin’s (2000) claim that it is impossible for an author to write a text which does not bear the traces of its author. The use of a first person voice in research presentation is now supported by ample precedent and theoretical debate (Onn, 1998).

1.6.3 The Structure of the Thesis

Chapter 2 presents the origins of my research ‘journey’, acknowledging the impact of retrospective experience, personal background and theoretical understandings on my values, attitudes, beliefs and assumptions. Drawing on techniques of personal narrative (Clandinin & Connelly, 1994; Peshkin, 1988) I explore how my academic and professional background led to my involvement in the research. This discussion is structured through an exploration of the personal origins of the journey, the theoretical origins, the pragmatic origins and the methodological origins. Five phases of my professional life are explored and I outline the influences that these had on my beliefs and assumptions. From this brief biographical background I focus specifically on the theoretical understandings which informed the conceptualisation of the research, principally the literature surrounding adult learning, notions of competency and capability, the ‘learning organisation’ and constructivism. The pragmatic origins of the journey provide opportunity to detail how I came to be involved with teaching the Unit which is the focus of the research. Finally, the methodological origins of the research journey are presented, detailing the research focus and its conceptualisation as action research. Two key issues are explored: firstly, the notion of participation, and, secondly, issues surrounding validity and rigour. Chapter 1 concludes with a summary of the assumptions that impact on my approach to the research.
Chapter 3 details the planning, acting, observing and reflecting phases of cycle 1. The initial modifications to the ‘inherited’ Unit materials are listed, including the planning of data collection and analysis processes. The centrality of reflection and reflective learning in my research and teaching is justified and issues surrounding the use of reflective journals as a source of data are explored. Cycle 1 utilises a grounded approach and, from the analysis of the cycle 1 data, a number of functional and student learning issues are identified. My reflections upon this data conclude this chapter and lead into the planning of cycle 2 in chapter 4.

Chapter 4 forms a ‘theoretical bridge’ between cycle 1 and cycle 2. Here I provide an account of my personal engagement with, and reaction to, social cognitive theory (Bandura, 1977; 1981; 1997), and attribution theory (Kent & Martinko, 1995a; 1995b; Martinko, 1995) and their application in computer learning contexts. This exploration encompasses a range of general and applied theory and in particular explores concepts of computer anxiety and ‘technophobia’. Through my reflective engagement with this literature, I was led to the literature concerning metacognition and the notion of the ‘expert learner’. I also trace my engagement with experiential learning theory. Chapter 4 thus documents my growing interest in the potential of a metacognitive orientation to computer learning and teaching in facilitating the development of capable computer users.

Chapter 5 presents the planning phase of cycle 2. I begin by enunciating the research question for cycle 2: ‘Can a teaching approach which emphasises metacognitive learning processes, in particular a focus on self-efficacy, attribution theory and learning styles, help facilitate the development of ‘capable’ computer users?’ My choice of a mixed method approach is justified and I describe my development of a psychometric instrument as both a prompt for metacognitive reflection and as a source of data. An outline is provided of the Unit’s re-development, including the addition of a ‘Thinking’ module to the Unit. These changes are grounded firmly in the data derived from cycle 1. In concluding chapter 5 the scene is set for the commencement of semester 2, 2000 and hence the beginning of the action and observation phase of cycle 2.

Chapter 6 presents the acting, observing and reflecting phases of cycle 2. The chapter opens with a description of the student cohort including participation rates and demographic data. Students were introduced to theory relating to self-efficacy, attribution and learning style and the research explored whether metacognitive awareness and reflective learning processes could change (and improve) student computer learning. Metacognitive reflections, both my own and those of students, are presented and students’ reflections and evaluative feedback on the learning and teaching contexts are explored. Chapter 6 then explores nine case studies of individuals’ engagement with the metacognitive learning approach. This chapter concludes with a critique of the metacognitive approach, its issues and limitations, a summary of the learning gained and the challenges for change and improvement in cycle 3.

Chapter 7 is somewhat more complex and represents a divergence from the strictly chronological research presentation. It presents the research conducted during 2001 where three smaller cycles (cycle 3a, 3b and 3c) were incorporated into one more substantive cycle. Chapter 7 discusses the incorporation of a number of further theoretical constructs in the metacognitive approach, namely cognitive playfulness (Martocchio & Webster, 1992;

**Chapter 8** represents what might conventionally be seen as the ‘discussion’ or ‘findings’ of the overall research. In chapter 8 I discuss my ‘discovery’ of complexity theory (Bossomaier & Green, 1998; Davies & Gribbin, 1991; Kauffman, 1995; Lissack, 1999; Waldrop, 1992; Zhang & Fowler, 1996) and provide an overview of the complexity literature and its key postulates. Particular emphasis is placed on the application of complexity in the social sciences. Three perspectives on complexity are addressed: complexity as perspective on epistemology, as perspective on methodology and as perspective on learning and education. I then explore how complexity assisted me to ‘make sense’ of my research, as well as the learning and teaching context of end-user computer education.

**Chapter 9** depicts my research as both journey ending and journey beginning. A number of issues raised earlier in the research are revisited in the light of my experiences and new understandings, including research validity and theory generation. A summary of the research ‘findings’ and the impact of the research on both theory and practice is detailed. Most importantly, but quite unconventionally, chapter 9 presents the argument that action research should never ‘conclude’. Instead the thesis ends with a description of the exciting possibilities for further action which have already arisen from the research – the new journeys and new futures which in themselves depict the value of the research undertaking.
Chapter 2 - Journey Origins and Point of Departure

This chapter explores the professional, theoretical, pragmatic and methodological origins of the research spanning the years 1989 to 1999. The theoretical underpinnings of adult learning theory, and in particular the debate surrounding competency based training and the alternative concept of capability are discussed, with specific reference to the computer education contexts. I then explore the influence of my constructivist beliefs on my approach to the research. The pragmatic origins of the research are detailed: specifically, how I came to be involved in the Unit that forms the context for the research. The methodological origins of the research journey are then explored, including the focus of the research and its conceptualisation as action research. Issues of participation, validity and reliability are considered before the chapter concludes with a summary of the assumptions that I brought, as a researcher, to the investigation.

2.1 Professional Origins of the Journey

To establish a context for this research it is necessary to provide an account of the professional experiences which led me to the research, and which inevitably impacted on my assumptions, attitudes and beliefs. Such an exploration is an essential aspect of reflexivity (Gergen & Gergen, 2000; Rossman & Rallis, 1998; Smyth & Shacklock, 1998), exposing my personal investment in the research and the biases I bring to the project. As detailed in chapter 1, my presentation draws on the tradition of personal narrative. This section provides a brief description of five phases of my early professional experience and the theoretical and reflective perspectives that these bring to the research. These five phases are summarised in Table 3.

Table 3 My professional experiences and their theoretical contributions to the research

<table>
<thead>
<tr>
<th>TIME-FRAME</th>
<th>PROFESSIONAL CONTEXT</th>
<th>THEORETICAL CONTRIBUTIONS TO THE RESEARCH</th>
<th>SECTION WHERE DISCUSSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989-1992</td>
<td>BA (Library and Information Science)</td>
<td>• Information and computer literacy</td>
<td>2.1.1</td>
</tr>
<tr>
<td>1993-1996</td>
<td>Master (Distance Education)</td>
<td>• Andragogy • Lifelong learning • Self-directed and learner managed learning • Distance education and flexible delivery</td>
<td>2.1.2</td>
</tr>
<tr>
<td>1995-1998</td>
<td>Research Assistant</td>
<td>• Observations of the individual differences in adaptation to computers • Growing awareness of various research methodologies and paradigms • Action research</td>
<td>2.1.3</td>
</tr>
<tr>
<td>1998</td>
<td>Project Manager Online Developments</td>
<td>• Awareness of competency/capability debate • Experiences with online teaching and learning • Change management and the ‘Learning Organisation’</td>
<td>2.1.4</td>
</tr>
<tr>
<td>1998-1999</td>
<td>Tutor in End-User Computing</td>
<td>• Limitations of group teaching techniques • Flexible learning</td>
<td>2.1.5</td>
</tr>
</tbody>
</table>
2.1.1 The Value of Information and Computer Literacy

My narrative begins with reference to my personal development while completing a Bachelor of Arts (BA) in Library and Information Science. This course was undertaken at a distance while working, mostly full time, in an academic library. Technology was an important component of this course although, in this era, end-user computing was still fairly crude and developmental. The course required very little computer skill development as, consistent with computer literacy concepts of the time (Higdon, 1995), the emphasis was on theory, terminology and computer concepts rather than hands-on application. Focus was placed on computers as a tool for accessing and organising information, and consequently for research and learning. Undertaking my study at a distance, I developed an affinity for independent learning and, with it, information literacy.

On reflection, the computer skills that I developed during this period were gained almost entirely independently. I was in an employment context where computers were being utilised heavily and from which support was readily available. However, much of my skill development occurred without any external pressure or expectation. Progress in the development of computer applications was rapid and I was inspired and motivated by curiosity, particularly concerning early hypermedia. That said, computers per se were not of particular interest. I had no desire to undertake units in programming or further computing subjects. However, I did see computers as an essential organisational, informational and presentation tool to support my study; computers were the key to accessing and managing the body of information which I was so eager to draw from as an independent learner.

From my involvement in this external degree I developed a great interest in the field of distance education, perceiving information skills as central to the experience of independent learning. On completion of my BA, I enrolled in a Master of Distance Education through Deakin University.

2.1.2 My Emergent Focus on Self-Directed and Lifelong Learning

Through my Masters degree I became aware of the theoretical underpinnings of adult education (andragogy) and the literature surrounding educational design. I became interested in notions of learner-centred education, independent and lifelong learning and in particular self-directed learning (Phelps, 1995). In selecting a focus for my research I was drawn to connect my postgraduate study with my undergraduate degree. My thesis was entitled *Information skills and the distance education student: An exploratory study into the approaches of Southern Cross University distance educators to the information needs of external students* (Phelps, 1996a; Phelps, 1996b).

On reflection, this academic and educational grounding was more significantly connected to my current research than may immediately be evident. I gained a passion for innovative instructional design and became increasingly aware of the possibilities technology was creating for distance education. I had my first experience (none too successful) of synchronous communication with my supervisor and her other students. More importantly, however, I was developing (almost entirely independently) a wide range of computing skills. During my research I taught myself to use bibliographic and qualitative data analysis software, as well as advanced word processing features to compile and present my thesis. I
learnt to create Web pages (using HTML) by first attending a short introductory course and then furthering my skills by creating personal Web sites. I realise, now, that very few people around me were taking the same initiatives. At the time I didn't think too much about it. I was curious and adventurous and, as a novice, thought I was probably just learning what everyone else already knew. Almost 10 years down the track, I now realise that many academics still have not developed what I, then, considered essential research, information retrieval and presentation skills. To this day, I do not consider myself a ‘computer’ person, and am far less interested in how computers work than in what they can do.

The other critical understanding gained in this era was how the development of computer skills dramatically opened up employment possibilities. In 1995 I was successful in gaining a position in one of the (then) faculties of the University as a research assistant, a feat in no small part due to my knowledge of various research support software, and my information skills.

2.1.3 Assisting with Research: Training by Stealth

In my role as research assistant I found myself working collaboratively with a wide range of academic staff and postgraduate students. I began to realise that proficiency in using computers was not as commonplace as I had expected. Viewing technology, as I did, as a valuable (and in fact essential) learning and research tool, I was surprised at the level of adoption by many academics and students. While all staff and students were using word processors, very few were utilising the advanced features intended for professional and academic publishing. While many had heard of bibliographic software (and some had purchased and installed it), few were using it. While many were teaching about qualitative data analysis software (and criticising it heavily) few had utilised it. While many were advocating the value of the emerging World Wide Web, very few were interested in learning to Web publish. Technology was certainly being used, but minimalistically and non-adventurously. All this, of course, is said with an emphasis on the general; there were some notable exceptions and I began to reflect on what it was that made these people different.

In my role as research assistant, I was frequently called upon to provide ‘training’ or assistance in information technology, from one-on-one structured and unstructured assistance to group workshops and manual writing. I became acutely aware of individual differences in computer skill acquisition. While some staff and students picked up new skills easily, others had far greater difficulty. While some sought step-by-step instructions others responded well to brief introductory overviews. While some constantly returned to me for directive assistance, others were rapidly independent. I began to question the factors affecting this learning dynamic. Around this time I was introduced to the concept of capability (see section 2.2.3), which assisted me to make sense of my observations. I began to reflect on the prevalence of competency-based approaches to computer education and started to question whether such approaches were appropriate.

This period of my professional life also brought me into close contact with a range of practitioners adopting action research, including Zuber-Skerrit, Dick, Hase, Fisher, Jennings and Graham. Through my involvement with the Innovative Links Program (Southern Cross Roundtable Portrayal Evaluation Team, 1996) I worked with both school
teachers and academics in supporting school-based action research. Through these connections, I gained a greater appreciation of the potential of action research, both in improving practice and generating theory.

2.1.4  **Project Managing Online Development: Staff Development and Culture Change**

In 1998 I became involved in managing a project which aimed to move a significant number of undergraduate units online. The role entailed assisting both academic and support staff to make fairly major changes to their work practices. The emphasis was on pedagogical design and hence on creative integration of technology. As systems-wide change, this initiative involved addressing fairly significant staff development issues (Ellis & Phelps, 1999; 2000a; 2000b; Fisher, Phelps & Ellis, 2000; McMurray & Dunlop, 1999; Phelps, Ledgerwood & Bartlett, 2000). The staff involved in the project were not ‘online mavericks’ but a diverse group of individuals, some ready to adopt technology, others not so.

This professional experience provided me with a greater theoretical and practical understanding of educational design issues, particularly regarding online and flexible learning. It also, inevitably, increased my focus on change management and led me to support a philosophical approach to change, based on action learning and the concept of the ‘learning organisation’ (Phelps, Ledgerwood & Bartlett, 2000) (see also section 2.2.5). Again, this experience emphasised the differences in individuals’ capacity to adopt new technologies. All of us were in an unknown technological context and, while a range of training opportunities were provided, the success of these was questionable. In this period of rapid change and technological experimentation, the individuals who thrived seemed to be those who adopted highly independent computer learning approaches.

2.1.5  **Teaching Novice Computer Users: Group Instruction**

A change in professional direction in 1998 found me involved in teaching a first year introductory computer and learning skills unit known as ED220 (Learning, Communicating and Educational Computing). This was my first real involvement in teaching groups of novice computer users. It also represented a conceptual transition back to face-to-face teaching. My experiences and understanding of online and flexible learning had, however, shaped the way I viewed the internal on-campus learning experience, and thus influenced my approach to the unit.

Many of the students in ED220 had not used a computer before. Some were motivated and excited, others highly reticent and anxious. At the time, I taught ED220 in the best way I thought I could and, in retrospect, the way that it had always been taught: utilising a highly directive approach. My teaching experience in this Unit was antithetical to my beliefs about education and I increasingly became self-critical of my teaching practice. My mind was continually drawn to the difficulties experienced by students, particularly the absolute beginners. Some focused on writing down steps, despite the fact that they were provided with a fairly comprehensive print-based resource. Others struggled to keep up with the pace of the group, panicking when they fell behind. Others diagnosed that they did not need to follow through the steps, choosing instead to ‘do their own thing’, keeping one ear open on the happenings of the class. Some of these individuals were quite capable of picking up the skills themselves; others less so. Despite emphasis on its importance, many students did not
engage in follow-up practice. In summary, my observations and reflections led me to believe that a significant proportion of the students I was teaching did not employ appropriate computer learning strategies. That said, I did not feel I was employing appropriate teaching strategies.

While I was unable to make the tutorials anything other than compulsory, I recognised that the wide range of experiences which students brought to the Unit required a more flexible teaching approach. To this end I developed a small Web-based flexible learning resource to supplement the tutorials incorporating an outline of learning objectives, a ‘self-test activity’ on the basic skills followed by extension activities. These received little use. What challenged me most from these experiences was my realisation that many students just wanted to be told what to do and expected me as a teacher to be able to deliver ‘all there is to know’. This urged me to reflect again on what effective technology teaching and learning was all about. I was conscious that these were novice computer users and I felt fairly comfortable that the approach I had taken was appropriate in an introductory context. However, I was self-critical of the longer-term outcomes of my teaching approach for these students, believing that I was in many ways reinforcing learner dependency.

2.2 Theoretical Origins of the Journey

Four related bodies of theory influenced the beliefs and assumptions that I brought to the research: constructivism, adult learning theory, the competency/capability debate and the ‘learning organisation’. This section provides a review of this literature, thus outlining the theoretical origins of the research.

2.2.1 Constructivism: My Window on the World and on my Research

At its simplest, constructivism posits that knowledge is constructed; in other words, individuals make sense of their world by constructing their own representations or models of their experiences (Jonassen, Peck & Wilson, 1999).

“Reality” does not exist separately and independently from the person; it is assumed to be a created co-construction of individuals, groups and societies. Generalisable laws do not exist, since there are no absolute truths. Rather, knowledge is local, contextual and historically bounded (Neimeyer & Mahoney, 1995).

More briefly, ‘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). Guber and Lincoln (1994) who, incidentally, view constructivism as a fourth research paradigm, note that constructivism represents a relativist ontology, a transactional and subjective epistemology and a hermeneutical and dialectical methodology. Constructivism is founded on the work of individuals such as Piaget, Dewey, Vygotsky, Ernst von Glasersfeld, Kant and Kuhn (Bickhard, 1998; Delanty, 1997; Glasersfeld, 1998; Phillips, 1995; Twomey Fosnot, 1996). However, a number of constructivist positions have emerged including cognitive, radical and situated constructivism and co-constructivism (symbolic interaction or social constructivism). These differ particularly in terms of the relative emphasis placed on the role of the individual versus the ‘social’ (Bickhard, 1998; Phillips, 1995). Kanuka and Anderson (1999) note that each of these positions have four beliefs in common: that new knowledge is built on the foundations of previous learning, that learning is an active rather than
passive process, that language is an important aspect of learning and that learning environments should be learner-centred. These constructivist values were a critical impetus for my adoption of action research in my roles of both teacher and researcher alike. As has more recently been emphasised by Gash (2000), constructivism invites an openness to consider the ideas of other people and to reconsider one’s own ideas, requiring both tolerance for uncertainty, and respect for others. Such tenets are germane to this study because they embrace my recognition that change cannot be implemented, nor knowledge generated, in isolation from those involved. In improving my own teaching practice I could not work in isolation from the students with whom I interacted. The congruence between constructivism and action research was re-emphasised with my later reading of Lincoln (2001).

Constructivism is also foundational to my approaches and beliefs as a teacher. As emphasised by Twomey Fosnot (1996), constructivism, as a theory of learning, has major ramifications for the goals teachers set, the strategies they adopt and the methods of assessment they use. Constructivism might be best understood by contrasting it with instructivist approaches whereby teachers identify what is to be taught (learning objectives), how it is to be taught (learning sequence and strategies) and determine if the teaching has been effective. Constructivist approaches, however, emphasise the importance of students raising their own questions, generating their own hypotheses and models and testing these themselves. Concepts cannot be taught out of context. Constructivism perceives ‘errors’ as important sources of learning; and reflection and dialogue are seen as the driving forces of learning (Twomey Fosnot, 1996). Teaching is thus not about imparting knowledge but about facilitating learning: assisting learners in their own construction of knowledge.

Constructivism has established a firm foundation in the instructional design literature, particularly that concerning computer-mediated and online learning (see, for example, Gordon, 1996; Jonassen, Peck & Wilson, 1999; Wilson, 1996). Jonassen, Peck and Wilson (1999) emphasise that students cannot learn from teachers or technologies but rather students learn from thinking; ‘thinking about what they are doing or what they did, thinking about what they believe, thinking about what others have done and believe, thinking about the thinking processes they use... technologies can foster and support learning... if they are used as tools and intellectual partners that help learners to think’ (p.2). Acknowledging my theoretical beliefs as a constructivist will assist the reader in understanding many of the methodological and instructional directions assumed throughout this research.

2.2.2 Adult Learning Theory

As already outlined, my professional and educational background was in adult learning theories. Since the understandings embodied in this literature are foundational to my practice as an educator, and to the foundational understandings upon which this thesis is founded, it is germane to provide an exploration of this literature.

The notion of andragogy has been well explored in educational literature (Brookfield, 1990; Garrison, 1988; Knowles, 1970; 1990; Pratt, 1988). Whereas pedagogy is subject and competence oriented, andragogy is problem-centred, geared to developmental cycles through which the individual is passing, and focusing on solutions to problems currently faced or about to be faced (Long, 1990). Andragogy sits comfortably with constructivist
views, placing the student’s role in learning as central and active (Tinker, 1993). It challenges the role of the ‘teacher’ and prompts an emphasis on facilitation and learner-centred approaches (Boud & Higgs, 1993; Brookfield, 1990; Candy, 1990; Higgs, 1993; Keegan, 1986; Knowles, 1970; Smith, 1982).

Emerging from the andragogical literature are a variety of other conceptual constructs including: self-directed learning (Bagnall, 1989; Brookfield, 1984; Brookfield, 1990; Candy, 1990; Chene, 1983; Garrison, 1987; Knowles, 1970; 1990; Leslie, 1987; Moore, 1986; Piskurich, 1993; Pratt, 1988), independent learning (Candy, 1990; Gow & Kember, 1990; Paul, 1990), lifelong learning (Candy, 1990; Smith, 1982), autonomous learning (Brookfield, 1990; Chene, 1983), self-direction in learning (Hiemstra, 1994; Hiemstra & Brockett, 1994) and learner-managed learning (Cairns, 1993; Fowler, 1993; Graves, 1993; Henry, 1993; Long, 1990; Tinker, 1993). It is relevant to explore two of these terms: self-directed learning and learner-managed learning. Self-directed learning is defined as ‘a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies and evaluating learning outcomes’ (Knowles, 1970, p.18). As such, self-directed learning provides opportunities for the learner to make decisions about what to learn: to ‘pursue the study of personally significant areas in an independent manner, free of the bonds of time, space and prescription usually imposed by conventional instruction’ (Moore, 1977, p.190).

Learner-managed learning is a broader concept emerging from the shared ground between various theories, including experiential learning, self-directed learning, independent learning, action learning, reflective learning and problem based learning (Cairns, 1993; Henry, 1993). As described by Graves (1993, p.2), ‘learner-managed learning is not a simple approach to education but a whole range of attitudes, teaching strategies, curriculum schemes and course designs which place the student at the focal point of the learning activities to ensure his/her involvement throughout the process’. Learner-managed learning is about ‘encouraging us to seek out the knowledge that we need as we progress through life and to open our minds to the potential of formal and informal learning occurring from every experience’ (Long, 1990, p.51). Long goes on to describe it as ‘moving the power base away from the teacher or trainer and giving it to the learner’ (p.161).

While there are many fundamental similarities between self-directed and learner-managed learning, a distinction can be drawn between them in relation to their variant institutional and non-institutional foci. The institutional approach (represented in learner-managed learning) involves observing how adults learn outside educational institutions and applying this to the institutional context (Keegan, 1986; Moore, 1986; Moore, 1977), while the non-institutional or autodidactic approach sees self-direction as applying only (or properly) to learning situations outside educational institutions (Leslie, 1987; Smith, 1982). Brookfield (1984, p.60), however, has challenged ‘the false dichotomy in which institutionally sponsored learning is seen as purposeful and deliberate and learning occurring in non-institutional contexts is held to be serendipitous, ineffective and wholly experiential’. Contemporary developments in adult learning theory draw closer unison between institutional and non-institutional learning with an emphasis on experiential learning (Boud, 1989; Henry, 1989; Henry, 1993; Kolb, 1984; Packham, Roberts & Bawden, 1989; Weil & McGill, 1989), double-loop learning (Argyris & Schön, 1996) and reflective learning (Boud, Keogh & Walker, 1985a; 1985b; Boud & Walker, 1998; Candy, Harri-
Augstein & Thomas, 1985; Grimmett & Erickson, 1988; Schön, 1988). This dialogue is central to the ideas developed in this thesis, in particular the notion of capability discussed in the following section.

2.2.3 The Competency/Capability Debate

As mentioned earlier, my engagement with the capability movement came at a time when I was reflecting on, and critically challenging, traditional computer learning and teaching approaches. The concept of ‘capability’ emerged from the UK in the mid 1980s as a response to the need for increasing organisational competitiveness and the rapid changes occurring in the nature of work (Hase & Davis, 1999). The capability movement was formalised with the publication of the ‘Education for Capability Manifesto’ (Royal Society for the Encouragement of Arts Manufactures and Commerce, 1996) and, around this same time, an Australian Capability Network was formed. A now strong body of literature supports the value of capability approaches to learning (Bawden, 2000; Cairns, 1996a; 1996b; 1997a; 1997b; Hase, 2000a; Limerick & Cunningham, 1993; Price, 1996; Stephenson, 1996)

Capability is perhaps most succinctly defined by Cairns (2000, p.1) as ‘…having justified confidence in your ability to take appropriate and effective action to formulate and solve problems in both familiar and unfamiliar and changing settings’. Capable people are those who know how to learn, are creative, have a high degree of self-efficacy, can apply competencies in novel as well as familiar situations and can work well with others (Hase & Kenyon, 2000). Capability draws on Schön’s (1987) notion of ‘professional artistry’, and the importance of preparing students for ‘indeterminate zones of practice’: the ‘unfamiliar and changing settings’ referred to by Cairns.

It is impossible to discuss capability without comparing it to competency, a concept that, to some extent, prompted the rise of the capability movement. Again to quote Cairns (2000, p.2), competencies are ‘individual and measurable skills demonstrated and assessed against agreed standards of competence’; whereas capability is ‘an all-round human quality, an integration of knowledge, skills and personal qualities used effectively and appropriately in response to varied, familiar and unfamiliar circumstances’. This notion of adaptability to change is emphasised in the Statement of Belief issued by the Australian Capability Network (1996). This document states that in a world of change ‘our major resource is our ability to learn, adapt and apply new skills and knowledge’ and that ‘success in a changing world will require confidence in our ability to acquire and apply knowledge, new skills and understandings’ (p.81). Contexts with uncertain outcomes require courage, creativity, intuition and imagination, confidence in managing learning and in one’s ability to perform. These qualities contribute to capability.

Adaptability to change and an emphasis on lifelong learning are absent in competency-based initiatives. Wildman (1996) states that competencies, as widely adopted through the Australian National Training Reform Agenda (ANTRA), suggest a ‘reductionist philosophy that relates to specific measurable behaviours… measured against a set of standards’ (p.86). He goes on to state that ‘competencies tend to be prescriptive and are designed for a more stable environment with familiar problems’ (p.86). This is not to say that competencies are not important. As stated by Price (1996, p.4) ‘they are a necessary aid to living and they give added confidence to individuals along the path of life’.
However, again, it is the notion of change which presents challenges: ‘The problem with competency training is that it is always in danger of equipping the young for the performance of yesterday’s jobs’ (Price, 1996, p.4). Price draws another important distinction, stating that competencies are somewhat artificial in nature, representing a degree of simplicity rarely existing, whereas capability arises from the interaction of the individual with the world.

The literature surrounding competency and capability inevitably leads to an exploration of the discourse of ‘training’ versus ‘education’. The competency/capability dialogue is representative of a broader challenge faced by professional preparation contexts such as teacher education. Graham (2001) has noted that teacher ‘training’ as opposed to teacher ‘learning’ has emerged as a dominant discourse in recent times, reinforcing this through Bullough and Gitlin’s (1991) statement that teacher education:

...maintains a set of structures and embodies a cluster of ideologies which encourage the following: a constricted view of teacher intellect through emphasis on teaching as technique, an extreme form of individualism, teacher dependence on experts, acceptance of hierarchy, a consumer or ‘banking’ view of teaching and learning (teacher is ‘banker’; learning is consuming), a limited commitment to the betterment of the educational community and a conservative survivalist mentality among novice teachers (p.38).

Graham argues that teachers should be viewed as problem solvers, shaping their responses to changing needs, circumstances and demands of the profession. These are the values embedded in capability.

Before exploring these issues in more detail it would seem beneficial to further define and discuss competency-based approaches. Competency-Based Training (CBT) has its origins in the behaviourist movement which sought to focus attention on intended outcomes of learning and observable student behaviours (Bowden & Masters, 1993; Velde, 1999). This focus represented a shift from establishing an individual’s ‘knowledge’ to an emphasis on ability to competently perform specific workplace tasks and roles. Interestingly, CBT had its origins in United States teacher education programs in the 1960s and 1970s (Velde, 1999), diminishing as a favoured approach in the U.S. in the 1980s, and being considered in the past tense by the late 1980s and 1990s (Bowden & Masters, 1993). Much controversy surrounds the implementation of CBT approaches throughout the Australian Vocational Education and Training (VET) sector, and now in the compulsory education sectors (Bowden & Masters, 1993; Harris et al., 1995; Smith & Keating, 1997). Both Velde (1999) and Mulcahy (2000) claim that the adoption of CBT in Australia was driven by economic and social forces, rather than educational ones. Cornford (1997) notes the lack of rigorous evaluation or piloting and points to a range of research highlighting its less than successful implementation, claims supported by Bowden and Masters (1993). The capacity of competency-based approaches to preparing individuals for contexts of rapid change must be questioned, and it is interesting that Smith and Keating (1997) highlight the incompatability of CBT with notions of ‘double loop’ learning as implicit in action learning.
One further point might be made regarding the incompatibility between competency and constructivist approaches to learning and teaching:

In the decades since the introduction of CBET, educational research has provided insights into the learning process which are strikingly different from a conception of learning as a process of satisfying pre-specified ‘objectives’... Rather than being a passive process of mastering objectives on a checklist, meaningful learning is increasingly being recognised as an active process through which learners construct their own interpretations, approaches and ways of viewing phenomena and through which they relate new information to their existing knowledge and understandings (Bowden & Masters, 1993, p.50)

Bowden and Masters go on to point out that constructivist approaches cannot be easily incorporated into CBT systems, calling for further research in this area.

The more recent literature is beginning to challenge and critique traditional approaches and propose alternate models. Velde (1999), for instance, differentiates between three conceptions of competence: the behaviourist, the generic and the holistic. The holistic approach integrates knowledge, skills and attitudes and in some respects is a closer approximation to the notion of capability. Despite the evident advantages of a holistic approach to competence, Velde (1999) notes that it is rarely applied in practice; and James and Mulcahy’s (2000) research documents tensions between ‘espoused’ models of CBT and ‘models in use’. These researchers document how, in practice, CBT approaches are being contested and modified, with alternative or supplementary approaches such as action learning being integrated to enhance the learning process. This, James and Mulcahy note, is the ‘exception, rather than the rule’ (p.522).

2.2.4 Competency and Capability in Computer Education

The competency/capability debate is particularly evident in the context of computer education. Competency-based training was widely adopted throughout Australia in the 1990s, particularly in the TAFE sector (Australian National Training Authority, c.1998). More recently, ‘VET in Schools’ initiatives have brought competency based training into the school context (Griffin & Gillis, 1998; NSW Ministerial Advisory Council on the Quality of Teaching, 1997; Spring, 1999). Competency approaches have been particularly embraced in areas of information technology education (as indicated in the various state-based reports published in the May 2001 edition of Australian Educational Computing). In 2003 NSW will introduce competency based assessment for all year 10 students (NSW Board of Studies, 2002). Further evidence of the strong impact of CBT on computer education and training lies in the emergence of the ‘International Computer Drivers License’ (European Computer Driving License Foundation, 2002).

While CBT approaches are continuing to have a strong impact on school curriculum, evidence is beginning to emerge of the transition toward capability-based, rather than competency-based approaches. For instance, in 1998 the Victorian Department of Education, Employment and Training released a document Learning Technologies: Teacher Capabilities Guide (2000). While no rationale is provided for their choice of term, a notable ‘capability’ promoted in the document is that teachers should ‘continually develop skills, knowledge and understandings of learning technologies’: in other words, capacity to embrace lifelong learning. Similar attempts to widen the notion of competency are made by the NSW DET by their inclusion of a competency in each syllabus document.
which reads: ‘Develop the confidence to explore, adapt and shape technological understandings and skills in response to challenges now and in the future’ (NSW Board of Studies, 2001). While this outcome is laudable in principle, and highly consistent with capability, the ability to develop or assess such personal attributes in a competency-based framework is highly problematic.

The Australian Council for Computers in Education (ACCE) has also bought into the competency debate in a linguistic, but not, I would argue conceptual sense. In their preamble to Teacher Learning Technologies Competencies Project Background Paper (ACCE 1999), they state that ‘for some people the notion of competence deflects from a holistic view to one diminished to a list of skills and for others it represents a strategy for defining professional standards’ (p.2). They go on to state that the term ‘capabilities’ has been adopted by some to ‘help educational communities understand the competency movement in Australia as a professional development strategy and not a testing mechanism’ (p.2). While I agree with this perspective, their distinction goes only a small part of the way in distinguishing a ‘capable’ computer user from a ‘competent’ one. In fact the way many of these organisations define capabilities is as competencies: discrete, definable attributes, rather than the holistic conception of capability defined in the previous section.

Lowther and Chakrabarti (1998) refer to teacher computer competence as the ability to successfully integrate technology into their classroom. However the ‘capable’ computer user might be paralleled more closely with the exploration of self-taught computer-using teachers provided by Chandler (2000), in a paper I did not become aware of until cycle 3. Chandler speaks of teachers who have learnt to use computers out of their own enthusiasm, without substantial training. They feel comfortable about learning any software, are willing to ‘have a go’ and are generally not intimidated by computers. In reflecting on my assumptions and beliefs at this time, I documented my perception that a capable computer user has an ability to adapt to change, employs self-directed learning strategies, has a willingness to experiment, recognises appropriate avenues for integration, and is prepared to persevere.

As a facilitator of computer learning, I found the competency/capability debate to be relevant and influential. Many of my observations during, and reflections on, my professional experience had highlighted a distinctive difference between individuals who were able to perform standard tasks or functions, and those who diversified their computer use and developed new skills with minimal external assistance. My reflections led me to feel that there would be value in further investigation of the construct of computer ‘capability’, both in terms of its defining characteristics and whether it is possible, as an educator, to foster its development.

Before continuing, it is important to explicate my initial beliefs and assumptions regarding the nature of a ‘capable’ computer user. These encompassed confidence, an ability to adapt to change and a capacity for self-directed learning. At this stage in my research I had not encountered research or literature addressing such a distinction, although as my research progressed I located a small number of papers presenting similar ideas (Becker, 1994; Chandler, 2000; Ropp, 1997; 1998). These, and the very notion of computer capability, are discussed throughout this thesis.
2.2.5 Teacher Education and the ‘Learning Organisation’

The concept of the ‘learning organisation’ is not new, having been popularised by Senge (1993) and widely discussed in the human resource and organisational development literature throughout the 1990s (Argyris & Schön, 1996; Dirkx, 1999; Ellinger, Watkins & Bostrom, 1999; Field & Ford, 1995; Hase, Cairns & Malloch, 1998; Limerick, Passfield & Cunningham, 1994). Arising in part from an increasingly turbulent environment, requiring responsiveness to change and a renewed focus on development and learning, this concept can be viewed as a paradigm shift from more traditional management models. The learning organisation favours empowerment, individual capability, teams, learning and flexibility (Hase, 1999). Learning is not seen as something that has to be organised by others; rather, individuals have the capacity to learn continuously and in real time by interacting with their environment. The learning organisation embraces concepts of action learning and reflective ‘praxis’, approaches demonstrated as playing a significant role in both professional development and organisational change (Grundy, 1982; Zuber-Skerritt, 1991; 1992; 1993; 1996).

While widely discussed in management literature, the notion of the ‘learning organisation’ has been less frequently applied to schools and educational contexts; although, notably, in the later stages of my research I became aware of the work of Silins, Zarins and Mulford (2002) who apply the concept to schools, and Levin and Greenwood (2001) who apply these understandings in the context of universities. Within this research I perceived the concept of the ‘learning organisation’ as providing an appropriate metaphor for schools, and an informing vision for teacher pre-service and professional development. Under such an approach, learning is intrinsic to a teaching career and there is no expectation of a beginning and end to the learning process. Continual improvement in practice is integral to the learning organisation. All individuals need to be responsible for documenting their own learning and sharing this learning with others. Within such a model, responsibilities are assumed by all, thus fostering collaborative goal-setting and achievement and building internal attribution. In the learning organisation both success and failures are valued as learning opportunities. Existing culture is embraced and built upon, individuals are respected as contributors and co-participants, and transition and change are embraced. This notion of the ‘learning organisation’ as an ‘ideal’ for teachers, schools and educational institutions more widely, underpinned the value system which I brought to my involvement in pre-service teacher education.

2.3 Pragmatic Origins of the Journey: The Opportunity for a Research ‘Adventure’

In 1999 I became involved in teaching a unit at Southern Cross University designed to provide pre-service teacher education students with computer skills. The Unit, originally called DP329: Technology in Learning and Teaching had been developed as an online resource and delivered over the preceding two years by a staff member who had suddenly resigned from the University. Provided with licence to make changes to the Unit, this was a unique opportunity to investigate the development of a teaching approach which might foster computer capability, rather than simple competence.
The Unit resources which I ‘inherited’ 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. Many topics included in the Unit statement, such as word processing, spreadsheets and databases, were conspicuously absent from the online resource. The Web site contained over 880 Web pages, many extremely lengthy. The Unit was structured according to 26 topics, and navigation through the Unit 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 contents-style navigation structure had also been produced. I was unaware of the approach taken by the staff member in the face-to-face context; however, it was evident that the online resources assumed a highly directive approach.

The content was, in places, highly technical, with transcripts of interviews with Web publishing ‘experts’ and students were required to learn HTML. Remembering that the intended student group undertaking this Unit were teacher education students without necessarily a strong computer background (or in many cases even an interest in computing), I felt that this was an inappropriate approach. Furthermore, students had apparently been at least partially assessed through a final examination focusing on technical terms. To me such content and teaching approaches emphasised the highly technical nature of computers and their inaccessibility to ‘novices’. Such approaches also conflicted with my constructivist and andragogical ideas. Despite these concerns, the existing resources provided many exciting opportunities. Notionally a student could work through the Unit content independently and engage with the content at a level appropriate to them. I recognised this as an ideal opportunity to explore the possibilities for flexible and self-directed learning approaches in the computer learning context.

2.4 Methodological Origins of the Journey

In this section I outline my initial research focus and my decision to adopt an action research approach. I then explore two methodological issues: the notion of participation and matters of validity and reliability.

2.4.1 Focus of the Research

Problem definitions are often mediated ‘by the “stories” people tell about troublesome situations – stories in which they describe what is wrong and what needs fixing’ (Schön, 1979, p.255). The framing of these problems often depends on underlying metaphors (Reddy, 1979; Schön, 1979; Sternberg, Tourangeau & Nigro, 1979). It was so with my own research, where the aforementioned constructs of andragogy, capability and the learning organisation drove my perception of ‘problem’ in my professional context.

As Dick (1993) describes, initial questions in action research tend to be ‘fuzzy’, as do initial methodologies. This was certainly so in my own research. Peshkin (2001) makes an important distinction between research direction and research destination. Research direction, he states, gives a sense of knowing where you are going; but that is not the same
as knowing where you are going to end up. ‘If we take serious account of what we are learning then we must be prepared to make appropriate changes in our research plans’ (Peshkin, 2001, p.8). As the narrative of my research unfolds, the accuracy and relevance of this statement will become clearer.

Prideaux’s (1995) writing was also influential in the formulation of my research focus. Prideaux emphasises that ‘action research is self-research. It is not something that an outsider should ask others to do’ (p.6). My initial research focus was thus broad and focused on my own educational practice, namely: How can I develop my teaching practice to better facilitate the development of ‘capable’ computer users?

2.4.2 Conceptualising my Practice as Action Research

As previously noted, my professional experience both as a research assistant and an online project manager provided me with exposure and experience in action research. Driven by curiosity and a desire to improve my own teaching practice, I approached the new teaching context as an action research opportunity.

The first semester of teaching was 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. As mentioned in section 1.5.4, all students in the Unit were invited to be involved. In this respect my 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). As noted in section 1.5.5, initially I conceived the research as the type described by Grundy (1982) as ‘practical’ action research.

I also began to engage with what I perceived as relevant literature, with the intention of identifying methodologically and conceptually similar research. This process continued throughout the four years of the study. Very few similar studies were initially identified, and the first cycle of the research was not directly informed by wider research. A small number of methodologically and conceptually similar studies might be mentioned here, although chronologically they were not encountered until the end of phase one. In the teacher education context, Romeo (1995) utilised action research in a project involving nine classroom teachers which aimed to empower primary teachers with the knowledge, skills and confidence to understand, improve and transform their teaching procedures and practices with respect to the use of computers. A conceptually similar but methodologically different study can also be found in the research of Evans and Simkin (1989), who explore the effect of computer learning potential in successful computer use, aiming to predict success and help people make career choices. A number of other conceptually similar studies were later encountered (Chandler, 2000; Ferdig, 1998; Ropp, 1997; 1998; Zhang & Fowler, 1996); however the chronological significance of their ‘discovery’ necessitates their discussion later in this thesis.
2.4.3 Participation and the ‘Idealist Debate’

A primary methodological concern acknowledged early in the research related to the notion of participation. I was aware of literature advocating the criticality of participation in action research (Grundy, 1982; Kemmis & McTaggart, 1988; Miller, 1994; Onn, 1998; Shacklock & Smyth, 1998; Tripp, 1998; Wadsworth, 1998; Watkins & Brooks, 1994; Watkins & Shindell, 1994) and the distinction between ‘participation’ and ‘involvement’, with authentic action research entailing shared conceptualisation and practice (Kemmis & McTaggart, 1988). On the other hand, I was concerned about the level of involvement I could reasonably expect from my student participants. I was faced with teaching an already demanding Unit in terms of course content and was conscious of the 150 learning hour prescription for all units, and the limited number of weeks available for teaching. Similar concerns were noted by Watkins and Shindell (1994) who discuss the difficulty of making collaborative decisions about course content, activities, and assessment. While recognising these pragmatic limitations, I also wanted to maximise the input of students. I fully endorsed Grundy’s (1995, p.9) statement that ‘students can no longer be regarded as passive recipients of learning but are active constructors of the learning environment and processes’. I wished to maximise the benefits they could expect to gain from the research and recognised that participation could generate greater commitment and hence benefit to the students: ‘When change is a desired outcome, it is more easily achieved if people are committed to the change’ (Dick, 1993, p.6).

That said, differentiation between ‘participation’ and ‘non-participation’ is inevitably a simplification (Shacklock & Smyth, 1998). Reason (1994), for instance, notes that while the ideal is full reciprocity in thinking, decision making and idea generation, this does not necessarily mean that all involved individuals contribute in identical ways, nor that it is practical for full consensus to be reached on all decisions. ‘At a minimum, everyone involved needs to be initiated into the inquiry process and needs to give free and informed assent to all decisions about process and outcome’ (Reason, 1994, p.326). Recent literature acknowledges that complicated forces can undermine the effectiveness of collaboration and the responsibilities and roles of those involved (Zygouris-Coe et al., 2001). There are various levels and forms of participation, including passive participation, and projects vary between these approaches at different stages (Tripp, 1998). What, then, constitutes participation also varies and might include: the democratisation of knowledge production and use; ethical fairness in the benefits of the knowledge generation process; appreciation of the capacity of humans to reflect, learn and change; and a commitment to non-violent social change (Onn, 1998). Swepson (1998, p.2) argues that ‘some theorists have rightly attempted to establish the ideas of participation and emancipation in reaction to the untenable ideal of the philosophy of a value-free science’. Yet, she argues, in doing so they have fallen into the same idealist trap. It is worth quoting Swepson at some length on this issue:

I understand idealism to be the philosophical belief that the ideals that we create for ourselves, like truth, are achievable in the material world… In my own search for truth I have accepted the position of the sceptics who have demonstrated to my satisfaction that it is impossible to achieve ultimate ideals like certain knowledge, or truth, either with the methods of science or any other method of gaining knowledge. However… we must not abandon ideals because they are important guides for our actions, even though they can never be achieved in the material world (Swepson, 1998, p.2).
Swepson argues that the concepts of participation and emancipation in action research are ideals and are thus unattainable. This is not to say that they shouldn’t be pursued but that the vision and values of action research should be kept separate from methodologies, in order to develop both. I remained optimistic that the pragmatic realities of my research context could be accommodated without sacrificing the principle of participation inherent in action research. Participation continued to be a focus of reflexivity throughout the research as I critically analysed the dynamics arising in each research cycle.

2.4.4 **Validity and Reliability in Action Research**

In conceptualising my practice as ‘research’ it was essential to consider notions of validity and reliability. Action research is frequently criticised in terms of its validity, and action researchers are often depicted more as interventionists or change agents than researchers (Watkins & Brooks, 1994). In answer to this dilemma, many writers have suggested that new measures of validity are required in relation to action research, measures that value responsiveness over replicability (Altheide & Johnson, 1994; Dick, 1993; Dick, 2000; Dick & Swepson, 1994; Elliott, Fischer & Rennie, 1999; Greenwood & Levin, 2000; Kemmis, 2000; Kemmis & McTaggart, 2000; Lincoln, 2001; Whitehead, 1989; Zuber-Skerritt, 2001). Greenwood and Levin (2000), for instance, state that:

>Credibility, validity and reliability in action research are measured by the willingness of local stakeholders to act on the results of the action research, thereby risking their welfare on the ‘validity’ of their ideas and the degree to which the outcomes meet their expectations.... the core validity claim centres on the workability of the actual social change activity engaged in and the test is whether or not the actual solution to a problem arrived at solves the problem (p.96).

The importance of such tangible results is also reinforced by Kemmis and McTaggart (2000, p.592) who state that ‘the inevitability – for participants – of having to live with the consequences of transformation provides a very concrete ‘reality check’ on the quality of their transformative work’. These ideas are also voiced by Guba (1996, p.xi): ‘That action research may not conform to conventional criteria of research rigor is much less important than that it takes a more democratic, empowering and humanizing approach; assists locals in extending their own understandings of their situations; and helps them resolve problems they see as important’.

Another means by which action research gains validity is through the researcher’s attempts to find exceptions to the data collected and to disconfirm emerging interpretations (Dick, 2000). Action researchers ensure that their conclusions and their data have survived attempts to disprove them (Dick, 1997; Dick, 2000). Action research also gains rigour through triangulation or what Dick (2000) refers to as ‘dialectic’. Varied informants, different methods and multiple data sources are utilised and the comparison between them forms a check on their adequacy. If sources agree, then the researcher searches for exceptions in the next cycle. If they disagree, then the researcher searches for explanations (Dick, 2000, p.6). Thus, action research can be rigorous; however, the means of establishing and maintaining this rigour are somewhat different to other forms of research.
Notions of validity and reliability were foremost in the conceptualisation and conduct of this research. The search for disconfirming evidence drove my action and data analysis and is evidenced in my presentation of divergent and ‘outlying’ data. I return to these issues in the final chapter of this thesis.

2.5 Stepping Back and Moving On

My intent in this chapter has been to explicate the assumptions which I brought to the first research cycle and the importance of locating my current research within an historical narrative. These assumptions, values and beliefs have included the value of andragogical approaches to adult learning, the importance of self-directed learning and the importance of information and computer literacy in both academic and employment contexts. I have asserted a preliminary belief that there is a difference between computer ‘competence’ and computer ‘capability’ and that computer capability does not ‘come naturally’ to all computer users. Further to that, I approach this research with the belief that some students who struggle with computer technology employ inappropriate and ineffective learning strategies. My observations would seem to suggest that highly directive computer teaching approaches potentially reinforce learner dependency and that there is a need to align computer teaching practices with andragogical principles so as to foster ‘capable’ computer users. Drawing on the values inherent in the ‘learning organisation’, and applying these both to school and university education contexts, provides a fresh perspective from which to approach computer education. Thus far I have depicted the circumstances which brought me to the research and teaching context. In the following chapter I describe my ‘hasty departure’ into the first cycle of the research journey. I describe the initial plans and modifications to the Unit, made with only days available for preparation. Chapter 3 then describes the actions and observations occurring in cycle 1, including how these enhanced my understanding of students’ computer learning experiences.
Chapter 3 - Embracing Reflection as Navigation: Postcards from Cycle 1

This chapter explores the first research cycle, building on preliminary explanations provided in chapter 2, but moving sequentially through the planning, acting, observing and reflecting phases of cycle 1. The chapter begins by outlining the pragmatic limitations impinging upon the planning phase, and then lists the initially prioritised instructional design changes to the Unit. The adoption of a reflective framework is justified, including my plans for data collection through the use of reflective journals. Attention is then turned to methodological matters such as data collection and analysis, and ethical concerns. The acting and observing phases are introduced through an outline of the participation rates and demographics. Issues emerging from a grounded analysis of the student reflective data are explored under two broad categorical headings: functional issues and student learning issues. The overall student evaluative data is then presented, exposing the principal issues as perceived by students. The chapter concludes with my reflective engagement on the first research cycle, again structured through the framework of functional issues and student learning issues.

3.1 Planning Cycle 1: A Hasty Departure

As outlined earlier, cycle 1 occurred in the second half of 1999 when I was appointed to coordinate and deliver the Unit DP329. Having been approached 2 weeks prior to the commencement of the teaching period I was provided with 3 days of paid employment to familiarise myself with the Unit and make developmental adjustments. Understandably, there were limitations to the changes that could be made. I thus acknowledged that the initial delivery should be seen as an opportunity to investigate and document the issues encountered both by students and myself, so as to inform further development and refinement. I have already outlined in section 2.3 what I saw as some major issues with the Unit.

After prioritising changes needed to meet the requirements of the Unit statement, as well as those of the student group, the following alterations were made:

- removing the final examination;
- conceptualising the Unit within a reflective framework, and therefore including a reflective journal as a major assessment item (as discussed below);
- removing and/or replacing some existing content considered irrelevant, technical or inappropriate for the target group. For instance, the need to learn HTML coding was replaced with the use of an HTML editing program (Netscape Composer);
- including a ‘Skills Chart’ that enabled students to self-assess their skills in a range of areas, particularly those not currently dealt with adequately by the Unit materials (i.e. Basic Computer Skills, Word Processing, Spreadsheets, Databases), which also served to communicate the expected minimal level of skill development. The implications of this decision are further discussed in section 5.4.2.3;
- providing non-compulsory tutorials for students needing assistance on the skills-based learning objectives (above); and
- including a Challenge Assessment to ensure students met the basic computer skill requirements of employing bodies (NSW Ministerial Advisory Council on the Quality of Teaching, 1997). Students were required to complete a series of activities demonstrating skills such as copy and pasting, headers and footers, thesaurus use, Web searching and graph construction using spreadsheets. Students were able to re-sit the assessment twice and the assessment was presented as a ‘learning activity’ rather than a pass/fail ‘test’.

### 3.1.1 The Centrality of Experience

In my approach to the Unit I placed a high value on students ‘learning through doing’. Experiential learning (Boud, 1989; Henry, 1989; Kolb, 1984; McGill & Weil, 1989; Packham, Roberts & Bawden, 1989; Weil & McGill, 1989) was perceived as compatible with self-directed and lifelong learning and also, most importantly, with my capability. 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. Experiential learning can be ‘simultaneously an educational philosophy, a range of methodologies, and a framework for being, seeing, thinking and acting on individual and collective levels’ (McGill & Weil, 1989, p.245-6). Based on Kolb’s (1984) theory, experiential learning is seen as the process whereby knowledge is created through the transformation of experience through reflection or observation. Reflection is thus a key concept in experiential learning (Boud, 1989) and, as is outlined in the following section, it also became central to my research and teaching. I return to a consideration of experiential learning in chapter 4.

### 3.1.2 The Centrality of Reflective Learning

Key to the design both of the Unit and the research was the concept of reflection. Reflective learning is now a firmly established tradition, particularly in teacher education (Campbell-Evans & Maloney, 1998; Down & Hogan, 2000; Graham, 2001; Schön, 1983; 1988). Since the early work of Schön (1983), reflection has been embraced as an important component of professional education. In fact, several writers (Imel, 1992; Palmer, Burns & Bulman, 1994) have noted that the reflective practice movement emerged, at least partially, as a reaction to technical and competency based strategies. Mezirow (1991b) states that reflection is generally used as a synonym for higher-order mental processes, while Boud, Keogh and Walker (1985a) define reflection as an intellectual and affective activity leading to new understandings and appreciations. Kemmis (1985) sees reflection as ‘meta-thinking’ in which we consider the relationship between our thoughts and actions in particular contexts: ‘In reflection we choose implicitly or explicitly, what to take for granted and what to treat as problematic in the relationships between our thoughts and action and the social order we inhabit’ (p.148).

The adoption of a reflective learning framework can be seen as related to my constructivist perspectives, my understandings of adult learning theory, my perception of the value of experiential learning and my interest in fostering self-directed, ‘capable’ computer users:
Learning-to-learn involves more than learning how to study. It involves the higher order skills of analysis, synthesis and evaluation, the ability to think critically, to construct meaning and reconstruct understanding in light of new learning experiences. Courses where reflective practice is central inevitably help students develop into independent learners much more readily than those whose focus is on the acquisition of a large body of knowledge (Candy, Crebert & O'Leary, 1994, p.100-101).

In agreement with Candy’s premises I proposed that, through reflection, both students and myself might consider the influences on our computer use to date, challenge our assumptions, beliefs and our current learning and teaching approaches, and perceive appropriate paths for improvement in our teaching and learning practice, to better foster computer capability. Such an approach was consistent with constructivism. A further influence on my decision to embrace reflective learning was, of course, the enveloping of my research and praxis in an action research framework, and my desire to involve students in that process as much as possible. The centrality of reflection in action learning and research has been widely explored (Carr & Kemmis, 1990; Kemmis, 1985; Kemmis & McTaggart, 1988; Marsick, 1991). Thus, at the macro level, student reflection, together with my own reflection, formed a source of data to inform the broader action research study.

To this end, a major adjustment made to the educational design of the Unit was the replacement of the final examination with a reflective learning journal. Throughout the research I also kept my own reflective journal.

3.1.3 Journals as Prompts for Reflection and Sources of Data

The inclusion of a reflective journal as both a learning and assessment strategy was informed by literature such as Holly (1987), Kerka (1996) and Lukinsky (1991). As Holly 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). Here, Lukinsky is re-inforcing what many other writers have emphasised as an important feature of reflection: the recognition and analysis of assumptions, our ‘taken-for-granted ideas, commonsense beliefs and self-evident rules of thumb that inform our thoughts and actions’ (Brookfield, 1991, p.177). According to Vygotsky (cited in Kanuka & Anderson, 1999), journalling facilitates the process of internalising dialogue, a point reinforced by Kerka (1996, p.2):

> Writing is a critical ingredient in meaning making, enabling learners to articulate connections between new information and what they already know. The journal becomes another text on which to reflect, but it is a text written in the learner's authentic voice, and this personal engagement adds a necessary affective element to the learning process.

Ferdig’s (1998) narrative approach to computer education and his impetus for adopting such an approach (as portrayed in the introductory quote on page xi) had a significant influence on my teaching and research direction at this time. Ferdig advocates the use of journals to ‘help communicate between the observed, the observer and the educator’ (p.3),
stating that a narrative approach assists individuals to become aware of their own feelings and thoughts about computers in education.

The potential of the reflective journal as an avenue for ‘sharing’ learning was pragmatically appealing. I was, however, conscious of the limitations of journals, particularly as sources of data. Kerka (1996) highlights issues related to students’ preparedness to write openly and their tendency to write what they think the teacher wants to read, a point also made by Boud and Walker (1998). A further limitation in their application as source of data lies in their self-reported nature. However, given the constructivist framework upon which this thesis is founded, this was not viewed as problematic. As Charmaz (2000) states, data are narrative constructions of experience, not the original experience itself: ‘We can claim only to have interpreted a reality, as we understood both our own experience and our subjects’ portrayal of theirs’ (p.523). Data, and reflective data in particular, in this sense are viewed as representative of shared or individual reality. Despite awareness of these issues, I still felt that the benefits of reflective journals as learning tools and data source outweighed their limitations. Later in this thesis I return to a closer interaction with the theory and literature surrounding reflective learning to address issues which emerged in my research and practice.

3.1.4 Sources of Data and Ethical Considerations

As mentioned above, the primary source of data for cycle 1 were reflective journals, both my own and those of students. The assignment required students to maintain a learning diary throughout the semester, demonstrating engagement with the Unit’s learning resources and encouraging them to reflect on their own learning and apply that to the classroom setting. In a third component less relevant to this thesis, but embracing concepts of experiential learning, students were required to reflect on the application of technology in schools, based on their practicum experiences. Embedded in the Unit were various prompts to stimulate reflective and practical engagement with the Unit materials. While students were required to complete the journal as part of assignment requirements, they were offered the option of sharing their reflections as part of the macro-research. An assignment cover sheet was provided for students to indicate whether they wished to participate. Students were told that their contributions would help inform the further development of the Unit and assist to refine approaches to teaching about technology. Confidentiality and anonymity were assured, as was the right of withdrawal from participation. The reflective journal cover sheet was very similar to that used in cycle 2 and is provided in appendix 3.

A further source of data, one less intrinsic to my research design but nonetheless valuable, was the end of semester student evaluation administered by Southern Cross University’s Teaching and Learning Unit. This evaluation process provides data for staff on their teaching performance. It is usual for the student evaluation to contain 14 items selected by the staff member from a bank of possible questions, however it was also possible to supplement this format with additional questions specific to the Unit. A number of Unit specific questions were thus included and the final teaching evaluation form is included in appendix 4.
3.1.5 Approaches to Data Analysis

As previously mentioned, cycle 1 was primarily focused on uncovering the range of issues which this group of learners might encounter. Like Green (1999), I wanted to avoid making early decisions about the research focus merely to give the study a ‘false kind of clarity in its early stages’ (p. 106) or to artificially narrow the focus so as to arrive at a more ‘manageable’ thesis project.

My approach to analysis of the reflective journal data might be viewed as mirroring grounded theory approaches (Glaser & Strauss, 1967; Strauss & Corbin, 1994) but is more closely aligned to the constructivist model of grounded theory proposed by Charmaz (2000). Grounded theory embraces strategies of simultaneous collection and analysis of data and analytical coding and categorisation and constant comparison of data so that the themes emerge out of the data, rather than pre-determined structures being imposed on the data (Charmaz, 2000; Glaser & Strauss, 1967; Murray & Lawrence, 2000; Strauss & Corbin, 1994). From a constructivist point of view, the categories, concepts, and theoretical analysis emerge from the researcher’s interactions with the data: ‘the creation of concepts and categories, and the integration of the constructed theoretical framework reflect what and how the researcher thinks and does about shaping the collecting of data’ (Charmaz, 2000, p.522). Grounded theory thus ‘lines up’ theoretical possibilities with real data: ‘Any contest between insights and existing theory becomes a comparative analysis that delimits the boundaries of the existing theory while generating a more general one’ (Glaser & Strauss, 1967, p.255). It is congruent with grounded theory to initially ‘ignore’ the literature and theory in order to assure that the emergent categories are not contaminated by concepts more suited to different contexts (Glaser & Strauss, 1967) and, in this sense, it was appropriate that I had not read widely in the area before beginning my research journey.

My approach to data analysis was thus, firstly, to identify and extract portions of students’ journals which depicted their experience in the unit, including identification of issues, learning strategies and any other evaluative comments about the Unit or my teaching. These extracts were typed and the qualitative data analysis program, Scenario (Brooks, 1998), was utilised to manage the coding and categorising process. After issues were identified I went back to the student data to seek omitted or dis-confirming data. The analysis of reflective student journals can only be considered as a confronting and challenging process for a ‘teacher’. Journals can be both gratifying and shattering, something confirmed for me as I talked to other academics utilising journals. Engaging with students’ writing, I was conscious of assuming a ‘researcher’ role, to hear the voices of all students equally and not bias either positive or negative comments, or become defensive.

Analysis of the student evaluation data was initially conducted by the Teaching and Learning Unit, as is usual for the standardised questions. It should be noted that the Teaching and Learning Unit utilises a parametric approach to data analysis which, given the categorical nature of the questions, might be considered inappropriate. However, as this is the formally adopted and consistently used analytic approach, I decided to present the data in the format provided. Analysis of the Unit specific questions was my own.
3.2 Acting and Observing: Analysis of Data from Cycle One

The Unit had a student enrolment of 139 with 3 withdrawals after mid-semester when enrolment data were calculated. Of these 139, 47% were from the primary program and 49% were from the secondary program as indicated in table 4.

### Table 4  Unit enrolment by program and gender

<table>
<thead>
<tr>
<th></th>
<th>Bachelor of Education (Primary)</th>
<th>Diploma of Education (Secondary)</th>
<th>Other Course</th>
<th>Withdrawn</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>8</td>
<td>36</td>
<td>2</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>Females</td>
<td>57</td>
<td>32</td>
<td>1</td>
<td>2</td>
<td>92</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>68</td>
<td>3</td>
<td>3</td>
<td>139</td>
</tr>
</tbody>
</table>

A total of 115 students (83%) provided permission for their reflective data to be utilised in the macro-research. Of these, 55 were from the primary program and 57 were from the secondary program. Forty-one (36%) of the students providing permission were male and 74 (64%) were female. Response rates to the student evaluation are provided in section 3.2.2.

### 3.2.1 Themes and Issues Emerging from the Student Reflective Data

Broadly speaking, the issues that emerged from the reflective student data fell into two categories: those concerning functional aspects of the Unit and those relating to student learning. These issues are summarised in table 5.

### Table 5  Themes and issues emerging from the cycle one reflective data

<table>
<thead>
<tr>
<th>FUNCTIONAL ISSUES</th>
<th>STUDENT LEARNING ISSUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timetabling</td>
<td>Realising the value of independence</td>
</tr>
<tr>
<td>Technical access</td>
<td>Discovering a sense of excitement</td>
</tr>
<tr>
<td>Workload</td>
<td>Motivation through realisation of professional value</td>
</tr>
<tr>
<td>Electronic format</td>
<td>Motivation through achievement of an ambitious task</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Confronting fear and dealing with difficulty</td>
</tr>
<tr>
<td>Availability of support</td>
<td>Memory and retention</td>
</tr>
<tr>
<td>Tutorials</td>
<td>Knowing what is possible</td>
</tr>
<tr>
<td>Assessment</td>
<td>Reflections on computer learning contexts</td>
</tr>
<tr>
<td></td>
<td>Locating ‘models’ and anti-models</td>
</tr>
</tbody>
</table>

While there was overlap between the functional and student learning issues, in terms of my research I found benefit in the differentiation. Functional issues were those that were situation or context specific and were more likely to be addressed through minor modifications to the Unit. Some were essentially beyond my control. Student learning issues, however, were perceived as those more intrinsically related to the computer learning processes.

All students referred to in chapter 3 are from cycle 1 (1999) and, as outlined in appendix 1, will be referred to by allocated number.
3.2.1.1 Functional Issues

As mentioned above, functional issues were defined as those related to the context of the Unit, rather than those related to computer learning and use in a broader sense.

Timetabling

A number of students expressed their frustrations about the structuring of a block practicum in the middle of the semester (for instance, Student 101 & 141). This externally imposed limitation meant that the Unit lost continuity and students experienced a greater sense of isolation and lack of support while they were away from University.

Technical Access

Access to equipment was a frequently expressed concern. Those students without home computers felt disadvantaged and, in addition, students with computers at home but without Internet access also felt frustrated (for example Student 66). Childcare issues and travel distance from University were reasons cited for difficulty in utilising the University computer labs. Internet connection posed a further pragmatic concern as most students seemed to utilise the free (but limited) Internet access provided by the University. The frustrations experienced are well exemplified by Student 111: ‘I have wasted hours of time that I had available for learning because I couldn't log on... or because of blackouts’.

Workload

The Unit 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 (Student 20, 22, 66 & 141). 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’ (Student 34).

Electronic Format

Online learning presented a new experience for most if not all students. For many, the initial prospect of studying an online unit was ‘quite daunting’ (Student 54) and some students’ attitudes were coloured by discussions with students who had undertaken the Unit in previous years (for instance, Student 60). 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...’ (Student 111). Student 114 noted: ‘If I had the material in printed form I could access it at times that suit my lifestyle, for example, those times when I have to sit for hours in my car and wait for my kids’ (Student 114). Other students, however, commented on what they felt to be the intrinsic appropriateness of online learning for computer skill development (Student 54, 62 & 122). Some acknowledged the benefit of the screen-capture graphics (for instance, Student 53 & 62), others the content presentation: ‘I have never had such a simplified yet comprehensive explanation of the Web and its services’ (Student 2). The following analogy provided by Student 91 succinctly summarises the benefits of the online format: ‘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’ (Student 91).
Flexibility
The flexibility of the Unit offered a ‘dramatic change’ (Student 2) for most if not all students. Those who chose to comment here were, in general, highly appreciative of the opportunities such flexibility afforded: ‘I am enjoying learning online in that I have the freedom to pace the learning at my own standard. I decide when I want to learn and for how long I will engage with the computer’ (Student 79). Many students noted that they could work when they were feeling most productive (Student 16) and at times most convenient to them (Student 62). It allowed them to focus on aspects of the Unit most appropriate to their needs and they could spend the required amount of time on each section (Student 5). Other students commented on the ability to monitor their own progress through self-assessment and to refer back to information for revision.

The fact that we are able to work at a self governed pace encourages us to explore the areas we have personal difficulties with and subsequently attend to these problems in a time span that encourages a thorough digestion of the concepts and the skills. In retrospect we are not being forced to work at the pace of ‘computer nerds’ or in the same regard not being held back by people who are ‘techno-phobic’ and struggling to master the simplest of tasks (Student 65).

There were, however, students who expressed concern over design issues and adapted less readily to independent learning. This transitional process was well described by Student 52:

Initially I felt rather lost without a teacher to guide me through the work as has always happened before, however as I read and come to understand more about what and how I'm learning I am appreciating the ability to go as fast or as slow as I need to. I think it is a good way to run a course, providing the teacher is readily on hand to assist with any problems that may occur.

This student’s mention of understanding her learning becomes more pertinent in the light of my future research actions.

Availability of Support
A significant number of students expressed frustration at what they defined as a lack of support or the unavailability of the lecturer (for example, Student 20 & 49) particularly during the practicum period. For others these feelings were expressed more in terms of isolation due to the online nature of the Unit: ‘It can seem a bit clinical and removed from reality’ (Student 8). A number of students acknowledged fellow students as a valuable source of support and peer tutoring (for instance, Student 2, 52, 108 & 111). For some this was seen as compensation for, rather than supplementation of, teacher support. Other students acknowledged their need to actively pursue support when they most needed it: ‘Any problems can be met with through e-mail or personal contact with the tutor, so I believe this thoroughly covers any problem areas which may arise’ (Student 54): ‘If there is something I can not do there will always be somebody out there that I can ask’ (Student 4).

The Tutorials
Reactions to the tutorials were again, mixed. For some students the tutorials were well received, affording an opportunity ‘to interact with others, to learn new skills and consolidate my own knowledge through teaching skills to others’ (Student 35). For others the experience was far less positive. The large group situation was recognised by some as far from ideal: ‘I feel I am monoposising her time in such a large class so I tend to struggle
along alone which makes it slower and more painful’ (Student 141). Pace of instruction was an issue commented on by a significant number of students (for instance, Student 20, 36 & 66). Some students recommended streaming tutorials according to levels of experience while others (for instance, Student 66) acknowledged that advanced students didn’t need to attend. Tutorials were seen by a number of students as an opportunity to discuss issues (for instance, Student 36, 46 & 66) and interaction with a teacher was perceived as a source of motivation: ‘I personally feel you learn better from a teacher who is motivating and whose enthusiasm and ideas can rub off on you’ (Student 63). Some students suggested more tutorials.

The Assessment
Several students chose to comment on the Challenge Assessment in their journal. For some students this ‘test’ was a highly positive experience, and an opportunity to prove to themselves what they could achieve (for example, Student 87). For others it was confronting, making them realise that they didn’t know as much as they thought (Student 75). Overall there were very few critical comments made about the activity, apart from the following summary from Student 70 of their perceived problems and benefits:

I found that the test encouraged students to compete rather than collaborate. The test did not cater for students with special needs. There was no revision before the test. Some students were advantaged as they have access to a computer or a literate relative to help at home. Students can cheat by looking at the monitor besides them and students who come from diverse socio-cultural backgrounds may experience alienation, loss of self esteem and cultural identity if they do not have the skills to participate in or pass tests. [benefits]... the test identifies student and teacher strengths and weaknesses which is needed for future planning. It helps students identify areas which they need to learn about and it enables a teacher to maintain a particular standard of skills and knowledge that may be needed for further education or employment.

Few comments were made in relation to the reflective journal as a form of assessment.

3.2.1.2 Student Learning Issues
As previously defined, student learning issues were perceived as those intrinsically related to the computer learning processes.

Realising the Value of Independence
While many students emphasised the difficulties and problems of learning from the Unit resources, a small but not insignificant number experienced a realisation of the value of independent learning: ‘I have found that by actually interacting with the material I have learnt a lot more than I would have if I was just given the theory to view. I have been involved in a lot of trial and error, as I read information and then often try it out for myself’ (Student 79). Indicative of these reflective realisations is the following statement by Student 62: ‘the only way to become familiar with this resource is to use it and that’s what this self paced material is making us do’. A clear distinction was, however, evident in the journal data between those students who confronted the challenge of studying independently, and those who resisted it and relied primarily on the optional tutorials.
Discovering a Sense of Excitement
Quite a number of students expressed an initial lack of motivation to use computers, as humorously expressed by Student 70: ‘In high school we were told that we had to learn about computers because they would increase our chances of getting a good job when we left school. So of course, no one was intrinsically motivated to learn about them’. For other students this lack of motivation was due more to feelings of fear and lack of confidence and/or experience. A number of students voiced a realisation that computers provided them with a source of excitement. For some this was prompted by success: ‘I am really proud of myself today...I decided to put my new skills into practice... I was fairly amazed and excited when it worked’ (Student 4). For others it was a more general change in attitude: ‘The greatest opinion I have changed this semester is that computers are fun and interesting and not scary as I had previously thought. From now on when I get a spare moment I will get on a computer and fiddle and hopefully that will help me to learn more’ (Student 53). For Student 141, the Unit resources and format itself proved motivational: ‘I was enthused and eager to get through the topics. Not because they were compulsory but they were interesting, new and I was totally amazed at its huge content and function’.

Motivation through Realisation of Professional Value
Other students gained motivation from their realisation of the value of computers to their future career as a teacher: ‘It really made me excited to be a beginning teacher in a generation that will benefit so much from technology’ (Student 29). For Student 60 this perception of professional relevance came through observations of a student with a behavioural disorder while on practicum and their realisation that ‘with a computer, he was a completely different child’. For Student 87 it was a teaching experience in which they introduced their class to the Internet. Similar sentiments were expressed by Student 53: ‘After being at school and watching my class on the computer I've learnt so much. I actually enjoy getting on the computer and exploring the different aspects’. Student 19’s motivation in this respect was more extrinsically imposed as he commented on the fact that teachers should be ‘models of behaviour and skills’.

Motivation through Achievement of an Ambitious Task
An important theme to emerge was the value of Web site construction as a source of both motivation and confidence: ‘I felt like I was really special and spent the rest of the afternoon bragging to my friends that I was going to have my own Web site soon’ (Student 91). Student 60 is worth quoting at some length as she provides a wide range of insights into students’ learning experiences. The following extract expresses the detrimental effect of the ‘overtechnical’ but the even more powerful experience of mastering the seemingly un-masterable. This quote also expresses the power of self-realisation in one’s own capacity for independence, and the two-way benefits (psychological as well as technical) of collaborative learning. The final sentences indicate the potential benefits to the individual of the reflective process:

This week I entered the world of Web page creation and design. I thought it was going to be a complete nightmare of unknown procedures that would take ages to learn, and to be honest I was dreading it... But now, a couple of days after I went to the tutorial, I’ve completely changed my thoughts. Creating and designing my Web page has been one of the most, if not the most, enjoyable things I've done as part of my education degree. I had to be shown the procedure a few times, but now I'm confident with the basics and I've done a considerable amount of work on my page
already. There are a few small things that I'd like guidance with at future tutorials, but overall I'm really happy. I've worked a lot of it out by myself, simply by following the instructions on the DP329 Web page, or by trial and error, using my already established computer knowledge. I have been showing one or two other people the work I have done so far, and on one occasion, I went through how I had done it step-by-step because the person I was showing was having difficulty. Hopefully I've helped her out a bit. It's nice to be able to show someone else how to do something instead of being the confused one who needs showing! I've discovered that decent sites with factual information are hard to come by, and one can go around in pointless circles for hours before stumbling upon anything worth reading. That's actually told me something about Web page design. Obviously there are a lot of people out there who don't appear to have a great deal of intelligence - just judging by the amount of crap (if I may use that word) on the net, and they've managed to figure out how to design Web sites - so surely I should be able to! (Student 60).

Confronting Fear and Dealing with Difficulty

The above quote reveals another theme to emerge from the data: the potential of reflection in assisting students to confront their fears and deal with difficulties. The potential benefits of confronting beliefs and assumptions is demonstrated in the following excerpt: ‘This fear of the unknown has been the main reason for my previous belief that computers are only for really smart people and why I have not tried to learn more about computers... Computers are not out there to confuse and intimidate people, they are really quite user friendly and helpful’ (Student 70). For some students, fears could be pinned down to tangible experiences in their past. For others, fear was a more generalised sensation derived more from inexperience. Several students’ reflections depicted the potentially motivating influence of fear, as conveyed by Student 53: ‘after seeing what my Practicum class did today I am really scared to teach computers as I think they know more than me. To cure this problem I will need to get on the computer every spare minute I get’. Reflecting on their own counterproductive tendencies toward panic and fear was empowering for some students who took on the challenge of adopting more positive approaches to difficult situations. Student 4, for instance, reflected on the Challenge Assessment:

I was nervous going into the assessment and when I saw what we had to do I panicked. I kept thinking I won't be able to do this. I made myself take a few deep breaths and told myself to take each item, one at a time. As I progressed through the assessment I started to feel much more confident. Obviously all the extra work and time I had spent on the computer had helped me... I am now able to confront a problem and try and work it out instead of immediately giving up.

The potentially beneficial outcomes of the challenging nature of the Unit is again evidenced in the following: ‘Although it has not been the most straightforward process for me, the success I have experienced to date has changed my attitude (Student 54).

Memory and Retention

Retention of learning and the role of memory in the learning process challenged many students, frequently evoking stress and concern. Some students, it seemed, viewed the computer learning context as one requiring memorisation (for instance, Student 22 & 70), the resultant struggle being conveyed by Student 49: ‘This is the worst way to learn - you don't remember anything! Has anyone got a photographic memory?’ Much of this concern centred on the perceived importance of jargon; however some students’ reflections allowed them to challenge their initial assumptions: ‘the terminology used is really complex and I don't think that I will ever be able to remember it... I don’t feel as though it is really important to remember though’ (Student 74). For many students the perceived need to rely
on memory prompted them to adopt strategies of writing down steps, which for some led to frustration as they could not keep up in tutorials (for instance, Student 36). Student 142 provided an insightful reflection on the role of memory: "Throughout the different tutorials I noticed quite a few students writing down every step given for particular task. They were obviously worried that they would forget the instructions. I told them the best way to remember how the different tasks are done is through practice'.

**Knowing what is Possible**

An unforeseen theme, but one that made a great deal of sense, concerned the importance of knowing what is possible. Here I refer to a number of different but related insights. Firstly, this issue manifested for the beginner in terms of identifying functions of computers which they were not aware of, and thus hadn’t been prompted to learn about. This point is illustrated by Student 18 in relation to headers and footers: ‘I am embarrassed to say I have had a computer for two and a half years, and I never even knew there was such a facility. I did it all manually’. Secondly, this issue was presented by individuals who had used computers for some time but had reached what might be considered a ‘rut’ with their learning: ‘I had always thought that I knew a lot about the Internet but there are so many doors that I have never opened’ (Student 103); and again by Student 104: ‘Well I thought I knew a fair bit about the net and surfing it. How little did I know... After starting this subject 11 weeks ago and thinking how hard could it be or what could it teach me I now feel very much humbled’. The importance of acknowledging unknown skills or knowledge is an important one and potentially transformational for the learner. As stated by Student 25: ‘It seems the more I learn the less I know’.

**Reflections on Computer Learning Context**

Many students utilised the journal as an opportunity to reflect on the strengths and weaknesses of various learning contexts such as demonstration and observation, peer-group learning, one-on-one assistance and so on. Student 35, for instance, reflected on the pros and cons of learning e-mail through demonstration and observation: ‘After being given a demonstration of these skills I found that the best way to learn them was to practice it myself then reinforce what I learnt by teaching it to another’. There was frequent mention of the limitations of group instruction. Pace of instruction was perceived by many individuals as inappropriate. Student 66 for instance acknowledged their tendency to ‘do something else or talk to someone and often miss the next instruction’. Some students mentioned that they preferred one-on-one assistance: ‘I realise that one to one teaching is impossible but wouldn't it be great’ (Student 4). The other frequently mentioned approach was peer-assisted learning, with students citing benefits such as consolidating their own learning (Student 35 & 118), increasing their self-confidence (Student 113) and maximising feedback (Student 35): ‘Peer tutoring really is effective. Often someone can show you in a moment something that would take ages to learn from a book/Web or to discover yourself’ (Student 111). Student 108 described her collaboration with her flat mate: ‘we both built up our confidence in using the computer and also had the opportunity to ask each other questions or show what we had learnt ourselves’.

**Locating ‘Models’ and Anti-Models**

A further theme to emerge was the potential benefit of students identifying role models, or anti-role models, for their own computer use, particularly in their future careers as teachers. A number of students recorded their observations of others’ skill development and teaching
practice, providing an opportunity to explicate their own espoused values (for instance, Student 33 & 109). Such reflections brought several students close to exploring the characteristics of the ‘ideal’ computer role model. For Student 63 this definition encompassed motivation, enthusiasm and ideas, and for Student 112, patience. For Student 133 this reflective exploration led to a critical challenging of the ‘illusion of greater expertise’ which they recognised as evoking an ‘overwhelming feeling of inadequacy and hopelessness’ amongst others. What was most notable were the reflections of a number of students whose role models transcended notions of technical expertise, as expressed in the following metaphor:

One thing I’ve noticed is that those who are experienced users can get around the activities even though they might have a limited understanding about all the elements at work. I'm reminded of a story I was told by an international pilot. A jet travelling from Sydney to L.A. is going in the wrong direction more than 95% of the time! It is being constantly corrected by the auto-pilot. It arrives at a destination thousands of kilometres away by going in the wrong direction most of the time! It seems to me that most experienced computer users have a well developed auto-pilot - they correct their mistakes as they go and plough on. I get thrown by the first sign of turbulence (Student 101).

3.2.2 Student Evaluation Data

The student evaluation data were important in informing my teaching practice. However, in terms of broader focus of this thesis, only some of the data are of immediate relevance. While a full analysis of the data, both quantitative and qualitative, is provided in appendix 5 (as collated over the conduct of the entire action research) only certain aspects will be focused upon in this section.

Response rates to the student evaluation were not high in cycle 1: 29 out of 140 students (enrolment figures utilised by the Teaching and Learning Unit) returned these forms, representing 21%. This response rate was not unusual for these surveys and was understandable given that attendance at tutorials was not compulsory and thus not all students were provided with a designated time to complete it. Of the 29 respondents, 13 indicated that they were from the BEd (Primary) while 12 indicated they were from the DipEd (Secondary). One indicated they were from another course while 4 did not indicate a program of study.

As this data (as measured on a five point scale) indicates, students were generally satisfied with my teaching of the Unit, in particular my enthusiasm (µ=4.7), guidance (µ=4.7), preparation (µ=4.6), concern for quality of student learning (µ=4.7), and encouragement of student responsibility (µ=4.8). However the major concerns were with the pace of Unit (µ=3.9), and the balance between theory and practice (µ=3.9). These indications are consistent with journal data regarding timetabling and workload. Twenty one students (72% of respondents) indicated that they had attended three or more tutorials, however it should be noted that students submitting the evaluation sheets were more likely to be those attending the final tutorials when the evaluation sheets were distributed.

Students were asked to describe their skills and confidence both at the beginning of the Unit and at the end of the Unit. A five-point scale was utilised, with 1 indicating low and 5 high confidence or skills. Mean responses on these items are indicated in table 6.
Chapter 3 – Embracing Reflection as Navigation

Table 6  Average skill and confidence levels at the beginning and end of the Unit

<table>
<thead>
<tr>
<th></th>
<th>BEGINNING OF THE UNIT</th>
<th>END OF THE UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Self-perceived Skill level</td>
<td>2.5</td>
<td>4.1</td>
</tr>
<tr>
<td>Mean Self-perceived Confidence level</td>
<td>2.6</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Students were also asked to rate each of a range of learning resources (such as tutorials, online resources, one-one one assistance, peers and books) in assisting their learning, as well as the value of each of the three modules. A five-point scale was utilised with 1 indicating little value and 5 indicating great value. Average responses on these items are indicated in table 7.

Table 7  Perceived value of various learning resources

<table>
<thead>
<tr>
<th>FEEDBACK ON THE MODULES</th>
<th>MEAN PERCEIVED VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module One (Using the Internet)</td>
<td>3.4</td>
</tr>
<tr>
<td>Module Two (Learning and Teaching with the Internet)</td>
<td>3.7</td>
</tr>
<tr>
<td>Module Three (Publishing on the Internet)</td>
<td>4.3</td>
</tr>
<tr>
<td>FEEDBACK ON SOURCES OF SUPPORT</td>
<td></td>
</tr>
<tr>
<td>Face to face tutorials</td>
<td>4.2</td>
</tr>
<tr>
<td>Online resources</td>
<td>3.8</td>
</tr>
<tr>
<td>Assistance from tutor</td>
<td>4.7</td>
</tr>
<tr>
<td>Assistance from peers</td>
<td>3.8</td>
</tr>
<tr>
<td>Books or other resources</td>
<td>2.7</td>
</tr>
</tbody>
</table>

These data thus indicated that the Unit was successful in increasing students’ self-perceived skill level and their confidence. Assistance from the tutor was seen as of greatest assistance and, in connection with this, tutorials. The online Unit resources and peers were seen as equally beneficial and books and other resources least so.

On the open-ended questions students were asked to comment on what they considered the best aspects of the Unit and the areas in need of improvement. Best aspects included: creating a Web page (n=8); practical, relevant and interesting nature of content (n=7); teacher enthusiasm and sincerity (n=3), helpfulness (n=4) and explanations/assistance (n=2); flexibility, being able to work independently and at own pace (n=4); usefulness and applicability of the content (n=4), organisation of the online resources (n=1); relevance of the online medium (n=1); growth in confidence and skills (n=1) and reflection on practicum experiences (n=1).

Areas of the Unit perceived as needing improvement included the quantity of reading/work (n=5), preference for some print-based resources (n=4) or the Unit materials on disk (n=1); the pacing (n=1), size (n=2) and quantity of tutorials (n=5); the placement of the Unit in the degree structure (n=2); the availability of computers and Internet access (n=3); difficulties with independent learning including time management (n=2); assignment requirements (n=3); quantity of staff contact (n=5); expectations for work during Practicum (n=2); content issues, including more emphasis on basic computer skills (n=1); more links to Australian sites (n=1 student); and the Unit Discussion list (n=1).

These data support (triangulate) and re-emphasise the issues raised by students in their reflective journals.
3.2.3 Reflections on my Experiences and the Student Data

Reaction to the Unit’s design was variable. Overall, it can only be said that it received more criticism than praise. There were many sources of dissatisfaction for both the students and myself, yet there were also many indications of scope for the development of an empowering computer learning context. This section draws together the student data and my own reflections, mapping the path for further planning and action in subsequent cycles. This section is again structured according to the two themes: functional and student learning issues.

3.2.3.1 Pragmatic or Functional Issues

My own experience aligned with that of students in revealing the impact of functional issues on the successful delivery of the Unit. Timetabling difficulties, large (initially unforeseen) student numbers and the necessity of shaping the tutorial schedule around a four week block of Practicum had created a less than ideal context. I recognised the difficulties and frustrations being experienced by students in accessing the online materials. The computer labs were busy and I constantly witnessed the problems students experienced gaining access to a computer. That said, poor time management skills of some students inevitably compounded these problems. Units involving computer use inevitably raise equity concerns; however, compounding these were my beliefs that no degree of ‘teaching’ could substitute for regular ‘practice’ and experience on computers. As an educator I was torn between equity concerns and my belief that I should emphasise and require regular practice and revision. In reflecting on access issues I identified one potential partial solution as the production of a CD-ROM from the Unit Web site, enabling students with home computers to access the Unit materials without requiring constant Internet access. This approach would meet student requests for access to the materials after leaving the University while bringing with it limitations in terms of the capacity to update materials throughout the semester.

Many of the functional issues raised by students were associated with, or compounded by, the design and structure of the Unit resources, many aspects of which were still at odds with my vision of the Unit as 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. Despite the large quantity of content, the Unit materials were not aligned with the Unit Statement. This initial cycle had enabled me to identify a number of content issues; some topics were little understood by students and, furthermore, many students had difficulty thinking laterally about applications of the technology in the classroom. This observation was consistent with Laffey and Musser’s findings (1998). For the resource to truly facilitate self-directed learning some content areas needed revision, others needed to be added, and more explicit connections needed to be made to school-based application. I faced a considerable challenge in achieving such revision while decreasing the quantity of material and began to reflect on conceptual and pedagogical structures to solve this problem.

A significant number of student comments related to the availability of support. In my analysis it was important (but difficult) not to be defensive. This feedback came as quite a shock as I felt I had made myself highly available, providing intensive one-on-one assistance to a range of students who approached me and providing (I had felt) a highly
supportive tutorial environment tailored for less experienced computer users. I did acknowledge that I had a high student to staff ratio and that, as a casually employed staff member, I was not on campus at all times. However this situation was not very different from other Units the students were enrolled in. Two things, I felt, were exacerbating student concerns. Firstly, the nature of the subject itself, computing, is highly practical and potentially problem ridden. Anyone (students, staff, even myself) experiencing technical frustrations will undergo feelings of lack of support if assistance isn’t immediately available and I noted that immediacy of support may be a significant issue confronting computer education contexts. I also found it interesting that many of the students speaking of a lack of support did so purely in terms of the tutor/lecturer, not recognising the validity of other forms of support such as peer interaction. Again, to me, this spoke of an expectation of teacher-directed learning and a consequent reluctance by students to explicitly acknowledge the important role of ‘others’ in the learning experience.

I did give consideration to student suggestions of streaming of tutorial groups. However, I did not consider this to be a feasible option given timetable constraints imposed by other subjects. Instead, I placed a greater emphasis on the non-compulsory nature of tutorials and alternate, valid forms of pursuing learning, to strengthen the potential of building learner independence.

3.2.3.2 Student Learning Issues

On closer examination I recognised that the Unit focused almost entirely on content, with very little focus on learning processes. From a constructivist perspective I felt uncomfortable with this balance, viewing the educator’s role as not simply to provide information but to create conditions in which learning can take place (Kanuka & Anderson, 1999). Taking this one step further, my perspective on capability prompted a desire to assist students to create optimum learning conditions themselves.

It was an important and confronting experience for me to acknowledge the wide range of views and sentiments expressed by students on the flexible self-directed learning context. Why were some students so positive and others almost antagonistic? What was it that prevented some students from responding positively to independent learning while others highly valued the approach?: ‘I like the responsibility that work of this nature hands back to students - it empowers them to be active in their own learning’ (Student 89). I was forced to acknowledge my potentially paternalistic assumptions that self-directed learning was ‘good for them’; yet I also couldn’t escape concern that, as future teachers, students should be prompted to confront their own assumptions about teacher-directed learning. Was I justified in holding these beliefs? Engaging with the reflective data I perceived a fundamental difference in the way individual students were approaching the learning experience. Some were seeing the online and flexible context as a learning experience in itself and were reflecting on its implications for their own future practice as teachers. These students were more likely to analyse the strengths and weaknesses of specific learning experiences and to look for similarities and differences in the experiences of other students. They were also more likely to be searching for reasons and justifications for their feelings and suggesting alternative approaches and solutions to their issues. The other noticeable group of students were more, perhaps, ‘consumerist’ in their approach. They viewed the learning and teaching context at face value, expecting a refined approach ideally suited to their learning needs and expectations. While this, in itself, was not unreasonable it was
often expressed with little questioning of assumptions or critical self-reflection and was based primarily in terms of familiarity and comfort rather than longer-term considerations.

Interesting, also, were comments concerning memory. Reflecting on the assessment approach utilised in previous years (the examination on computer terminology) I noted how this approach must have emphasised memorisation and was fascinated that, despite its removal, students still adopted what I considered to be an inappropriate learning approach. There appeared to be an assumption that all information provided to students needed to be internalised and ‘memorised’. Again this indicated expectations of ‘teacher-centred’ and surface learning approaches which were, potentially, what students were expecting. In providing feedback to one student on their journal I challenged them to consider whether, as a teacher, I should only provide access to information that I want students to memorise? What seemed evident was that students were not differentiating between core and supplementary information: what required full engagement and what required skim-reading. Here was an area in which the Unit needed to be more explicit in order to facilitate students’ adoption of appropriate learning strategies.

Overall, I was impressed by the learning represented in the journals; however, I also acknowledged that some were far richer in reflective insights than others. Mature aged students, for instance, tended to be stronger at reflection than some of the younger students (although this was a generalised and non-substantiated impression). In some respects this put them on a more equal footing with younger students who, I assumed, had more technical experience. I realised, though, that I was making a number of assumptions (such as those mentioned here) in relation to the student body, based only on general interactions with the students and with their work. I needed, in future cycles, to gain a greater understanding of the student body’s demographics. I was also conscious of what was not being said in the journals. Anxiety, for instance, was rarely mentioned, despite my observations of this being an issue for many students. The journals were not prompting students to engage in the affective domain, nor was there a broad acknowledgment of learning strategies.

I began to rethink the context of the journal and the content of the Unit. Revisiting the student journals, particularly the accounts of those students who gained a great deal from the reflective experience, I identified a number of ‘techniques’ prompting insights into the learning process. Firstly, a number of students chose to reflect on their past experiences and how these impacted on current approaches to learning. Secondly, a number of students gained insight by reflecting on their observations of other computer users (both adept and not so). In both cases the reflections, when related to their own approaches, seemed beneficial. Thirdly, as mentioned above, students who saw their study in the Unit as an ‘experiment’ and a source of reference for their own future teaching practice seemed to gain more personal productive learning. I began to wonder whether these approaches might be explicitly acknowledged in the teaching approach. Could I challenge students to actively seek out diverse learning contexts and reflect on their respective merits? Could I challenge them to think about the potential value of independent learning approaches? I strongly believed that providing learners with opportunities to ‘learn how to learn’ was as important as the actual content being covered, in many cases more important than a focus on the knowledge with an ‘ever declining half-life’ (Hiemstra, 1994).
3.3 Stepping Back and Moving On

This chapter has presented the plans, actions, observations and reflections which comprised cycle 1. From this ‘grounded’ analysis I came to a greater understanding of the functional and learning issues that impacted on the Unit’s delivery and on the computer learning experience for students. In particular I began to understand the important role that students’ beliefs, not only about their own computer abilities, but also their approaches to the learning context, had on their learning outcomes. Affective reactions such as excitement, realisation of potential professional value, sense of achievement and confrontation of difficulty would have potentially powerful impacts on students’ learning. Provided with the opportunity to reflect on these experiences in cycle 1, and to engage further with the literature, I entered a transitional phase of planning for cycle 2. This entailed a substantial engagement with the literature in an attempt to ‘make sense’ of the observations and reflections emanating from cycle 1. It is this theoretical transition which led me to perceive value in trialing a metacognitive approach to computer learning in cycle 2.
Chapter 4 - Encountering a Theoretical Bridge: Crossing to a Metacognitive Approach

This chapter outlines the theoretical journey traversed in the planning stages of the second action research cycle. An account is provided of a body of theory previously unfamiliar to me, and the assimilation of this theory into my existing understanding of the computer learning context. In particular I note that increased computer experience may exacerbate rather than ‘cure’ computer anxiety and that there is an imperative in computer education to consider the triadic reciprocal influences of behaviour, cognition and environment. I describe how my ontological understandings provided new perspectives on the psychologically-based literature and how, from this engagement, I was led to adopt a metacognitive approach to my teaching.

4.1 Introduction: Literature as Road Map

The grounded theory approach taken in the first research cycle exposed a number of issues impacting on students’ computer learning experiences, and consequently on my practice as an educator. However, the first cycle had raised more questions than it had answered. The rapidity with which I had been drawn into cycle 1 provided little opportunity to consult the relevant literature. Presented with six months for planning and redevelopment of the Unit prior to the second round of implementation, engagement with the literature became an imperative. Initially I did not specifically seek ‘answers’ to the issues raised in cycle 1, reading broadly instead in the area of end-user computer education, and relating theory to my observations and reflections. As this literature was to have a profound influence on the design of the second research cycle, it is appropriate to provide a detailed critical analysis of the theory encountered, and my reactions to it.

4.2 Social Cognitive Theory: The Role of Outcome Expectations and Self-Efficacy

One such body of literature concerned the application of social cognitive theory to end-user computing and computer education. Social cognitive theory had immediate relevance to my teaching context, embracing a wide range of factors observed as influencing students’ behaviour in the computer learning context, in particular students’ beliefs about their own abilities to use computers and the importance of perceiving the personal or professional relevance of the technology. Before detailing the computer-specific literature a brief explanation of social cognitive theory is provided.

Social cognitive theory, based on the work of Bandura (1977; 1981; 1997), is heralded as a widely accepted and empirically validated theory of individual behaviour (Igbaria & Iivari, 1995). This theory posits a triadic reciprocal causation model in which behaviour, cognition and the environment all influence each other in a dynamic manner (Compeau & Higgins, 1995b). According to this theory, individuals choose the environments in which they exist, in addition to being influenced by those environments. Social cognitive theory incorporates two specific expectational dimensions: outcome expectations and self-efficacy. Individuals are more likely to undertake behaviour they believe will result in valued outcomes (i.e. outcome expectations); however, outcomes in themselves may be
insufficient in influencing behaviour if individuals doubt their capabilities to succeed (self-efficacy) (Compeau & Higgins, 1995a; 1995b).

Self-efficacy is a comprehensive summary of an individual’s belief in their capacity to perform on a particular task. Self-efficacy is not concerned with the skills one has but with judgements of what one can do with whatever skills one possesses (Bandura, 1986). Self-efficacy differs from self-esteem in that self-esteem is a generalised evaluation of the self, whereas self-efficacy is a judgement specifically about task capability that is not inherently evaluative (Gist, 1992). Self-efficacy has been likened to Vroom's (1964, cited in Gist, 1992) expectancy theory: that expectations influence action. Self-efficacy, however, represents a more comprehensive formulation of the rationale underlying expectancy theory and is viewed as having generative capabilities, influencing thought patterns, emotional reactions and performance. Self-efficacy is an important motivational construct influencing individual choices, goals, emotional reactions, effort, coping, persistence and resilience, and ultimately the level of learning and human accomplishment (Gist, 1992; Gist, Schwoerer & Rosen, 1989; Igbaria & Iivari, 1995). Individuals who distrust their capabilities are easily discouraged by failure, whereas those who are highly assured of their efficacy for goal attainment will intensify their efforts when their performances fall short and persevere until they succeed (Wood & Bandura, 1988). Specifically, environmental and personal factors, such as verbal persuasion and experience, influence expectations that subsequently affect individuals' outcomes (Igbaria & Iivari, 1995). There seemed to be significant synergies between social cognitive theory and capability, a connection I later realised had been made by Cairns (1997a).

4.2.1 Social Cognitive Theory as Applied to Computer Learning

‘Computer self-efficacy’ thus refers to an individual’s judgement of their ability to use a computer. It does not refer to simple component sub-skills but rather to judgements on ability to apply skills to broader tasks (Compeau & Higgins, 1995b). My research in cycle 1 had emphasised the importance of belief in one’s ability to use a computer. Social cognitive theory seemed, therefore, to offer a valuable framework for improving my teaching practice.

Various researchers have applied social cognitive theory to computer contexts, giving rise to both derivational and extended models for understanding computer learning. One model in particular is relevant to outline here, the technology acceptance model proposed by Davis (1989) and referred to by a range of authors (Adams, Nelson & Todd, 1992; Coffin & MacIntyre, 1999; Davis, Agozzi & Warshaw, 1989; Igbaria & Iivari, 1995). The technology acceptance model is derived from the theory of reasoned action (Ajzen, 1989; Fishbein & Ajzen, 1975) and the theory of planned behaviour (Ajzen, 1985; 1989). When applied to computer learning, the theory of reasoned action maintains that individuals use computers if they see that there are positive benefits (outcomes) associated with them (Compeau & Higgins, 1995b). In other words, behaviour is determined by individuals’ perceptions and attitudes towards the behaviour (behaviour beliefs), as well as social influences or pressure (normative beliefs) (Igbaria, Parasuraman & Baroudi, 1996). The technology acceptance model thus focuses on perceived usefulness and perceived ease of use (self-efficacy) as the determinants of usage, suggesting that individuals will use computer technology if they believe it will result in a positive outcome (Igbaria & Iivari, 1995; Igbaria, Parasuraman & Baroudi, 1996). Various researchers have extended the
technology acceptance model, incorporating factors such as computer anxiety, perceived ease of use, perceived usefulness, perceived enjoyment and perceived complexity (Compeau, Higgins & Huff, 1999; Igbaria & Iivari, 1995; Igbaria, Parasuraman & Baroudi, 1996). A wide range of literature documents the application of social cognitive theory to computer use and provides evidence of a relationship between self-efficacy and:

- computer anxiety, perceived ease of use and perceived usefulness (Gist, Rosen & Schwoerer, 1988; Gist, Schwoerer & Rosen, 1989; Igbaria, 1993; Igbaria & Iivari, 1995);
- decisions involving computer usage and adoption (Compeau & Higgins, 1995a; Davis, Agozzi & Warshaw, 1989; Ellen, Bearden & Sharma, 1991; Hill, Smith & Mann, 1987; Igbaria & Iivari, 1995);
- goal level and goal commitment (various studies cited by Compeau & Higgins, 1995b; Gist, 1992);
- emotional responses, including stress and anxiety (various studies cited by Compeau & Higgins, 1995b);
- registration in computer courses at university (Hill, Smith & Mann, 1987);
- performance in software training (Compeau & Higgins, 1995a; Ellen, Bearden & Sharma, 1991; Gist, Schwoerer & Rosen, 1989; Hill, Smith & Mann, 1987; Igbaria & Iivari, 1995, p. 588; Martocchio & Webster, 1992; Mulkey & O’Neil, 1999) and training transfer (Decker, 1999; Webster & Martocchio, 1995);
- adoption of technology products (Hill, Smith & Mann, 1986);
- continuation of computer use (Compeau, Higgins & Huff, 1999);
- organisational support (Igbaria & Iivari, 1995); and
- individuals’ satisfaction and sense of personal accomplishment (Ellen, Bearden & Sharma, 1991; Webster & Martocchio, 1995).

This research demonstrated the wide applicability of social cognitive theory in informing understanding of computer learning and teaching contexts, and hence emphasised its potential value to my own students.

4.2.2 Reflections on Social Cognitive Theory

Reflecting on Bandura’s writing, I perceived a strong connection with my beliefs about adult learning. The distinction between component skills and an individual’s ability to organise and execute action (Compeau & Higgins, 1995b) resonated with the competency/capability debate. Social cognitive theory was also congruent with my constructivist perspective; according to Bandura (1982, cited in Gist, 1992) it is the individual’s cognitive appraisal and integration of experiences that ultimately determines self-efficacy.

According to social cognitive theory, individuals who feel less capable of utilising computer technology may resist it because of fears of inadequacy or discomfort. Expectations of positive outcomes from computer use can thus be rendered meaningless if the individual doubts their capacity to successfully execute the behaviour. While at one level such statements seem to be based on common sense, the theory does emphasise the impact of the individual’s cognitive state on outcomes, and the importance of understanding both self-efficacy and outcome expectations. In the context of computer education for teachers, social pressure and outcome expectations were key influences. Socially and
politically imposed expectations regarding computer use by teachers were impacting on education policy and dialogue (NSW Department of Education and Training, 1997; NSW Ministerial Advisory Council on the Quality of Teaching, 1997; Ponting & Kendall, 1997). However, from the first phase of the research, I realised that the outcome expectations of individual students did not necessarily match those imposed by education systems, and this affected students’ willingness to adopt computer technologies. Factors such as attitude, role of peers and teachers, confidence, use by others, interest and relevance had emerged (albeit sometimes as part of other issues) during the first phase of the research. Social cognitive theory presented a theoretical framework, which began to account for some of the many factors observed as impacting on students’ learning during the first phase of the research.

I was struck by the implication of social cognitive theory for computer learning contexts, reflecting that my previous practice had inadequately accounted for environmental and cognitive dimensions such as outcome expectations and social pressure. A related body of literature drew my attention to computer anxiety.

4.2.3 Computer Anxiety and ‘Technophobia’

It will be remembered that computer anxiety was recognised as affecting a number of students in cycle 1. Computer anxiety has received considerable attention in the psychologically-based literature and is defined as generalised emotional distress or the tendency of an individual to be uneasy, apprehensive and/or phobic towards current or future use of computers in general (Igbaria & Iivari, 1995). Computer anxiety may include worries about embarrassment, looking foolish or even damaging computer equipment (McInerney, McInerney & Sinclair, 1994). A number of studies have documented the importance of computer anxiety as a key variable related to perceived usefulness, usage and avoidance (Gilroy & Desai, 1986; Igbaria & Chakrabarti, 1990; Morrow, Prell & McElroy, 1986). Trait-based anxieties are personality tendencies that are stable over time and situations, whereas state-based anxieties are a transitory response to a specific situation. Computer anxiety is a form of state anxiety and Igbaria and Iivari (1995) claim that it can be altered through adequate training offered at the user’s level of ability and confidence.

A number of studies have investigated the relationship between computer anxiety and other factors such as external locus of control (discussed in section 4.3), maths anxiety (Igbaria & Parasuraman, 1989) and self-directedness (Hemby, 1998). Higher levels of computer anxiety have been found in students of ‘artistic’ and ‘social’ vocational personality types as well as those enrolled in education (particularly elementary teacher training) and humanities courses (Winer & Bellando, 1989). Other studies (such as those cited by Rosen, Sears & Weil, 1993) have supported claims that women are not necessarily more computerphobic than men, that older people are not generally more computerphobic than younger people and that computerphobics are not simply anxious people demonstrating their discomfort in a different arena.

A number of studies have focused on the computer anxiety of pre-service and/or practicing teachers. McInerney and McInerney (1994) state that initial and continuing anxiety after training may be a function of an individual’s prior computing experiences, attitude towards computing, perceptions of self-efficacy and expectations of success. Worthington and Henry’s (1998) research revealed that practising teachers were more concerned that their
use of technology would conflict with their capacity to teach in the way they felt was most meaningful for students, rather than their ability to perform skills. They voiced concerns that the use of technology did not coincide with their goals as teachers, that it would restrict interpersonal contact and expose their students to inaccurate and unverifiable information.

Worthington and Henry (1998) coined the term ‘existential computer anxiety’ to describe this reaction. These findings are supported by Lowther and Chakrabarti (1998) and Laffey and Musser (1998), who found that many pre-service teachers feared that computers would interfere with the teacher-student relationship. Research in Australia by Russell and Bradley (1997) revealed three independent sources of computer anxiety identified by teachers in government schools in Queensland: concerns about computer damage, task performance and social embarrassment, including fear of being viewed as computer illiterate. In this study, teachers were supportive of the use of computers in education with 91% agreeing that computers were a necessary tool.

A number of studies have found that, for computer anxious individuals, increased exposure tends to exacerbate rather than ‘cure’ the problem, with additional computer experiences strengthening negative affective reactions and promoting further computer avoidance (Mahmood and Medewitz, cited by McInerney, McInerney & Sinclair, 1994; Rosen, Sears & Weil, 1993). In fact, Rosen, Sears and Weil’s research challenges traditional skills-based courses, proposing instead three models, each appropriate for use with individuals with different ‘types’ of computerphobia, as summarised in table 8:

Table 8 Three models for approaching computerphobia (Rosen, Sears & Weil, 1993)

<table>
<thead>
<tr>
<th>TYPE OF COMPUTERPHOBIA</th>
<th>DESCRIPTION</th>
<th>APPROACH TAKEN</th>
<th>DETAILS OF APPROACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxious computerphobics</td>
<td>Display classic physical signs of anxiety reactions</td>
<td>Individualized systematic desensitization</td>
<td>A hierarchy of scenes is developed depicting interaction with the feared object (the computer). The client is taught to relax and progressively pairs learned relaxations with imagined scenes.</td>
</tr>
<tr>
<td>Cognitive computerphobics</td>
<td>Seem calm and relaxed but internally are highly negative</td>
<td>Thought-stopping/ covert assertion</td>
<td>The client makes a list of internalized negative self-statements and then learns to stop these messages thus leaving an internal void. Using covert assertion the client develops positive, motivating statements and internalizes them to fill the void.</td>
</tr>
<tr>
<td>Uncomfortable users</td>
<td>Slightly anxious</td>
<td>Information/support group</td>
<td>Specific information about computers (partly structured, partly unstructured) is provided to clients, including myths and realities about technology, future prospects for technology and actual computer parts and their functions. The process includes self-disclosure, discussion, problem-solving, skill acquisition and attempts to provide a feeling that they are not alone.</td>
</tr>
</tbody>
</table>
4.3 Attribution Theory

A second theory that was encountered at this time, and was found to have particular relevance to the students with whom I worked, was attribution theory. The basic premise of attribution theory is that individuals function as ‘naïve psychologists’, developing causal explanations for significant events (Martinko, 1995). These beliefs influence expectations, which in turn influence behaviour. The theory asserts that people differ in their attributational style and that these differences contribute to motivation, performance and affective reactions to various life experiences. Revisiting the cycle 1 data emphasised readiness of students to attribute ‘blame’ for their learning issues and, as will be further explored in this section, attribution theory offered a valuable framework within which to explore these reactions.

There are three different, but not mutually exclusive, types of attributions: those that function to identify the cause of an event; those that seek to identify the responsibility for an event; and those that refer to personal qualities (Martinko, 1995). Underlying these specific attributions are attributional dimensions that represent the individual’s cognitive structure (Henry, Martinko & Pierce, 1993; Kent & Martinko, 1995a; Kent & Martinko, 1995b; Martinko, 1995). Locus of causality refers to whether individuals believe the cause resides within themselves (internal) or outside themselves (external). There is a differentiation here between locus of causality and the concept of ‘locus of control’ as an event can be internal yet uncontrollable (for example mood). The use of the term locus of causality is thus more appropriate (Rotter, 1966, cited in Kent & Martinko, 1995b). Stability (or variability) refers to the degree to which the cause is anticipated to change over time. Controllability refers to the extent to which a cause is under the control of the individual. Globality refers to whether the success or failure will occur in all similar situations or only specific sets of circumstances. Intentionality differentiates between effort and strategy where insufficient effort may be intentional. This latter dimension is contested in the literature based on arguments that intent and control generally covary and that intent is an action, not a cause, and therefore is beyond the scope of attribution theory (Kent & Martinko, 1995a).

To better explain attribution theory, it is important to differentiate between two constructs. Causal dimensions (those explained above) refer to the causal structure underlying the nearly endless list of possible attributions. Causal explanations, on the other hand, are the specific explanations people make concerning the causes of prior outcomes. These might include luck, ability or effort. External explanations might thus include group interdependence or distractions such as noise, whereas internal explanations might include health or mood. Some explanations are more or less under the control of the person (e.g. effort), some are largely controlled by the context (e.g. task variables), while others may be uncontrollable (e.g. weather or temporary illness). It is generally posited that it is the causal dimensions rather than the specific attributional explanations that influence expectancies: ‘It is not the individual’s belief in a lack of ability per se that is theorized to cause lower expectations, but rather it is the individual’s belief that the cause is stable and cannot be changed that results in the lowered expectation’ (Kent & Martinko, 1995b, p.26). Attributional theory thus provides a framework for understanding individuals’ beliefs and motivations. For instance, individuals who tend to blame themselves for negative events, who think that the cause will occur in different contexts and who think that it will last into
the future might be considered as having a ‘pessimistic’ attributional style. Those who rate the situation in the opposite fashion might be considered as having an ‘optimistic’ attribution style (Seligman, 1990).

Theory and research draws a close connection between attribution and self-efficacy determination. Some of the determinants of self-efficacy are well-recognised attributions (i.e. effort, ability, luck, task difficulty). However, attributions are distinct from efficacy beliefs in that attribution relates to causes of past behaviour while self-efficacy pertains to future performance capability (Gist, 1992). The factors singled out by attribution theory serve as conveyors of efficacy-related information that influence performance attainment mainly by altering people's beliefs in their efficacy: ‘Under conditions of failure, people with high self-efficacy attribute their failure to insufficient effort or bad luck, whereas people with low self-efficacy attribute their failure to lack of ability’ (Gist, 1992, e.p.).

4.3.1 Attribution Theory and Computer Usage

Despite the strong connection between self-efficacy and attribution, and the utilisation of social cognitive theory in the computer literature, studies of attributional style within computer-related contexts are less prevalent. One of the earliest connections between attribution theory and computer use was made by Igbaria (1989) who incorporated attribution as one variable in his research. Very few researchers carried through this early work until a study by Henry, Martinko and Pierce (1993) provided evidence of the potential impact of attributional style on computer-related performance. The relationship between pessimistic attributional style and course grade was not supported; however, ‘optimistic style’ students significantly outperformed less optimistic students. A longitudinal study by Rozell and Gardner (1995) revealed that optimistic users reported more favourable computer attitudes and higher levels of computer efficacy than pessimistic users. Attributional style also accounted for differences in computer related performance, with Rozell and Gardner concluding that negative computer attitudes, low efficacy expectations and negative affective reactions may cause pessimistic users to view the computer as a ‘foe’. More recently, a small number of studies have applied attribution theory to initial teacher education, although Wishart (1997) utilises the less preferred theoretical basis of ‘locus of control’ as opposed to ‘locus of causality’.

An interesting variation on the application of attribution theory to computer learning contexts has been made by Hall and Cooper (1991). These authors focus on causal explanations, but more specifically on the use of intimate or personal terminology (speaking of the computer as if it were a person) versus objective or instrumental terminology or phrases, when referring to computer interactions. This research indicates that when non-technically oriented students describe successful computer experiences, they are more likely to make mechanical or tool-like attributions to the computer while when reporting a failure experience they attribute more personal characteristics to the computer.

4.4 Reflective Synthesis of the Psychological Theory

Whilst engaging with this body of literature I became, increasingly, both embracing and critical. I perceived relevance in these theoretical foundations and findings to my own teaching and research context. However, I was also uncomfortable, from an epistemological perspective, with the methods employed, and became increasingly conscious of ‘gaps’ in the applicability of these research findings.
Research concerning computer self-efficacy, anxiety and attribution had evolved, almost exclusively, from positivist paradigms, specifically from psychological research focused on quantitative measurement and testing (Burkhardt & Brass, 1990; Compeau & Higgins, 1995a; 1995b; Compeau, Higgins & Huff, 1999; Davis, Agozzi & Warshaw, 1989; Delcourt & Kinzie, 1993; Ellen, Bearden & Sharma, 1991; Gist, Rosen & Schwoerer, 1988; Gist, Schwoerer & Rosen, 1989; Hill, Smith & Mann, 1987; Igbaria, 1990; Igbaria & Iivari, 1995; Webster, Heian & Michelman, 1990; Webster & Martocchio, 1993). For me, however, identifying the numerous variables impacting on individual self-efficacy was, in itself, of limited value. The predictive capacity of the models and theories was dependent on a wide range of interrelated variables, factors and constructs. While these studies vied to establish the validity of each variable as a direct or indirect influence, and their level of significance, what I gained most from this literature was a greater understanding of the complexity of the interrelationships between variables. This complexity was highlighted by Evans and Simkin (1989) who noted that no single set of variables (demographic, behavioural, cognitive or problem-solving) accounted for more than 23% of the variation in computer proficiency. I was also inspired by the holistic approaches assumed (in a non-technology based context) by Mathieu, Martineau and Tannenbaum (1993) who discussed both individual and situational variables. Individual variables include knowledge, skills, abilities, personality and mood, trainees’ goals, their levels of self-efficacy before, during and after training and their self-regulatory behaviours. Situational influences include task difficulty or complexity, distractions, normative influences, reinforcement and punishment contingencies, socialisation and group processes that influence trainees’ goals, self-efficacy and instrumentality judgements. These factors are all implicit in Bandura’s theory, however, assuming a positivistic approach to the research seemed to ignore this identified complexity and to limit the relevance of such research in ‘real-life’, as opposed to controlled, learning contexts.

My methodological positioning as an action researcher found me continually questioning the benefit of these studies to those being researched. Many of the studies involved control groups and experimentation with a focus on measurement rather than change and many (if not most) of the participants were not directly benefiting. All the studies were framed as research on learners rather than research with learners. What was of greatest importance to me as a researcher and teacher was an exploration of methods of enhancing self-efficacy, thus directly benefiting student participants. Given this, I turned to the literature to inform my understanding of the implications of social-cognitive and attribution theories in learning and teaching contexts.

4.4.1 Perspectives on ‘Training’

Overall, there is a paucity of research regarding the effectiveness of variant types of computer training approaches (Compeau & Higgins, 1995a; Gist, Rosen & Schwoerer, 1988; Martocchio & Webster, 1992). That emerging in the mid to late 1990s focused primarily on formal ‘training’ in organisational or higher education contexts, and generally employed positivist methodologies in ‘controlled’ situations. Gist, Rosen and Schwoerer (1988; 1989), for example, tested the effect of two different training methods on self-efficacy development, indicating that a behaviour modelling approach yielded higher self-efficacy scores and higher performance than a computer-aided instruction approach (Gist, Rosen & Schwoerer, 1988). A similar study by Compeau and Higgins (1995a) compared
video-based behaviour modelling to a lecture-based program, indicating that some software may lend itself better to modelling and that the impact of modelling is moderated by the learner’s familiarity with the particular software. Martocchio (1992) studied the effects of labelling computer use as an ‘opportunity’ and found that trainees in the ‘opportunity’ condition exhibited higher computer efficacy and learning, as well as lower computer anxiety, than trainees in the neutral group. Webster and Martocchio (1995) also studied the effects of realistic versus optimistic computer training previews. Realistic previews contained both positive and negative information about the computer program while optimistic previews contained exclusively positive information. These researchers found that optimistic previews enhanced the immediate training experience, but did not directly relate to trainee satisfaction or learning, whereas the realistic preview directly affected post-training reaction.

This literature predominantly drew from a ‘training’ model rather than an adult learning perspective. The distinction is highlighted by Novak and Gowin (1984, p.xi) who speak of the ‘yoke of the behavioral psychologists’ who view learning as synonymous with a change in behaviour. Rather, these authors highlight the alternative view that learning is a ‘change in the meaning of experience’. There appeared to be little, if any, research which examined the relevance of these theories in promoting lifelong learning or greater learning independence. My background in distance and adult education prompted me to challenge ‘training’ models where a defined set of skills and knowledge is claimed to be ‘transmitted’ from trainer to trainee. Engagement with this literature did, however, emphasise the important influence of learners’ analyses of task requirements, of their own capabilities and their analysis of the reasons behind their performance level and provided a useful theoretical framework for considering change processes.

According to Gist (1992) experiences of mastery, modelling, persuasion and arousal (categories of experience originally identified by Bandura) contribute a variety of external and internal information cues that can influence self-efficacy. External cues include task attributes (such as the resources required), task complexity, task environment (such as distractions, risk or physical conditions), vicarious experience or modelling (which provides information on correct performance strategies) and external verbal persuasion (with credibility, expertise, trustworthiness and prestige of the person doing the persuasion being of critical importance). Internal cues on the other hand include familiarity with the task through personal experience (including not only knowledge and skills but behavioural strategies, analytical strategies and psychological strategies such as persisting and managing anxiety; the individual’s assessment of whether his/her strategies are adequate and whether they are fixed or able to be improved through training and/or experience; and their level of positive arousal (such as excitement, enthusiasm) or negative arousal (fearful, anxious). Arousal may be induced by external variables, physical conditions, personality factors and/or immediate effect (or mood).

I began to question whether assisting individuals to become more aware of the factors affecting their self-efficacy might evoke change in their approach to computer learning. Gist (1992) suggests three strategies for changing self-efficacy: providing information that gives the individual a more thorough understanding of the task attributes, complexity, task environment and the way these factors can best be controlled; providing training that directly improves the individual’s abilities or understanding of how to use abilities
successfully in performing the task; and providing information that improves the individual’s understanding of behavioural, analytical or psychological performance strategies or effort expenditure required for task performance. All three of these approaches seemed relevant in my own context, and I became interested in how I might utilise Gist’s strategies, in isolation or combination, with the students in the Unit. I was also interested in whether sharing information regarding these theories, and the various factors identified as impacting on the learning context, within a reflective framework, might assist students to adopt strategies to overcome negative influences and capitalise on positive ones.

This strategy of awareness building underlies the approach to training recommended by Rozell and Gardner (1995). These writers advocate helping pessimistic computer users learn about their tendencies to think negatively and enabling them to recognise and change negative thought patterns. Rozell and Gardner recommend a combined approach of both awareness and skill-building as an integral component of computer training programs. Such ‘attributional training’ could provide ‘highly practical and effective tools for empowering and energizing the pessimistic computer user’ (p.143). Similar recommendations were made by Henry, Martinko and Pierce (1993) who argued that attributional instruments such as their own may be useful in screening and identifying individuals susceptible to frustration and failure and that techniques such as attributional counselling and modelling could be used to ‘immunize and alleviate the unproductive attributions which may lead to failure and learned helplessness’ (p.350). Similar literature can be found in relation to improving self-efficacy. Hill, Smith and Mann (1986) note that one method of convincing a ‘computer phobic’ that they are capable of learning to successfully interact with a computer is to simply tell them; the trick of course is to get the person to believe you! These researchers investigated the importance of source credibility, finding that individuals with higher self-efficacy are more likely to be persuaded by novice users, while individuals with low self-efficacy are more likely to be persuaded by ‘experts’. Gist (1989) investigated the use of cognitive modelling of psychological performance strategies; this involved ‘listening’ to one's thoughts as one performs an activity and utilising self-instructional thoughts to guide performance. Gist’s research identified that a training method composed of cognitive modelling with practice and reinforcement provided significantly higher participant self-efficacy than a lecturer and practice alone (Gist, 1989). Cognitive modelling strategies were also utilised in the fore-mentioned study by Martocchio and Webster (1992). Ellen, Bearden and Sharma’s (1991) research into resistance to technological innovations further reinforced my growing curiosity as to whether increasing students’ awareness of the limitations of their existing learning behaviours might prompt them to adopt alternate learning approaches.

These four studies (Ellen, Bearden & Sharma, 1991; Gist, 1989; Hill, Smith & Mann, 1986; Rozell & Gardner, 1995) were to have a significant impact on the planning of the second research cycle. However, from my paradigmatic, ontological and methodological position, I was uncomfortable to proceed following similar experimental methods. Rather, I became curious as to whether enhancing students’ awareness of the concepts of self efficacy, anxiety and attribution, and assisting them to seek out role models of effective learning approaches, could assist them to develop more positive approaches toward computers and computer-learning contexts. As a constructivist and action researcher I preferred to view my teaching as ‘nurturing the ongoing process whereby learners
ordinarily and naturally come to understand the world in which they live’ (Knuth & Cunningham, 1993, p.164).

4.5 Metacognition: My Emerging Focus

At this stage in my research I encountered a research paper by Ropp (1998) who had been involved in investigating the influence of individual characteristics on the computer learning of pre-service teacher education students. It was not until later that Ropp’s full thesis was accessed. Before exploring Ropp’s research it is appropriate to outline some key and significant literature introduced to me by Ropp; that surrounding metacognition.

Metacognition refers to knowledge concerning one's own cognitive processes, and the active monitoring and consequent regulation of these processes in the pursuit of goals or objectives (Flavell, 1976; Flavell, Miller & Miller, 1993). There are two components of metacognition: metacognitive knowledge and metacognitive monitoring and self-regulation. Borkowski et al. (1990) refer to Flavell’s work as first generational, and point to a second wave of research characterised by increased theoretical complexity and focusing on the interconnectedness of metacognitive knowledge and motivational-attitudinal factors, including strategy knowledge and metamemory.

John Biggs is one of the most well known educational theorists to discuss metacognition, adopting the term ‘metalearning’ to refer to students’ awareness of their learning and control over their strategy selection and deployment (Biggs, 1985). For Biggs, the metacognitive process is a link between personal, situational, process and outcome variables. Biggs (1988) states that students need to be aware of their motives, task demands and their own cognitive resources to exert control over strategies used. He makes the connection between ‘deep’ and ‘achieving’ (versus surface) approaches to learning, asserting that students usually choose strategies that are congruent with their motives. Metalearning is evident when the student matches strategy with motive and task to produce a desired outcome. Biggs also raises the all-important question of whether students can be induced by metacognitively oriented interventions to change their approaches to learning so that they can produce more satisfactory outcomes. His research (Biggs, 1988) indicates the value of a metacognitive approach in facilitating self-directed learning and goes on to suggest that student learning may be enhanced in three ways: discouraging a surface approach; encouraging a deep approach; and developing an achieving approach.

Both Paris and Winograd (1990) and Jones and Idol (1990) discuss two dimensions of metacognition: ‘self-appraisal’ and ‘self-management’. Self-appraisal refers to reflections about one’s knowledge state and abilities, including what you know, how you think and when and why to apply knowledge and strategies. Cognitive self-management refers to ‘metacognitions in action’ (Paris & Winograd, 1990, p.18) or the ability of the individual to plan and implement appropriate strategies and to monitor, adjust and ‘trouble shoot’ their performance. This framework might be considered a simplification of Bandura’s identification of self-observation, self-judgement and self-reaction (Schunk, 1994). Paris and Winograd identify three ways in which metacognition is embedded into learning: through metacognitive judgements, metacognitive beliefs and choices and actions. Here there is a direct connection with the aforementioned attributional theory, with attribution being a primary manifestation of metacognitive belief. Other dimensions include instrumentality, control and purpose. Paris and Winograd note that the benefits of
metacognitive teaching lie in the ability to transfer responsibility for monitoring learning from teachers to students and, secondly, promoting positive self-perceptions, affect and motivation among students. These were ideals that lay at the heart of my teaching approach.

Metacognition has also been explored by Zimmerman (1986; 1994) and other writers (Zimmerman, Bonner & Kovach, 1996; Zimmerman & Weinstein, 1994) in discussion of self-regulated learners. Self regulation is the process whereby ‘students activate and sustain cognitions, behaviours and affects, which are systematically oriented toward attainment of their goals’ (Schunk & Zimmerman, 1994a, p.309). This is contrasted with motivation, which is seen as the process whereby goal-directed activities are instigated and sustained. Close connections have been drawn between self-efficacy and attribution and the notion of self-regulation (Schunk, 1994). Zimmerman proposes a model of self-regulated learning involving three interrelated components: metacognition, motivation and behaviour. Metacognitively, self-regulated learners are people who plan, organise, self-instruct, self-monitor and self-evaluate at various stages of the learning process. Motivationally, self-regulated learners perceive themselves as competent, self-efficacious, and autonomous. Behaviourally, self-regulated learners select, structure and create environments that optimise learning. Self-regulated students are those who blend ‘personal ingredients’ of cognition, metacognition, motivation and affect with behaviour to match the needs of the learning environment (Newman, 1994). Schunk and Zimmerman’s (1994a) model thus incorporates factors such as time management, practice, mastery of learning methods, goal-directedness, help-seeking and a sense of self-efficacy. Self-regulation thus involves students’ deliberate use of higher level strategies to direct and control their concentration on academic tasks (Corno, 1994). Zimmerman (1996) speaks of the potential empowerment of metacognitive processes, enabling individuals to become controllers of the learning process rather than victims of it. Paris and Winograd (1990) also point out the consistency between metacognition and constructivist approaches to learning, stating that ‘metacognition helps learners become active participants in their own performance rather than the passive recipients of instruction and imposed experiences’ (p.18). The connection between metacognitive learning and ‘capability’ had also been made, I later discovered, by Stephenson (1996).

4.5.1 The Expert Learner and the Centrality of Reflection

Ertmer and Newby (1996) extended Zimmerman’s notion of self-regulated learning in their discussion of ‘expert learners’, a concept which adds the ingredient of reflection. By way of definition, Ertmer and Newby state that ‘expert learners use the knowledge they have gained of themselves as learners, of task requirements, and of specific strategy use to deliberately select, control and monitor strategies needed to achieve desired learning goals’ (p.1). In other words, they are aware of the knowledge and skills they do or do not possess, and use appropriate strategies to actively implement or acquire them. ‘Expert’ learners are thus self-directed and goal oriented. As these authors continue:

Expert learners notice when they are not learning and thus are likely to seek a strategic remedy when faced with learning difficulties... Novice learners, on the other hand, rarely reflect on their own performance and seldom evaluate or adjust their cognitive functioning to meet changing task demands or to correct unsuccessful performances (Ertmer & Newby, 1996, p.6).
These authors identify two basic components of metacognition: *metacognitive knowledge*, which includes an understanding of the task demands, of oneself as a learner, and the comparative relationship between the two; and *metacognitive control*, which is the application and evaluation of that knowledge in action, or the management and regulation of learning. These two aspects interact in a cyclic, interactive and dynamic way to bring about expert learning, as indicated in Figure 2.

Figure 2  Ertmer and Newby’s (1996, p.15) model of expert learning

Reflection on the process of learning is seen as the critical link between knowledge and control of the learning process. ‘By employing reflective thinking skills to evaluate the results of one’s own learning efforts, awareness of effective learning strategies can be increased and ways to use these strategies in other learning situations can be understood’ (Ertmer & Newby, 1996, p.1). The above model illustrates how learners’ metacognitive knowledge of cognitive, motivational and environmental strategies is translated into regulatory control of the learning process through ongoing reflective thinking. ‘It is the monitoring and self-regulatory skills that enable experts to know not only what is important (declarative knowledge) but also how (procedural knowledge), when, where and how (conditional knowledge) to apply the right knowledge and actions’ (p.5). Reflection can thus lead to changes in future processing and increased metacognitive knowledge about learning:

As a powerful link between thought and action, reflection can supply information about outcomes and the effectiveness of selected strategies, thus making it possible for a learner to gain strategy knowledge from specific learning activities… Whereas metacognitive knowledge might be regarded as the “static” knowledge one has accumulated regarding task, self and strategy variables… reflection is believed to be a more active process of exploring and discovering (Ertmer & Newby, 1996, p.14).

In contexts of rapid change, expert learners’ metacognitive strategies provide distinct advantages: ‘When asked to deal with novel situations, the specific cognitive skills and learning strategies we have available become more critical than the limited content knowledge we may possess’ (Ertmer & Newby, 1996, p.7). As pointed out by Ropp (1997; 1998), in novel situations, an understanding of ‘how’ to learn by using specific cognitive skills and strategies distinguishes expert learners from novices who may have an equal unfamiliarity with the content of the domain.

Engaging with this literature as an action researcher I was particularly interested in Ertmer and Newby’s extension of Schön’s notions of reflection *on* action and reflection *in* action to include reflection *for* action. Reflection *on* action was defined as the active process of
making sense of past experiences for the purpose of orienting oneself for current and/or future thought and action. Reflection in action is managing the process of learning and constantly adjusting and changing as new information is assimilated. Reflection for action, however, means that by ‘employing reflective thinking skills to evaluate the results of one’s own learning efforts, awareness of effective learning strategies can be increased and ways to use these strategies in other learning situations can be understood’ (Ertmer & Newby, 1996, p.18).

4.5.2 Ropp’s Research: A Key Influence on my Theory and Method

I have already noted that engagement with the literature surrounding metacognition, self-regulated learning and ‘expert’ learning was prompted by Ropp’s research, initially a single paper (1998), and later her full dissertation (1997). This research drew on notions of self-regulated learning, arguing that teachers need to go beyond being active participants in their technological professional development to becoming active directors of their own learning processes. ‘Each teacher must decide what and how to learn based on the unique combination of students, subject matter, and self-perceptions of individual development as a teacher’ (Ropp, 1997, e.p.). Ropp argues that students need to understand themselves, what's important to them, and their learning competencies and abilities, in order to maintain learning interest and to adopt appropriate learning skills and strategies.

Ropp explores five individual characteristics: attitude toward computers, technology competence, computer anxiety, computer self-efficacy and computer coping strategies; and she involved students in a range of activities designed to trigger metacognitive experiences and strategies and prompted students to adopt active learning approaches. Ropp saw her research as providing teacher education programs with a new approach to preparing teachers to teach with technology. Her research also pioneered a model for combining psychometric measurement and qualitative research methodology as part of the pedagogy of a computer education program. Involving students in completing the instruments was intended not only as a data collection process but also to increase pre-service teachers’ awareness of the range of competencies, computer coping strategies and potential uses of technology in education and to increase their self-awareness of their individual level of computer anxiety, self-efficacy and attitude toward computers: in other words, their knowledge about the task and their knowledge about themselves.

At the beginning of cycle 2 I was aware of the theoretical basis of Ropp’s study, and the general aims of her research from her conference paper (1998) but was not fully aware of her pedagogical approach, or her research methods and survey instruments. My own research was inevitably shaped by Ropp’s study; however, the similarity of our methods and findings (as will be further discussed in section 6.7.7) and in particular our use of psychometric instruments as an integral part of pedagogy (as outlined in section 5.3) was largely co-incident. This convergence can be seen as re-inforcing the value of such techniques as an approach to metacognitive development in computer learning contexts. That said, the underlying paradigmatic and methodological differences in our approaches led our research in quite different directions.

Aside from Ropp’s research, I was unable to locate many other practitioners utilising a metacognitive approach in computer education. An exception might be Coombs and Smith’s (1999) integration of ‘thinking’ (metacognition) to boost student achievement.
While initially this research sounded similar to my own, these authors were focusing on the development of critical and creative thinking skills in general through the use of IT, rather than the development of these skills for the purpose of enhancing computer learning, as in my own context. The only other study which remotely resembled my developing focus was Aker and Yalcnalp’s (2000) study of adults’ metacognitive knowledge about information seeking skills via the Internet. Unfortunately, only a brief and superficial report of this research could be located.

4.6 A Parallel Perspective: Experiential Learning and Learning Style Theory
As already noted, the literature surrounding social cognitive theory and attribution emerged primarily from the psychological literature. It was also important to explore educational literature that might inform my teaching practice. Two studies (Birkey & Rodman, 1995; Bostrom, Olfman & Sein, 1990) emerged as of particular value: both utilised Kolb’s experiential learning theory (mentioned earlier in section 3.1.1).

4.6.1 A Further Exploration of Experiential Learning Theory

*Experiential learning theory* has been widely utilised in higher and adult education, not as an alternative to behavioural and cognitive learning theories, but as a holistic integrative perspective on learning that combines experience, perception, cognition and behaviour (Kolb, 1984). Kolb’s theory conceives learning as a continuous process, grounded in experience: a holistic process of adaptation to the world, involving transactions between the person (the subjective internal state) and the environment (the objective external state). Knowledge results from the transaction between these objective and subjective experiences in a process called learning. Kolb (1984, p.38) thus defines learning as ‘the process whereby knowledge is created through the transformation of experience’.

Experiential learning theory conceives of learning as an integrated, four stage process involving the use of four different cognitive modes:

- **Concrete experience** – the ability to involve oneself fully and without reservation;
- **Reflective observation** – the ability to reflect on and observe experiences from different points of view;
- **Abstract conceptualisation** – the ability to generate concepts that integrate one’s observations into logical sound theories; and
- **Active experimentation** – the ability to apply those theories to solve problems and make decisions.

According to Kolb, the structural basis of the learning process lies in the transactions among these four adaptive modes and the way in which the adaptive dialectics get resolved. Kolb represented the learning modes as a dialectic between prehension (comprehension vs apprehension) and transformation (intention vs extension) as illustrated in figure 3.
The result of this dialectical tension is four different forms of knowledge:

- divergent knowledge - experience grasped through apprehension and transformed through intention;
- assimilative knowledge - experience grasped through comprehension and transformed through intention;
- convergent knowledge - experience grasped through comprehension and transformed through extension; and
- accommodative knowledge - experience grasped by apprehension and transformed by extension (Kolb, 1984, p.41).

Those with an orientation toward *extensional transformation* are primarily concerned with maximising success, with little concern about failure or error. *Intentional transformation* is associated with concern about avoiding failure and error and a willingness to sacrifice opportunities for successful performance in order to do so. Kolb’s central proposition is that learning, and therefore knowing, requires both a grasp of experience and some transformation of that experience: either alone is not sufficient. Yet people program themselves to grasp reality through varying degrees of emphasis on apprehension or comprehension, extension or intention. Kolb speaks of this as ‘self programming’ and states that it is conditioned by experience. Hence, the task or problem the person is working on shapes the individual’s learning approach. Different tasks require different sets of skills for effective performance. The effective matching of task demands and personal skills results in what Kolb terms an *adaptive competence*. Adaptive competence is a concept which might be related to our earlier discussion of capability.
Although effective learning requires the use of all four modes, Kolb claims that most people develop a preference for one member of each contrasting pair, which constitutes their learning style. To be an effective learner, individuals must continuously choose which set of abilities they bring to bear in a specific situation. According to Kolb, any educational program or course design can be viewed as having degrees of orientation toward each of the four learning modes in the model. Affective environments emphasise the experiencing of concrete events, symbolic environments emphasise abstract conceptualisation, perceptual environments emphasise observation and appreciation and behavioural environments stress action taking in situations with real consequences.

4.6.2 Experiential Learning Theory in the Computer Context

As previously mentioned, two particular studies related experiential learning theory to computer contexts. Birkley and Rodman (1995) had conducted a study to determine the extent to which self-concept, learning style, gender, population characteristics and attitude towards computers served as predictors for enrolment in programs with high computer use or low/no computer use. Two of Kolb’s learning styles (accommodator and converger) emerged as significant predictors, with both learning styles having active experimentation as a common learning mode. Birkley and Rodman highlight that the adult population is especially vulnerable to avoidance of careers that require computer skills, due to their well-established learning styles.

Bostrom, Olfman and Sein (1990) examined the influence of a novice’s learning style in learning common programs such as spreadsheets and e-mail. Their findings indicated that learning style is an important predictor of learning performance, both in itself and in interaction with training methods. These researchers provide evidence that abstract learners performed better than concrete learners and, in most cases, active learners performed somewhat better than reflective learners. ‘It is almost axiomatic that learning how to use a computing system can be accomplished best through actually using it... therefore an active experimentation mode seems more suitable to learning a computing system than a reflective observation mode’ (Bostrom, Olfman & Sein, 1990, p.114). This research highlights that convergers who combine active experimentation and abstract conceptualisation performed better than those individuals with other learning styles.

Other notable learning style studies include Woelfl’s (1984) connection between online bibliographic search behaviours and learning style, Fetherston’s (1998) use of Gardner's multiple intelligences to discuss the use of interactive multimedia and Kerola’s (1990) utilisation of the Human Information Processing Survey (HIPS), the Learning Style Inventory (LSI) and the Myers-Briggs Type Indicator (MBTI) with students involved in computer learning. This latter study, while sounding relevant, was poorly reported.

4.6.3 Personal Perspectives: Empowerment and Disempowerment through Learning Style Theory

My experience and conversations with students and colleagues (including those in critical friend roles) suggested that learning style theory was often misunderstood and misapplied. The strengthening focus on learner-centred education had led many educationalists to speak of the need to alter teaching approaches to more closely align with the existing learning styles of students, a model discussed by McKeachie (1995) and referred to by Bostrom, Olfman and Sein (1990) as the definite learning style continuum model. While
Kolb (1984) had noted that learning environments that are dissimilar to a person's preferred style of learning are likely to be rejected or resisted by that person, he also emphasised the value of metacognitive approaches, whereby teacher and student explicitly discussed their respective theories of learning. The intent of such an approach was not solely for the teacher to modify his or her approach, but also so students could gain an insight into why the subject matter was taught as it was, and what adjustments they need make in their approach to learning the particular subject (Kolb, 1984).

My own view was that an approach of ‘maximum accommodation’ disempowers learners who, consequently, do not develop their abilities to learn in a variety of situations. Life, of course, presents a wide array of learning environments (affective, symbolic, perceptual and behavioural) and it is not always reasonable to assume that the learning opportunities that life affords will accord with one’s preferred learning approach. My own belief was that teachers should help students to strengthen their learning in each domain so that they might better adapt to any learning context, an approach consistent with the situational learning style model mentioned by Bostrom, Offman and Sein (1990) and, to a lesser extent, by McLauchlin (1999).

This is not to de-emphasise the importance of accounting for individual learning style, nor to question the criticality of addressing the individual needs of students. As Kolb (1984) states (and I agree), approaches that individualise the learning process to meet the student's goals, learning style, pace and life situation will pay off handsomely in increasing learning. However, if, through an explicit recognition of preferred approach, steps can be taken to improve learning in non-preferred contexts, then the experience will be more empowering for the learner in the longer term. These personal beliefs are supported by Kolb when he states that:

… the learning style that is felt to be appropriate for a given area of study must also be considered when educational objectives are set… in making students more ‘well rounded’ the aim is to develop the weaknesses in the students’ learning style to stimulate growth in their ability to learn from a variety of learning perspectives… the aim is to make the student self-renewing and self-directed… Here the student is taught to experience the tension and conflict among these orientations, for it is from the resolution of these tensions that creativity springs (p.203).

This empowerment of learners was to have a strong influence on my approach to the second cycle, as detailed in the following chapter.

4.7 Stepping Back and Moving On

This chapter has traced my navigation through a range of literature, exploring the application of these theories to computer education and indicating how this engagement provided a clearer understanding of the student experiences outlined in cycle 1. I have indicated how this engagement with the literature led me to perceive the potential of a metacognitive approach. As was outlined in both the introduction to this thesis, and in chapter 2, my observations of many professional development programs and ‘computer courses’ had led me to question whether directive, skills-based approaches were successful in facilitating the development of learning approaches suitable for lifelong learning. The literature surrounding metacognition led me to ask whether metacognitive teaching strategies might better facilitate the enhancement of more ‘capable’ computer users. Again, I believed that lifelong learning strategies were critical in rapidly evolving computer
contexts and, like Ropp (1997; 1998), felt that teachers who were self-regulated in their efforts to learn to use computers, regardless of their level of technology proficiency, might be more likely to engage with computers than avoid them. Metacognitive teaching and learning processes provided a potentially important vehicle for fostering capable computer users and this was the challenge presented to me for cycle 2. The following chapter will trace my plans and actions in developing a metacognitive foundation for the Unit. In particular it will consider the methodological and philosophical issues and choices that arose from the literature reviewed in this chapter, and how these influenced the changes to my teaching practice.
Chapter 5 - Integrating Metacognition: Planning for Cycle 2

This chapter describes the planning of the second research cycle. It begins by identifying the focus of the cycle and reiterating the psychological and metacognitive foundations for this direction. Paradigmatic and pragmatic issues implicit in adopting a mixed model approach to data collection and analysis are discussed, including the development of a ‘self-assessment survey’ and its utilisation, not in a predictive capacity, but rather as a basis for reflection: to promote growth and change. Finally, the issues identified in cycle 1 are revisited and the way in which these were addressed in the planning of cycle 2 are emphasised.

5.1 Formulation of the Cycle 2 Research Focus

Having engaged with the literature outlined in the previous chapter, I hypothesised that adopting a metacognitive approach to my teaching might better facilitate the development of capable computer users. The research question underpinning the second cycle was: Can a metacognitive teaching approach, in particular one with a focus on self-efficacy, attribution theory and experiential learning theory, help facilitate the development of ‘capable’ computer users? A metacognitive teaching approach was defined as one that assists students to become more aware of their attitudes towards computers and their past and current computer learning approaches, experience and strategies. Consistent with action research, I wanted to involve students in reflecting on the theories (social cognitive theory, attribution theory, experiential learning theory and metacognition itself) and to engage them in a participatory exploration of the relevance of these theories to their own computer learning.

5.2 The Choice of Mixed Methods

The psychological literature, together with my reflections on its implications for computer learning, presented a methodological dilemma. I could see significant value in the theory and felt it provided an enhanced understanding of the factors affecting computer skill development, as revealed in cycle 1. Yet the literature failed to adequately explore the application of these theories in changing and improving teaching practice, and in particular its application in fostering improved learning outcomes. While I wished to draw on the theory, I was not comfortable to adopt an experimental approach given my constructivist perspectives. I was not interested in simply using the theory as a basis for measurement and prediction, as other researchers had done (for example, Geer, White & Barr, 1998). Rather, I wished to focus on the capacity of these theories to inform individuals’ understandings and frameworks regarding computer learning; in short, to inform the metacognitive approach. Bandura (1992) had himself acknowledged the importance of such an approach, stating that ‘the value of a psychological theory is judged not only by its explanatory and predictive power but also by its operative power to enhance the quality of human functioning’ (p.32). Such improvement in student learning outcomes was my aim as a teacher and action researcher.
I perceived value in the many psychometric instruments developed in previous research, not solely as a source of data, but in their potential as prompts for reflection and self-awareness, and as aids to the explanations of theoretical constructs. Methodologically I was more experienced and paradigmatically and practically comfortable with post-positivist research methods. Acknowledging that method choice, as well as paradigmatic commitments and epistemic style, is a function of one’s learning history and repertoire (Hammersley, 1996; Hoshmand & Martin, 1995), I was prompted to challenge my habitual approaches and consider moving outside this zone of comfort and familiarity. Turning again to the literature, I was influenced by writing on multi-method and mixed-model research (Brewer & Hunter, 1989; Hammersley, 1996; Howe, 1988; Lingard, 2000; Tashakkori & Teddlie, 1998), acknowledging that there is no clear-cut distinction between qualitative and quantitative approaches, and that almost all qualitative research involves quantitative claims (Atkinson, Delamont & Hammersley, 1988) and vice versa. As Reichardt and Rallis (1994) point out, there are many fundamental values shared by the qualitative and quantitative traditions and the differences can be used to enlighten each other. I could not, however, move away from my constructivist values and beliefs: beliefs such as the inseparability of the knower and the known and that the complexities of social constructs can only be interpreted and illuminated and never ultimately ‘known’.

In pursuing research in this second cycle I therefore decided to employ a mixed model approach to data collection and analysis. I would draw on a range of strategies including observation and one-to-one informal discussion, self-reported reflections, evaluation and Likert-scale survey data. Each of these methods was intended to triangulate the others and to enhance the capacity of the research to interpret the learning context as perceived through the ideas and experiences of the student participants. Furthermore, I would utilise a range of analysis techniques including statistical analysis, case study analysis, and standard qualitative code-and-categorise techniques. In the following section I describe my development of a somewhat unique approach to data collection and pedagogy.

5.3 Design of the Self-Assessment Survey

Having decided to employ a mixed method approach to data collection and analysis, I turned to a closer examination of the instruments which had been developed to elicit self-reported empirical data on attributional style, self-efficacy and learning style. The term predominantly used in the psychological literature was that of ‘measurement instrument’; however, given my diminished focus on ‘measurement’ per se and my strong focus on constructivist learning and reflective practice, I did not wish to utilise this term in my research. Instead I chose to refer to the instrument I developed as a self-assessment survey, emphasising its value in the reflective processes. This section outlines the literature informing the development of the self-efficacy and attributional components of the self-assessment survey, followed by a discussion of my philosophical and practical approach to the survey and how it differed significantly from experimental approaches.

Numerous instruments have been developed and utilised to measure self-efficacy or its contributing constructs (Adams, Nelson & Todd, 1992; Burkhardt & Brass, 1990; Compeau & Higgins, 1995b; Davis, 1989; Davis, Agozzi & Warshaw, 1989; Delcourt & Kinzie, 1993; Gist, 1989; Gist, Schwoerer & Rosen, 1989; Heinssen, Glass & Knight, 1987; Hill, Smith & Mann, 1986; Hill, Smith & Mann, 1987; Igbaria, 1990; Loyd & Gressard, 1984; Murphy, Coover & Owens, 1989; Webster, Heian & Michelman, 1990;
Various tools have also been developed to measure attributional style; however, such development has been surrounded by contention concerning two issues. Firstly, the literature reveals debate regarding what such instruments are actually measuring. As discussed in section 4.3, the focus of many attributional studies and hence survey instruments is on causal dimensions (the causal structure underlying the nearly endless list of possible attributions, for instance locus of causality or stability), as distinguished from causal explanations (the specific explanations people make concerning the causes of prior outcomes, for instance luck, ability, effort) (Kent & Martinko, 1995a; 1995b). Some survey instruments ‘force’ data by classifying subjects’ attributions along a predetermined set of causal dimensions, thus assuming that the researcher and the participant assign the same meaning to the explanation (Kent & Martinko, 1995a). Other instruments, however, ask the respondent to assign a cause for the success or failure of the event, then to classify that cause according to specified dimensions. This latter approach is claimed to be more accurate (Russell, 1987, cited in Kent & Martinko, 1995a) and there does appear to be general consensus in the literature that causal reasoning is most appropriately assessed by evaluating causal dimensions rather than analysing specific attributional explanations (Kent & Martinko, 1995b). The second issue surrounding the development of attributional measurement instruments concerns the difference between trait versus situational approaches. The situational approach argues that attributions should be measured based on causal dimensions regarding a single specific situation. In contrast the trait approach proposes that individuals possess an ‘attributional style’ that is consistent across situations (Henry & Campbell, 1995).

Given my constructivist position, any approach that relied on the researcher’s reconstruction of individuals’ understandings was inconsistent and inappropriate and it was important that students themselves be asked to provide their own cause for the success or failure, then to classify that cause according to the causal dimensions. With regard to the second of the two issues this research was focusing on one very specific learning context: that relating to computer use. Furthermore, my observations over many years working with computer end-users supported claims that attributional style was state-rather than trait-based. I was aware of arguments regarding the relative validity of instruments presenting very specific situations versus moderately specific situations (Henry & Campbell, 1995), for example, performance with computers in general versus performance with specific software packages. However, I argue there was value in presenting moderately specific computer-use situations which were of relevance to my target student group. Simplicity, speed and ease of completion by students was also a consideration. The attributional approach used in the survey was based on that developed by Kent and Martinko (1995a) and adopted by Henry and Campbell (1995). Their instrument presented a number of hypothetical situations involving either success or failure and asked participants to cite a major cause for each situation, then to rank the cause according to the dimensions of causality, globality and stability. I was also aware that the literature claimed that, while such tools possessed relatively high validity and consistency, they held questionable
predictive validity. My own research was not attempting to utilise the survey in a predictive
capacity, but rather as a basis for reflection, to promote growth and change.

The self-assessment survey (Appendix 6) was thus adapted from the previously developed
and tested instruments. Data were collected under ten categorical headings (A – J), with
each sub-question in the survey considered to be a valid variable in its own right and
potentially independent of all other variables.

A. **Demographic Information and Approval for Use of Data.** This question collected
basic demographic information about the student, including age, course and ID number so
that their pre-semester data could be accurately recorded and matched to post-semester
data. Students were also asked to indicate whether they gave permission for their data to be
utilised for course improvement and research.

B. **Frequency and Duration of Computer Use** was measured by two items using a seven
point scale. These items were derived from Igbaria and Ivari (1995) and were similar to
the four items utilised by Compeau and Higgins (1995b).

C. **Encouragement by Others.** The extent to which computer use was encouraged by
others in the individual's reference group was measured by five items using a seven point
scale. These five items were modelled on the seven devised by Compeau and Higgins
(1995b) but were modified to more accurately describe the probable reference group of a
pre-service teacher, rather than an employee. Encouragement by others was viewed as
representing ‘verbal persuasion’ (Compeau & Higgins, 1995a; 1995b).

D. **Frequency of Use by Others.** The extent to which computers were used by others in
the individual’s reference group was measured by five items using a seven point scale.
These five items were modelled on the seven devised by Compeau and Higgins
(1995b) but were modified to more accurately describe the probable reference group of a pre-service
teacher, rather than an employee. This construct was relevant in that learning by
observation or behaviour modelling has been demonstrated to be a powerful means of
behaviour acquisition (Compeau & Higgins, 1995a; 1995b).

E. **Support.** The perceived level of support available to the student was measured by five
items using a seven point scale. These five items were modelled on the six devised by
Compeau and Higgins (1995b) but were modified to more accurately describe the support
structures of a preservice teacher. The support of the organisation for computer users can
be expected to influence judgements of self-efficacy. This also includes availability of
assistance. Level of institutional support will also influence outcome expectations as it
reflects the organisational stance regarding computers and hence the possible consequences
of using computers (Compeau & Higgins, 1995a; 1995b).

F. **Perceived Usefulness.** This category measured the student’s outcome expectations and
presented a variety of outcomes that might be associated with computer use by a student.
Eleven items were provided using a seven point scale. These eleven items were modelled
on those devised by Compeau and Higgins (1995b), Igbaria and Ivari (1995) and Delcourt
and Kinzie (1993) but were modified to more accurately describe the probable relevant
outcome expectations of a pre-service teacher.
G. Attitude. Affect (here referred to as attitude) was measured by five items using a seven point scale. These five items were modelled on the five devised by Compeau and Higgins (1995b) but again were modified to be more relevant to a pre-service teacher.

H. Feelings. Anxiety (here I used the more neutral term ‘feelings’) was measured by seven items using a seven point scale. These seven items were drawn directly from Delcourt and Kinzie (1993) although negative statements were reversed for ease of self-scoring.

I. Learning Dependency. Originally termed ‘self-efficacy’, this heading was later changed following confusion from students and reflection on the relevance of the heading to the questions being posed. Learning dependency was measured by nine items using a seven point scale, students being asked to rate their expected ability to accomplish a task using unfamiliar software. These nine items were modelled on the eight devised by Compeau and Higgins (1995a) but a simplified response scale was utilised. This category was different to the others as the nine items represented a sliding scale of highly dependent to highly independent learning contexts. Analysis of these data was thus approached quite differently, as described in section 6.2.

J. Attribution. Attribution was measured using a simplified version of the attributional style questionnaire developed by Henry and Campbell (1995). Students were presented with six scenarios and asked to write down one major cause associated with each scenario. For each scenario they then responded on a seven point scale to three questions relating to the three dimensions of attribution: internal versus external; stability versus instability; universality versus specificity. The scenarios presented were modified to reflect computer-based contexts relevant to the student group.

The self-assessment survey was intended to be completed by students at the beginning and end of semester, thus serving as a pre- and post-test. I have chosen to provide the version of the self-assessment survey in appendix 6, as it was utilised in cycle 3.

5.3.1 Philosophical and Pragmatic Considerations Underlying the Survey

As metacognition is something of a ‘fuzzy’ and open-ended concept, its measurement is open to critique. Its self-reported nature and difficulty of measurement make data collection problematic: ‘the problem of measurement is severe when considering the performance of experts who may be unaware of the complexity of their thinking or novices who may be unable to explain their thinking’ (Paris & Winograd, 1990, p.20). From an interpretivist and constructivist perspective these concerns were less a limitation than they may be perceived to be in positivist research. As Paris and Winograd continue, accuracy of self-reported metacognition is not the critical issue: ‘Instead it is the relationship between what people say and how they act that determines the functional role of the person’s thoughts and feelings about thinking’ (p.21).

The use of questionnaires and inventories has been critiqued by educationalists such as Candy (1991) from a number of perspectives, including the tendency to seek reactions and responses not natural to the person, the need for the respondent to figure out the meaning intended by the person framing the question and the high degree of inference implicit in interpreting the findings. They also do not reveal alternative ways that respondents could
Chapter 5 – Integrating Metacognition: Planning for Cycle 2

view the test items (Candy, 1991). My methodological and philosophical approach to the survey data was, however, fundamentally different to traditional survey approaches. I was more concerned with exploring how students’ engagement with metacognitive constructs might impact upon their thoughts and feelings and whether such metacognitive engagement might be of benefit to them as learners. Analysis of the data was considered secondary to the student’s own interaction with, and reflection on, the survey and its underlying theory. The survey was principally viewed as a means by which students could gain an insight into their own self-efficacy and attributional characteristics.

The approach to data collection was also radically different to conventional ‘experimental’ approaches. No attempt was made to ‘control’ variables between the pre- and post-semester ‘tests’. Furthermore, the interventions occurring between pre- and post-testing were naturalistic and indicative of a pragmatic learning and teaching context. Unlike conventional experimental approaches, participants were fully informed of the theories underlying the survey instrument’s development as an integral component of the metacognitive teaching approach. In these respects the psychometric self-assessment survey was a fundamental part of both the pedagogy and methodology of the learning and teaching context. Integral to the design of the self-assessment survey was a ‘self-scoring’ format, enabling students to undertake their own basic analysis of the survey data, thus facilitating further reflection. This self-scoring form is included in appendix 7; however, as is detailed in section 6.7.6, this aspect of the survey was not successful and was subsequently excluded from future cycles. Administering the survey during the introductory lecture would ensure that the majority of student completed it before engaging with the Unit material, as further discussed in section 5.4.5. Thus, a primary consideration in the design of the survey was completion time.

5.4 Instructional Design Considerations: Planning the Learning and Teaching Activities

In light of experiences and reflections in cycle 1, and given the research focus for cycle 2, my aim in re-developing the Unit was to embed prompts for students to engage metacognitively with the Unit content and to promote their ‘experimentation’ with various computer learning strategies. Planning for cycle 2 thus entailed further redesign of the Unit materials, as detailed in this section.

5.4.1 The ‘Thinking’ Module

The planning phase of cycle 2 entailed the development of a ‘Thinking’ module. In this module, students were prompted to reflect upon their past learning experiences in the context of computing and the strengths and weaknesses of these approaches in both imparting skills and in developing overall computer capability. Arrangement of reflective prompts and the presentation of theory, encouraged students to challenge their assumptions, beliefs and current learning strategies. Consistent with constructivism, the metacognitive approach brought learners’ prior knowledge and experience to the fore so that they could apply their current understandings to new situations in order to construct new knowledge (Kanuka & Anderson, 1999). In an approach paralleling that of Akar and Yalcinalp (2000) and as advocated by Derry (1990), students were asked to think of someone they perceived to be a proficient and capable computer user, and to consider their characteristics and how they learnt. The module prompted students to reflect on different
computer learning approaches including four possible ‘pathways to learning’: group instruction, individual instruction, peer-group learning and self-directed learning. They were then encouraged to consider the strengths and weaknesses of these approaches. The module challenged students to think about the feasibility of various learning approaches for their continued professional development. My own reflections on this issue were presented to model reflective writing. A brief and accessible account was then provided of social cognitive theory (specifically focusing on self-efficacy) and attribution theory. In the light of this theory students were encouraged to reflect on their responses to the self-assessment survey. The Thinking module, then, provided a simplified learning style survey (Kolb, 1981; 1992; Smith & Kolb, 1986). Students were asked to complete this survey and then to reflect on a brief body of theory discussing the applicability of experiential learning theory to computer learning contexts. In particular, students were asked to consider which learning styles might be most appropriate in computer learning contexts and then to reflect on how that differed from their own preferred learning approach. The Thinking module did include Bostrom, Olfman and Sein’s (1990) findings supporting the value of active experimentation over reflective observation in computer contexts, but again emphasised Kolb’s point that effective learning requires all four approaches: feeling, thinking, perceiving and behaving.

Cycle 2 thus reflected the principles outlined by McLoughlin (1999) and was more closely informed by experiential learning theory (Kolb, 1984) than was cycle 1. The metacognitive approach established a balance between all four learning modes. It also embraced the foundational processes of metacognition, namely self-analysis and self-management. The Thinking module embraced Marsick’s (1991) claim about the benefits for adult educators in starting from the basis of learners’ experiences and assisting them to re-evaluate the frames of reference upon which they understand their experiences. Redwine (1989) has also discussed how ‘autobiography’ can boost self-esteem and self-confidence, acting as a catharsis and helping the student deal with areas in their life not previously addressed. Furthermore, the approach was also consistent with Brookfield’s (1991) use of ‘critical incidents’: brief descriptions of significant events in individuals’ lives which seek to highlight particular, concrete and contextually specific aspects of their experiences. As Brookfield notes, such an approach is less threatening than asking learners to respond to general questions: ‘Focusing on biography grounds the activity of critical reflection in the context of the daily decisions and dilemmas learners face’ (p.192). The full text of the Thinking module can be found in the cycle 2 CD-ROM. Three approaches were envisaged as means to prompt students to self-identify appropriate personal strategies for learning about, and with, computers:

1. prompting students to reflect on past learning experiences and ‘pathways to learning’ (as described above);
2. prompting students to reflect on a variety of learning and teaching methods via the tutorials; and
3. prompting students to reflect on other learning experiences throughout the semester.
Figure 4 provides a visual representation of the planned structure for the Unit delivery. Further information regarding the presentation of these tutorials is provided in section 5.4.1.1.

Figure 4  Structure of the Unit (cycle two) showing relationship of actions and observations over the 14 week teaching semester
The reflective journal task was retained and remained open and flexible, allowing students the opportunity to demonstrate their experiences and understandings in multiple and varied ways.

### 5.4.2 Reflecting on Different Teaching Methods: The Approach to Tutorials

To provide a further catalyst for students’ reflections, I planned to employ a range of teaching methods in the tutorials, prompting students to evaluate these approaches both in terms of their immediate value and their relevance to their ongoing learning. As detailed in Phelps (2001), these strategies ranged from highly directive to non-directive, paralleling Davis and Wiedenbeck’s (1998) use of both instruction-based and exploration-based training. As these authors define it, instruction-based training is formally structured, based on deductive reasoning and step-by-step directions, leaving little to the learner’s discretion. It uses materials that leave the learner little responsibility for discovering new knowledge.

Exploration-based approaches, in contrast, are learner directed, based on inductive reasoning and involving high learner control over the type and sequence of activities. Here, materials tend to be incomplete, stimulating the learner’s curiosity to explore and experiment. In designing these activities I drew on the theory outlined in section 4.4.1, particularly Gist’s (1989; 1992) suggested strategies of providing task information, direct training and enhanced understanding of strategies. Consistent with social cognitive theory, I wished to emphasise flexibility and choice in learning environments and to utilise mastery, modelling (both behaviour modelling and cognitive modelling), persuasion and arousal in my interactions with students. The intention was, again, to invite students to evaluate these approaches as supports for their own learning and reflect on whether these were appropriate methods to employ in their own classrooms. The teaching methods that were planned are summarised in table 9.

#### Table 9 Summary of tutorial teaching approaches employed

<table>
<thead>
<tr>
<th>TEACHING APPROACH</th>
<th>TOPIC COVERED</th>
<th>DETAILS OF TECHNIQUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Assistance</td>
<td>Basic Skills</td>
<td>Assistance provided by tutor and fellow students</td>
</tr>
<tr>
<td>Verbal Directions</td>
<td>E-Mail</td>
<td>Highly directive, step-by-step instruction Basic then advanced concepts</td>
</tr>
<tr>
<td>Abstract Conceptualisa-</td>
<td>Databases</td>
<td>Use of metaphor Data projection Emphasis of basic concepts and terminology Fully ‘hands-off’ Online ‘quiz’ as revision.</td>
</tr>
<tr>
<td>tion and Observation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Modelling</td>
<td>Spreadsheets</td>
<td>‘Thinking out loud’ instruction illustrating thought processes involved in working with a technology Verbal rather than visual Real-life scenario Conscious illustration of problem-solving and using errors as a way to learn Students replicate on own computer</td>
</tr>
<tr>
<td>Exploratory Learning</td>
<td>Word Processing</td>
<td>Strategies for exploratory learning were presented including use of icons, menus, defining goals and using ‘help’ Emphasis on being able to ‘undo’ Task cards provided at basic, intermediate and advanced level Students working independently or in pairs One-on-one assistance as needed but fostering ‘problem-solving’ techniques</td>
</tr>
</tbody>
</table>

(Derived from Phelps, 2001).
While the first, second, third and fifth of these approaches were based on my own experiences, the fourth, cognitive modelling, was informed by social cognitive theory, particularly Compeau and Higgins (1995a). The approach also mirrors that of Ethell and McMeniman (2000) (a study I subsequently became aware of) who utilised a video-based technique to explicate the cognition and metacognition of an expert teacher.

A teaching strategy evaluation form (appendix 8) was designed to obtain feedback from students at the end of each tutorial. A carbon copy of the sheet was retained by the students to prompt further reflection on the teaching approach via their journals. Given that attendance at tutorials was non-compulsory, I also prompted students to engage in a variety of learning contexts outside of the tutorials, such as working independently or with peers. One way of allowing all students to benefit from the tutorial feedback was to provide a weekly summary of the evaluative data, including my own reflections as a teacher, via the Unit’s online discussion list.

5.4.2.1 The Challenge Assessment
I began to become aware of the incongruity of the skills-based ‘test’ and its accompanying ‘Skills Chart’, with my espoused emphasis on capability. It could be argued that the Skills Chart represented a reductionist approach, focusing students on specific pre-defined tasks and skills (competencies) and de-emphasising their own learning initiatives. As Bowden and Masters (1993) had highlighted, competency-based approaches, through their use of externally pre-specified competencies, can foster external locus of control and define minimum requirements, thus encouraging minimal achievement rather than excellence. However, as noted in section 3.2.1.1, students had responded positively to the inclusion of the Challenge Assessment and it had represented an important source of metacognitive reflection. Harris et al. (1995) have noted that declaring learning outcomes prior to the learning process allows the learner to judge the relevance of the learning process to his or her needs, thus motivating learners to engage in the learning process. I was prompted to reconsider my initial concerns and reflect on whether competency-type approaches might be embraced but in a conceptually and qualitatively different way: one that fostered capability. While maintaining the Skills Chart I consciously moved away from prescriptive goal-setting toward more open prompts for self-directed goal-setting, thus fostering metacognitive engagement. A ‘taking it further’ list of skills was added, each category concluding with an open prompt for students to identify their own learning goals. The challenge assessment which had been introduced in cycle 1 (see section 3.1) was also retained in cycle 2, with a continued focus on its role as a learning opportunity, rather than as a ‘test’.

5.4.3 New and Revised Technical Content
In addition to the instructional design considerations above, a major revision and re-development was carried out on the Unit content to better meet the learning objectives of the Unit. This involved:

- inclusion of additional content areas such as basic computer skills, Web-based e-mail programs, spreadsheets, databases and word processing;
- simplification and clarification of a number of topics which were not well understood, such as synchronous communication, file transferring, mailing lists and newsgroups;
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- restructuring of all content and activities associated with the application of computers in schools, including additional sections concerning values (Hoekstra, Gordon & Donald, 1999), classroom management, self-regulation and educational software; and

- restructuring all content relating to Web publishing, with highly technical information being presented as ‘optional’.

I was conscious to include more explicit connections between the topics and classroom practice emphasising integration and connections to curriculum. This focus, which had been lacking in the original resources, was consistent with Laffey and Musser’s (1998) observation that pre-service teachers need help to reflect on how to teach with technology. Such an approach also emphasised the importance of outcome expectations, as implicit in social cognitive theory.

5.4.4 Involvement of Another Tutor

In cycle 2 I planned to involve another part-time tutor in the delivery of the Unit. Consistent with action research, I was keen to work collaborative with this tutor in both the teaching and research process. I met with the tutor and discussed the research which I had been involved in, my philosophical and methodological approach to the Unit and the research. I outlined my commitment to participatory involvement and invited him to contribute to the shape of the research. The tutor in question had a background in psychology and so was familiar with the theoretical underpinnings of the metacognitive approach. He was not, however, familiar with action research approaches, nor with postpositivist research. He was happy to be involved and to discuss his experiences with me as the semester progressed. As outlined in the Tutor Letter of Consent (appendix 9) I did not require him to undertake any additional work or face any additional time demands above those usually required of tutors. The role of the tutor in the research was not, in the long term, a significant one. While this was not ideal, from my point of view it was not ethically appropriate to expect greater commitment to, and involvement in, the research.

5.4.5 Revisiting the Cycle 1 Issues

In planning cycle 2 I was also conscious to revisit the issues raised in cycle 1, to ensure, to the best of my ability, that I was addressing and accounting for the student voice.

Functional Issues

Timetabling: Cycle 2 presented even more severe timetabling issues than cycle 1 due to the four week Olympic break in addition to the four week Practicum period. These constraints cut heavily into the semester, leaving only nine teaching weeks, four of which fell late in the semester. These constraints were severe but unavoidable.

Technical Access: While it was unrealistic to think that I could solve all access issues for all students, the development of a CD-ROM from the Unit Web site meant that students with computers at home could access the Unit materials without needing to be connected to the Internet.

Workload: This was a major area of re-design. I focused on a reduction in the amount of ‘reading’ through the explicit differentiation of core reading and optional content. Students were prompted to ‘study to their own level’. I also reduced the linearity of the Unit material. Rather than 26 sequential topics, a more flexible structure was designed to allow
students to work through topics in the most individually appropriate sequence and timeframe. The resultant Unit was structured around four modules: Thinking, Using, Applying and Creating, with a corresponding graphic interface, as illustrated in appendix 10. The Thinking module was discussed in section 5.4.1.

**Electronic format:** I maintained my position with regard to the benefits of the electronic format but took account of students’ desire to undertake at least some of the Unit away from a computer. The Thinking module was thus produced in a print-based booklet format (also available online).

**Flexibility:** The flexibility offered in cycle 1 was maintained and, in many ways, was increased by the restructuring of the content as core or optional (as outlined above).

**Availability of Support:** Feedback from students prompted me to realise that I needed to be available on campus for more hours and I committed to do so. I was also forced to recognise that I could not manage the Unit on my own (given work load constraints). After negotiations with the Head of School, I was able to secure the appointment of a tutor (as outlined in section 5.4.4).

**Tutorials:** My re-conceptualisation of the tutorials as a part of the metacognitive approach was detailed in section 5.4.2.

**Assessment:** The broad assessment strategies were retained, however improvements were made based on experiences in cycle 1, principally clarification of wording and further integration of the metacognitive approach.

**Student Learning Issues**

**Realisation of the value of independence:** The promotion of independent learning was perpetuated through the flexible format and the retention of the ‘optional’ tutorials. Further prompts were built into the Unit to encourage students to ‘experiment’ with, and reflect on, independent learning approaches.

**Discovery of a sense of excitement:** Again, the Thinking module prompted students to reflect on their past, current and future learning experiences and the factors affecting their learning.

**Motivation through realisation of professional value:** Perceived usefulness and outcome expectations were an integral component of the self-assessment survey which students were prompted to reflect on. I also increased the focus in the Unit on classroom integration, prompting and assisting students to relate all their learning to their future career. Similar emphasis was placed on the practical relevance of skills covered in the tutorials.

**Motivation through achievement of an ambitious task:** The Web site construction assessment was maintained and I was able to draw on experience (my own and those of students) to emphasise the sense of personal achievement gained through completion of an ‘ambitious’ task.
Confronting fear and dealing with difficulty: Students were prompted to reflect on factors evoking anxiety as an integral component of the metacognitive approach.

Memory and retention: This was the one issue that I felt, as yet, unprepared to address explicitly in the Unit. I was unsure whether this was an issue raised in response to the heavy workload and emphasis on technical content which had since been reduced. By prompting students to reflect on their learning processes, I hoped, in cycle 2, to determine whether memory and retention remained an issue.

Knowing what is possible: I attempted to incorporate my growing understanding of this issue through both the inclusion and enhancement of the Skills Chart and also through the prompts in the Unit materials and tutorials to ‘explore’ and experiment with various program functions.

Reflections on computer learning contexts: As already noted, the Unit redesign incorporated a range of tutorial teaching strategies, prompting students to think about different ways of learning. Students studying independently were also prompted to experiment with, and reflect on, a range of learning contexts such as peer group learning and exploration.

Locating ‘models’ and anti-models: This strategy of model identification was embraced as an integral component of the Thinking module. Students were prompted to reflect on someone they considered to be a ‘capable’ computer user and to reflect on the characteristics of that person and how they learnt.

5.4.6 Setting the Scene

With tutorial time limited, I felt an introductory lecture would be the most efficient and effective means of conveying the Unit requirements to students, as well as an important opportunity to invite students to participate in the research. In this section I briefly outline some key considerations in my presentation of this introductory lecture.

In setting the scene for both the teaching and research, I shared with the students the quote from Ferdig (1998) which forms the prologue to this thesis (p.xi) and which had inspired my approach to the research. Through this I hoped to convey to students the research purpose. Consistent with my action research philosophy I noted to the students my belief that I had as much to learn from them about my teaching as they have to learn from their own experiences in the Unit. I emphasised that I believed in researching with and not on, and that I hoped the research would be of tangible and immediate, as well as long term, benefit to them personally. In inviting them to participate in the research, I emphasised that there were no additional requirements and that sharing their learning was voluntary. This choice would not affect their results, and their confidentiality and anonymity was assured. I also noted my commitment to incorporate their feedback and share my learning during the semester via the Unit online discussion list. When asking students to complete the survey at the introductory lecture, I was mindful to emphasise that the survey was as much for their own learning as for the research. In planning (and delivering) the lecture, emphasis was placed on the philosophical approach which I brought to both the Unit and the research. I highlighted the Unit’s focus on confidence building, not just skill development. That said, the Unit would take them beyond the mandatory requirements of employing bodies and
provide them with skills much sought after in schools, hence emphasising outcomes and perceived usefulness. I noted that all students would need to improve on their current skills no matter how much experience they already had and that students were expected to be active rather than passive learners. In concluding the lecture I told students that, above all, I hoped they would find the experience a fun way of learning.

A Unit Information Guide was compiled to provide students with an outline of the Unit requirements and information about the research, thus supplementing the introductory lecture and providing all information in writing. The same booklet was utilised for external students and the written format also served to inform any students who were unable to attend the lecture.

5.5 Stepping Back and Moving On
Chapter 5 has described the planning of the second research cycle. It has traced my development of a self-assessment survey, but emphasised the unique approach to this psychometric instrument in conceptualising it first and foremost as a prompt for metacognitive reflection. I have also detailed a number of considerations that informed the re-design of the Unit within a metacognitive framework, including the addition of a Thinking module and a range of teaching approaches to be implemented and evaluated during the tutorials. I have also emphasised how these changes addressed many of the issues identified in cycle 1. The description of the introductory lecture set the scene for the implementation, observation and reflection phases of cycle 2. Chapter 6 is necessarily more extensive because it presents a rich array of data, both qualitative and quantitative, from cycle 2. In particular, it presents a summary of the data derived from the self-assessment survey and students’ reactions to its conclusions. It also traces students’ reflections on the various theories explored in chapter 4, and presents a number of case studies depicting students’ engagement in the metacognitive computer learning process.
Chapter 6 - The Journey Continues: Postcards from Cycle 2

This chapter presents a discussion of the actions, observations and reflection on the second research cycle. Consistent with a key tenet of action research, a strong focus is placed on reflection. A description of the student cohort is first presented, including demographic data and participation rates. This is followed by the self-efficacy data, including a statistical analysis derived from pre- and post-semester surveys and the attribution data, including emergent themes and statistical analysis. The chapter then presents students’ metacognitive reflections on the theory, including capability, social cognitive theory (particularly self-efficacy), attribution and learning styles and their reflections on learning and teaching contexts, including students’ past experiences, Unit tutorials and other experiences during the semester. Twelve case studies are discussed, focusing on metacognition and individual capability. I then provide a critique of the metacognitive approach, including the benefits of the theories presented and the approaches employed, followed by a comparison of the issues emerging from cycle 1 and 2. Finally, I discuss the issues and limitations of the metacognitive approach and the challenges for change.

6.1 Participation Rates and Demographics

The initial enrolment in the Unit in Semester 2, 2000, as derived from official enrolment lists supplemented by actual attendance at the week one lecture, was 181 students. After a number of late enrolments and some subsequent withdrawals, this number settled at 179. Participation rates in the three data collection processes (pre-semester survey, reflective journal and post-semester survey) are indicated in table 10 and table 11.

Table 10  Participation in self-assessment semester survey (pre-semester) and reflective journal

<table>
<thead>
<tr>
<th>PARTICIPATION IN SELF-ASSESSMENT SURVEY (PRE-SEMESTER)</th>
<th>JOURNAL PERMISSION</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
<td>91</td>
<td>9</td>
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<tr>
<td>No</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>Not submitted</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>130</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 11  Participation in self-assessment survey (pre- and post-semester) and reflective journal

<table>
<thead>
<tr>
<th>PARTICIPATION IN SELF-ASSESSMENT SURVEY (PRE- AND POST-SEMESTER)</th>
<th>JOURNAL PERMISSION</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
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<td>Yes</td>
<td>No</td>
</tr>
<tr>
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<td>4</td>
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<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>130</td>
<td>16</td>
</tr>
</tbody>
</table>

While 67% of students participated in the pre-semester survey and 73% contributed to the research via their journals, the reduced response rate on the post-semester survey led to a participation rate across all three tasks of 25%. Some explanation of these response rates is...
required. The majority of the pre-semester surveys were completed and returned at the initial lecture, which was attended by approximately 100 students. Students who did not attend the initial lecture, including externals and late enrolments, were provided with the survey with their Unit Information Guide and were asked to complete and return it in their own time. The majority of the 40 surveys which were not returned could be expected to be from this group. As such, this represents a non-return rate of 50% from those not attending the lecture. The post-semester survey was distributed to students in the final tutorial. While strongly encouraging students to complete the survey in tutorial time I considered it inappropriate to insist on its return. While some attendees returned it at the tutorial, others wanted to take a little more time and they returned it via a box outside my office. A further reminder was made as each student submitted their final assignment; however, as it was the end of the year, many students left the area and further follow-up was not possible. With regard to the reflective journals, students were asked to complete the reflective journal cover sheet (appendix 3) on submitting this assignment. Despite follow-up reminders, 18% did not return the permission slip. It will be remembered that the emphasis was not only on the survey data per se but on the students’ reflections on the survey data and whether this enhanced their learning. Many of the students who did not complete the survey, or provide permission for its utilisation, still included reflections on their survey responses in their journal. The high participation rate on the journal (73%) was thus most relevant.

The self-assessment surveys were utilised to provide demographic information concerning the students’ gender, age, course enrolment and KLA (as provided in appendix 11). Notably, these data were derived only from the 119 students who provided consent for their pre-semester survey data to be utilised. Forty-six percent (46%) of participating students were drawn from the BEd (Primary) and 54% from the DipEd (Secondary). Seventy three percent (73%) were female and the majority (69%) were between the ages of 21 and 30. Ten percent (10%) of participating students were between 41 and 50 years.

6.2 Self Efficacy: An Analysis of the Data

The goals of the self-efficacy data analysis were to gain an understanding of the overall level of perceived computer self-efficacy amongst the student group, particularly so as to understand and describe individuals in relation to the overall student cohort. The analysis also aimed to identify individuals with significantly different (‘outlying’) responses for the purpose of case study analysis, and to examine the pre- and post-semester survey data to determine if there was a significant change from the beginning to the end of the semester. No attempt was being made to predict or generalise from the data, nor to test hypotheses about the population’s parameters.

Mindful of the many assumptions underlying the use of parametric statistics and acknowledging that I was working from ordinal-level data (in the form of seven-point Likert scales), I chose to employ descriptive and non-parametric tests (Argyris & Schön, 1996; Daniel, 1990; Gibbons, 1985; Siegel, 1956; Sprent, 1987). For each self-efficacy question in the pre-semester survey a basic descriptive analysis was conducted to determine median, mode and frequency distributions, as provided in appendix 12. Section 6.2.1 provides a succinct discussion of the pre-semester self-efficacy data, highlighting findings of particular significance. An analysis of the outlying responses is then provided in section 6.2.2 and section 6.2.3 provides an analysis of association between certain key variables.
utilising Spearman’s rank order test. Section 6.2.4 analyses pre- and post-semester data utilising the Wilcoxon signed-ranks test for ordinal data.

6.2.1 Analysis of the Pre-semester Self-Efficacy Data

Frequency and duration of computer use: As a cohort, students tended to use computers frequently but for short periods of time: 71% of students used computers less than one hour per day while only 7% of students indicated that they used computers for three or more hours per day. Ninety-two percent (92%) indicated that they used computers at least weekly while only 4% indicated that they used them occasionally or never. The most frequent pattern of use would appear to be around one hour per day, several times a week (see appendix 12, table 25).

Encouragement by others: The strongest and most consistent source of encouragement for students were lecturers or tutors, with 83% of students either agreeing or strongly agreeing that they were encouraged to use computers by academic staff. Family was seen by 40% of students as encouraging and by 42% as not encouraging. School teachers were similarly equally split with 39% viewing them as encouraging and 38% as not encouraging. Friends and work colleagues were overall more likely to be encouraging than discouraging. Only 5% saw lecturers as not encouraging.

Frequency of use by others: Lecturer/tutor use was again perceived to be high, with 62% of respondents perceiving lecturer use as daily. Family use was also surprisingly high, with 70% indicating family use of computers at least weekly and 23% indicating family use as seldom or never.

Support: Fellow students, friends and the University were seen as good sources of support for around 65% of respondents (only 2% disagreeing). Responses regarding the ease of seeking assistance using hardware, software or purchasing equipment were more evenly distributed between support and lack of support.

Perceived usefulness: Overall, responses were strongly supported across the ten items with the exception of ‘enhancing standing with peers’. Ninety four percent (94%) of students agreed or strongly agreed with the statement that computers ‘will help in future teaching’: 89% indicated that using computers would help them get a job and a further 89% indicated that using computers can assist create instructional materials to enhance teaching. The same number indicated computers could help them access information for their teaching.

Attitude: Eighty nine percent (89%) of students either agreed or strongly agreed that they would prefer to use a computer to write assignments. Similarly 84% of students indicated that they either agreed or strongly agreed that they would choose to use computers in their teaching. Attitude toward using computers in spare time was somewhat more subdued. While 40% agreed with this statement, 41% disagreed (19% undecided). Similarly, response to the statement regarding finding it hard to stop once on a computer met with a weaker reaction; 39% agreed while 32% disagreed and 30% were undecided. It would seem that computers were viewed by a majority of the participating students as a means to an end, rather than as a recreational activity in their own right. A not insignificant proportion (11%) indicated that they did not like working with computers and 7% that they would not choose to use computers in their teaching.
Anxiety/Feelings: The majority of students had positive feelings (i.e. low anxiety) toward computers: 67% indicated that they felt at ease learning about technology and were comfortable about their ability to work with computers; 63% indicated that the thought of using computers was not frightening, while 60% indicated that they did not feel threatened by technology. Again, however, what is of greater significance were indications that 23% did not feel at ease learning about computer technology and 30% indicated that they would/could do well with computers. Furthermore, 21% indicated that they found computers frightening, 19% felt threatened by the impact of computers and 24% did not feel confident in their ability to do a course requiring computer use. While a minority, these responses represent a significant level of computer anxiety amongst the student group.

Learning dependency: The final group of nine questions required a different approach to analysis. Here a focus is placed on the first and last questions. The first question, whether the student felt confident to use an unfamiliar program if there was no one around to assist, was an indication of computer learning capability. A total of 53 students (44%) agreed or strongly agreed with this statement. It was also interesting to consider those students who indicated that they would not be confident using an unfamiliar program even with high levels of assistance. If we include here students who were not sure whether they would or wouldn’t be confident (i.e. they neither agree or disagree with the statement) then 15% of students indicated that they would not (or might not) be confident if someone showed them how to use the software. Ten percent (10%) of students indicated that they would not (or might not) be confident if someone gave them step-by-step instruction.

To summarise, the social-cognitive data indicates that, overall, the group of students participating in the research:

- were frequent but brief users of computers;
- were most strongly encouraged by tutors/lecturers;
- were from families that were fairly frequent users of computers;
- held high perceptions of the usefulness of computers;
- perceived computers as valuable for professional and educational purposes but less so for recreational purposes; and
- generally did not feel anxious regarding computers.

Despite indications of overall high self-efficacy and outcome expectations, a notable 21-24% of students indicated significant levels of anxiety and 10-15% indicated a lack of confidence learning even in contexts of high dependency; 6-11% expressed low levels of perceived usefulness.

6.2.2 Analysis of Outlying Self-Efficacy Data

An analysis of outlying responses to the pre-semester survey was conducted to identify individuals who varied significantly from the student cohort on a consistent number of factors. Outlying responses were defined as those with one, two or three student responses only. For each sub-question that had outlying responses, either positive or negative, individuals providing such responses were identified. By focusing on individuals with uncharacteristic responses it was hoped to determine patterns relating to strongly positive or negative self-efficacy. Four individual students were identified as intensive computer
users, spending four or more hours on the computer per day (Students 8, 43, 78 & 122). The remaining outliers on all self-efficacy questions were predominantly indicative of low self-efficacy, a summary of which is provided in appendix 13.

**Encouragement by others** revealed very few outlying responses. Only ‘encouragement by lecturers’ warranted further analysis with one student (Student 55) disagreeing moderately strongly that lecturers encouraged computer use.

**Frequency of use by others**: Three statements regarding frequency of use by others produced outlying responses. The second statement, frequency of use by friends, attracted two outlying responses (Students 10 & 167). Two students (Students 151 & 156) did not feel that academic staff were frequent users of computers, and one student (Student 28) indicated that other students were not frequent users of computers.

**Support**: Students 134 and 162 disagreed strongly that fellow students and friends were a source of support and Students 90 and 116 indicated that the University was not a source of support.

**Perceived usefulness** elicited outlyers on five of the ten questions. Students 28 and 103 mildly disagreed that computers would help them in their future teaching. These same students and an additional one (Student 75) disagreed that using computers would help them get a job. Students 6, 50, 118, 116 and 161 strongly disagreed that using computers gave them a sense of accomplishment. Students 6, 75, 142 and 179 strongly disagreed that computers would provide them with better results as a student. In relation to creating instructional material, Students 75, 132 and 142 strongly disagreed that computers would be of assistance and in terms of whether using computers would help them feel more confident teaching, Students 6, 67, 116 and 118 strongly disagreed.

**Attitude**: Seven students provided outlying responses in relation to preferring not to use computers to write assignments (Students 19, 68, 88, 108, 118, 132 & 172). Two outlying responses were received on choosing to use computers in teaching (Students 106 & 114).

**Feelings/Anxiety**: The only question eliciting outlying responses regarding anxiety was the sixth question concerning breaking computers (Students 108, 132 & 154).

**Learning dependency**: Here it is most valuable to examine the last two statements (Question 18 and 19). Students lacking confidence in contexts of high assistance were Students 37 and 101 (where step-by-step instructions were provided) and Students 108, 73, 91, 95, 103 and 118 (where someone was showing them how to do it). Note that one student’s responses (Student 37) indicated being totally confident with highly independent learning but also lacking confidence in a context of step-by-step instructions. This seems somewhat contradictory, however this issue is explored in section 6.5.1.

Very little pattern emerged from this analysis in terms of consistent indication of low self-efficacy across the categories. Only four students had outlying responses on more than one survey question: Students 108, 116, 118 and 132. It was hoped to learn more about these students through case study analysis, however journal data was only available for one student, Student 108. Students 116 and 132 did not provide permission for their journal to
be utilised in the research and Student 118’s journal was very brief and non-reflective, barely receiving a pass grade and not providing data suitable for analysis, something which, in itself, is quite interesting. A case study is, however, provided on Student 108 in section 6.6.1.

6.2.3 Correlation Analysis of Self-Efficacy Data

An analysis was performed to identify patterns of association (correlation) between various key variables surveyed in the instrument. The non-parametric Spearman’s rank-order test ($r_s$) was utilised. In particular, five key questions from the survey were examined:

1. perceived ability to do well with computer technology (Question H3);
2. ability to use software independently (Question I1);
3. choice to use computers in their spare time (Question G3);
4. using computers provides a sense of accomplishment (Question F3); and
5. choice to use computers in teaching (Question G5).

The first question was selected as specifically indicative of computer self-efficacy and the second particularly related to capability. The third question was selected as indicative of intrinsic motivation, as was the fourth which related to gaining a sense of accomplishment. Finally, the fifth question was selected with reference to the target student population and the goals of the Unit, to assist students to utilise technology in their future teaching careers. Together, these questions were felt to be indicative of what I personally perceived to be a ‘capable’ computer user. Correlation data on each of these questions are provided in appendix 14.

It was significant that age, gender and KLA area had no significant correlation with any of the factors investigated. Frequency of computer use had a significantly strong association with each of the five key variables, while duration of computer use was found to be significantly associated with four of the variables. Support, attitude and anxiety (feelings) were fairly consistently associated and frequency of computer use was more closely and consistently associated than duration of computer use. Most aspects of perceived usefulness were also positively correlated. Encouragement by others and use by others were less consistently associated factors. These findings lend support to the metacognitive approach’s emphasis on the affective domain and re-emphasise the value of a strong focus on personal and professional application and usefulness. It also re-emphasises the importance of encouraging regular use of computers by students.

6.2.4 Analysis of Pre- and Post-Semester Data

An analysis of the pre- and post-semester data was conducted utilising the Wilcoxon signed-ranks test for dependent samples. The results of this analysis are provided in appendix 15.

Students reported a significant increase in both daily computer use and frequency of computer use. This could be expected given the intensive hands-on involvement required in the Unit. Similarly, students indicated a significant increase in encouragement by lecturers, friends and school teachers (presumably here teachers on their practicum) but, as would be expected, there was not parallel change in encouragement by family or work colleagues.
Students reported increased levels of support from all but students and friends. This was somewhat surprising given the Unit’s encouragement of ‘buddying’ and peer-group learning. Students also reported changed perceptions of the usefulness of computers on five of the nine indicators. There was no significant change in students’ perceptions regarding computers helping them in their future teaching, helping them get a job, helping them access information for their teaching or helping them feel more confident with their students. The first two of these findings were particularly interesting given my explicit emphasis on DET employment requirements and the need for teachers in schools to have sound computer skills. These findings can, however, be explained at least partially by the already high level of perceived usefulness, particularly on the first three of these questions. It also emphasised the importance of increasing focus on classroom integration issues.

With regard to attitude to computers, the Unit had an inconsistent impact. There was a positive increase in students’ ‘like’ for working with computers (z=-2.02, p=.043) and a more significant impact regarding finding it difficult to stop once on a computer (z=-3.83, p=.001). No significant change, however, occurred in choice to use computers in their spare time, to write assignments or in their teaching. The Unit did, however, reduce students’ anxiety levels, as indicated on all questions except concern about ‘breaking’ computers. Finally, in relation to learning dependency, the Unit had a significant influence on students’ comfort in employing independent learning approaches (Questions I1-I3).

### 6.3 Attribution: An Analysis of the Data

The second half of the self-assessment survey (pre-semester) presented students with six hypothetical scenarios, each representing a situation where, in using computers, they experienced either success or lack of success. Students were asked to provide, as an open response, a reason for that success or failure (attributional explanation) and then to indicate the causal dimension on a seven point Likert scale; in other words, whether they felt this reason was:

- something to do with themselves or something outside their control (locus of causality);
- something likely to occur in the future or not (stability); and
- something that affects them generally or only in this situation (generalisability).

In accordance with the approaches of Kent and Martinko (1995b), a primary focus in analysis was the attributional explanations, rather than the causal dimensions (locus, stability and generalisability). Rather than ‘force’ data into predetermined causal dimensions, Kent and Martinko’s (1995b) approach was utilised, coding attributional explanations into emergent categories. Common themes of attributional explanations were identified and broader categorical headings assigned. This was done for each question without reference to previous questions, and, hence, each of the causal explanations was grounded in the data. Frequency of responses for each of the emergent categories was cross-tabulated with attributional explanations and causal dimensions. Although the responses were provided on a seven-point Likert scale, responses were collapsed into three categories for the purpose of analysis, with responses of 1, 2 and 3 collapsed and responses of 5, 6 and 7 collapsed. In this way a clear distinction was made between internal/external, stable/unstable and generalisable/non-generalisable. Responses in the middle (i.e. responses of 4 on the 7-point scale) were excluded from analysis.
6.3.1 Analysis of the Attributional Data for Lack of Success

Four questions gathered attributional data relating to lack of success. Three of these questions related specifically to computer contexts and the fourth was general. The situations presented were: receiving a low mark on an assignment for presentation and layout (Question 1); not being able to get a piece of software to work (Question 3); a friend not being able to read an e-mail you send (Question 4); and, finally, things generally going badly (Question 8). The frequency analysis for each of these four questions is presented in appendix 16, tables 29-32.

Questions 1, 3 and 4 revealed a pattern of internal locus of causality across the participant group: 68% on Question 1, 62% on Question 3 and 42% on Question 4. These responses are roughly consistent with students’ general locus of causality for lack of success, being 56% internal. Notably the first two computer-based questions were independent activities, while the third (Question 4) involved another individual receiving the e-mail. A greater proportion of students still attributed this unsuccessful situation to internal factors (42%) as opposed to 36% who attributed it to external factors.

As previously mentioned, it is just as important to analyse the explanations which respondents assigned to the non-successful scenarios. The analysis of attributional explanations is provided in appendix 16, table 33. Four attributional explanations were consistently cited, these being: lack of knowledge and skills (cited, on average, by 26% of participants); technical problems (24%); incorrect information or instructions (14%); and lack of effort/time commitment (11%). Other factors, which were cited less frequently and less consistently, were ‘differing expectations’, ‘not following directions’, ‘communication fault of self’, ‘poor judgement’, ‘lack of experience’ and ‘frustration’.

For each of these four attributional explanations a frequency distribution was performed with each causal explanation, as shown in appendix 16, table 33. From this analysis it can be seen that a student attributing lack of success to lack of knowledge and/or skill is more likely to have internal locus and is somewhat more likely to view this as stable and non-generalisable. A student attributing lack of success to lack of effort or time commitment was again likely to report internal and stable factors, but these attributions were more likely to be generalised. Students attributing lack of success to incorrect information or instructions were equally likely to display internal or external attribution, or be stable or unstable, but would be more likely to report non-generalisability. In contrast, a student attributing lack of success to technical problems was more likely to report external locus and non-generalisability. No pattern was evident with stability. Thus, students with patterns of external attribution more frequently cited attributional explanations of either ‘technical problems’ or ‘incorrect information or instructions’ to account for their lack of success.

6.3.2 Analysis of the Attributional Data for Success

Four questions gathered attributional data relating to success. Three of these questions related specifically to computer contexts and the fourth was general. The situations presented were: successfully locating information on the Web (Question 2); teaching a successful lesson incorporating computers (Question 5); being able to solve a friend’s computer problem with little difficulty (Question 6); and, lastly, things generally going well (Question 7). The frequency analysis for each of these four questions is presented in appendix 16, tables 34-37.
All questions again revealed a strong pattern of internal locus of causality across the participant group: 58% on Question 2; 84% on Question 5; and 76% on Question 6. These responses were roughly consistent with students’ general locus of causality for success, being 76% internal. Most notably, no students cited external locus of causality in relation to general success. Six attributional explanations were consistently cited in relation to success, these being: knowledge/skills/experience (cited, on average, by 45% of participants); effort/time (16%); luck (9%); confidence (4%); education (2%); and ease of task (2%).

It could be expected that citing a particular factor on one scale (i.e. success) might lead to participants citing a lack of that same factor as leading to lack of success. This was the case in terms of ‘knowledge and skills’ and ‘effort/time commitment’. However ‘luck’ and ‘confidence’ were more likely to be cited as factors affecting success rather than lack of success. Bad luck, for instance, had not been associated with any of the unsuccessful computer tasks. On successful computer tasks, however, such responses were common. Nineteen percent (19%) saw luck as the reason for success on a Web search and 7% perceived luck as the reason for success solving a computer problem. It was only regarding the successful lesson that luck was less cited (2%). Luck was, however, mentioned frequently in terms of both general success (12%) and general lack of success (16%). Confidence, again, was cited by students far more often in terms of causing success but was not perceived as influencing lack of success. Only 2% of students mentioned lack of confidence as a factor influencing lack of success on an assignment presentation and 4% mentioned it in terms of general lack of success.

‘Hard work and effort’, while cited as a strong influence on general success (17.5%) and lesson teaching success (43.9%), was not frequently mentioned in relation to other computer tasks. For instance, with regard to the Web search, only 2.8% of students cited hard work and effort, while in relation to solving a computer problem, hard work and effort were not cited at all. This was somewhat surprising as both tasks would be expected to require considerable effort. These findings highlighted the range of attributional beliefs held by students and the inconsistencies, as I perceived them, between these beliefs and my own assumptions regarding the beneficial attributional underpinning for self-regulated learning.

6.4 Metacognitive Reflections on Theory

The previous two sections presented the data from the self-assessment survey. In this section, reflective data on both social cognitive and attribution theory is presented, together with reflections on capability and learning style theory. For each theory the student reflective data are presented, indicating student reaction and the impact of the theory on their learning. This is then followed by my own reflections on the value of including these theories in the metacognitive approach and how the process challenged my expectations and assumptions as an educator.
6.4.1 Reflections on Computer Capability

As discussed in section 2.2.4, I entered this research with my own impressions of the characteristics of ‘capable’ computer users. I acknowledged, however, that these assumptions were coloured by my experiences and pre-conceptions and required confirmation or contradiction from others, particularly students. The importance of such an approach has been emphasised by Dick (1997). To this end, students were asked to think of an individual who they perceived to be a proficient computer user and, in their journal, reflect on the characteristics of this person and how they learnt. Student responses were analysed using a grounded theory approach. Themes were identified and patterns of responses grouped under common headings, those identified by a significant number of students being seen as core. A full analysis of this data, showing respondents, terminology, pertinent quotations and divergent responses is provided in appendix 17.

As reported elsewhere (Phelps, Ellis & Hase, 2001) there was a significant degree of consistency across the responses with a core set of characteristics being identified time and time again. These core characteristics can be summarised as:

- confidence in their own skills and abilities;
- patience and persistence, determination and calmness;
- risk taking, courage to experiment and try new things; not afraid to make mistakes;
- methodical/logical thinking;
- enthusiasm and motivation; enjoyment of computers; positive attitudes and interest;
- technical knowledge;
- love of learning;
- constant use and deep immersion; and
- problem-solving abilities/deduction.

A second set of characteristics were cited less frequently, but by more than four students. At times these less frequently cited responses contradicted other more generally held perspectives, but all were relevant in terms of the diversity of perspectives represented. These are also summarised in appendix 17.

Students were also prompted to reflect on how their identified ‘capable’ computer user learnt. Again, the analysis of student responses is provided in appendix 17. Data overwhelmingly pointed to self-directed learning approaches, including experimentation, trial and error and ‘play’.

Several students (such as Student 6) contrasted their concept of a capable computer user with the clichéd ‘computer nerd’ (lacking in social skills). This, to me, was an indication of, and support for, the difference between competency and capability. This differentiation was again supported by Student 72 who challenged the view that ‘capability’ rested on technical skills. Rather, a capable computer user was ‘someone who can take their knowledge and apply it to a range of different situations… who can learn independently…
who may not know all of the answers but who knows where to find the answers’. It is someone who ‘continues to learn and develop their skills… they do not consider that they know everything there is to know - because I don’t believe that there is anyone who knows everything that there is to know’ (Student 72). Student 109 similarly distinguished a capable computer user from an ‘expert’, noting that ‘I think of someone who can quickly work through problematic situations even though they may not readily have the required skills’.

To return to the list of nine core characteristics, all but the sixth (technical knowledge) were metacognitive constructs. The majority of students considered technical knowledge to be secondary to more general traits, which were perceived as leading to a capacity to develop technical knowledge. ‘They seem to live and breathe what they learn… they make it relevant to their lives and interests; they make it interesting for themselves which goes further to feeding the enthusiasm and confidence’ (Student 111). For this group the capable computer user was not ‘all knowing’ but possessed a sound ability to learn. A smaller but discernible portion of students were focusing on the innate abilities of the capable computer user, as indicated by many of the less frequently cited characteristics listed in appendix 17.

6.4.1.1 Was there Value in Reflecting on Capability?

There was value in the inclusion of this reflective activity in the Thinking module, both for me as researcher and also for the students. Firstly, the activity confirmed my initial assumptions. Most students were able to differentiate between a technically competent and a capable computer user. Interestingly, there was considerable consistency between the factors identified by students and the capability literature. For instance, the most frequently cited characteristics, ‘confidence in skills and abilities’ (i.e. self-efficacy) and ‘problem-solving abilities’, directly parallel definitions of capability (Cairns, 2000). Learning ability and motivation were also central in the Australian Capability Network’s Statement of Belief (1996). The students identified ‘risk taking’ and ‘courage to experiment’, paralleling capability’s definitions embracing courage and creativity. The student data thus reinforced my perspective that a capable computer user was qualitatively different to a competent one, but also that the differences were comparable to those identified in the wider capability literature. It is worth noting that the list of core characteristics derived from the students’ reflections are supportive of those later discovered as having been identified by Chandler (2000) in relation to an ‘exemplar’ computer user, namely disposition toward problem-solving and innovation, use of play and discovery, confidence, openness to using computers and readiness to learn about computers whenever possible. Chandler’s study thus supported these findings. The student data also supported Ferdig’s (1998, p.3) finding that, ‘When asked about what makes a technology expert, many students reply that it is the ability to walk into most technology situations and not necessarily know everything that is happening, but not be afraid to try’. Through the contributions of students I was able to consolidate and enlarge upon my initial pre-conceived definition of a capable computer user and arrive at what might be considered a ‘working definition’ of the relevant characteristics.

As a learning experience, the exercise was also valuable. While few students responded immediately and explicitly to this exercise by challenging or re-affirming their cognitive or learning strategies, the exercise did provide a ‘goal’ or a ‘role model’ towards which
students could aspire: ‘as a result of this reflection, I can see not only the type of IT user I would like to become, but also the IT user I would like to create within my primary school classrooms’ (Student 144). In this sense the exercise can be seen to support Becker’s (1994; 2000) assertions that focusing on ‘exemplary’ computer users can help us understand what barriers exist for extending these practices to others. Responses from a number of students provided evidence of this occurring in practice. For instance, Student 26 expressed a determination to use ‘help’ more, while Student 109 reflected upon their tendency to procrastinate. For some students, however, the exercise simply highlighted differences between their own learning approaches and those of the ‘model’: ‘It is obvious to me that I learn differently to them when it comes to information technology’ (Student 65). Although the activity may not have been transformational for these students it did promote cognitive self-appraisal, and thus potentially formed a first step toward self-management. Unfortunately, for a very small number of students this exercise may have had a negative effect. This potential was emphasised by one particular student: ‘Rather than make myself feel less confident and proficient than I already do... I will just state what I believe I need to do to become a proficient IT user’. This statement merited further attention. My intention in presenting the activity was to encourage students to do exactly what this student decided to do: identify steps they could take to become more ‘capable’. On reflection, this intention could have been made more explicit; I needed to emphasise attainability rather than innate ability. The more consistent student reaction was, however, positive, as expressed by Student 37: ‘The first step is to start believing that those people who are completely conversant with technology have the same obstacles to overcome and that there is nothing inherently different about them - just that they have had more exposure’.

6.4.2 Reflections on Social Cognitive Theory

As outlined in chapter 5, students were presented with a brief overview of social cognitive theory and, together with their own responses to the self-assessment survey, were asked to reflect (in their journals) on the relevance of this theory to themselves as learners and future teachers. Specifically, they were asked to reflect on which factors added to, and detracted from, their self-efficacy and whether reflection on these influences might change their approach to computer learning. The intention was to determine not only whether social cognitive theory was a beneficial component in the metacognitive approach but also to triangulate the pre-semester survey data, providing a richer understanding of student responses to the quantitative instrument, and explaining some seeming anomalies in the statistical data.

While most students were decisive in stating that an understanding of social cognitive theory would influence their approach to teaching, a smaller but not insignificant portion of students were confident that it would influence their approach to computer learning. Students indicating the latter tended to be those engaging in a deeper level of reflection. Student 79 is worth quoting at some length:

I believe...that many of the factors that contribute to our self-efficacy are unchangeable... I think that even if I had an enhanced understanding of the role of self-efficacy that my approach to learning computers will remain the same... Actually, this may sound weird but I think I have had a change of heart as I have
been trying to write my answer to this question. Thinking about it now I can see the value... I could identify factors that were having a negative impact and attempt to deal with these. Rather than just feeling unconfident about my computer ability I could target specific areas of need.

These sentiments, while not commonplace, were also not isolated, particularly amongst students experiencing high anxiety: ‘By enhancing my understanding of self-efficacy and its effects on one’s computer abilities I can stop the chain reaction before it begins and influence the success of my own learning’ (Student 144). These quotes also emphasise the potentially transformational influence of the reflective process. A small number of students voiced concern (ranging from mild dislike to outright objection) regarding the self-assessment survey. Objections were two-fold. Some (for instance, Student 114) commented on the self-reported nature of the surveys, and that responses might vary according to the circumstances under which they were completed. A second group of students noted that they were ‘rushed’ when completing the survey and that they needed more time to reflect (Student 7). The majority of students were either neutral or found benefit in the self-assessment activity. Student 164, who was initially ‘very hostile’ to the survey, reported changing their view after further reflection and engagement with the Unit. ‘I think that it is wise to ask students if they can identify the factors that add or detract to their level of self-efficacy. This exercise makes people stop and think of their capability to use a computer and what affects it’.

For a number of students, social cognitive theory prompted reflection on the relative role of skills, as opposed to sociological and psychological factors. Student 33, for instance, stated that: ‘I don’t think it is as complicated as you’ve set it out... The more skilled you become, the higher confidence you have to try new tasks using these skills’. For Student 68, knowledge was seen as an important factor missing from the theory and others emphasised the interrelated nature of the various factors. Student 135, for instance, felt that skill and support were critical: ‘If the support is there, the skill level can increase quickly and so will the level of self-efficacy’. Similarly, Student 5 noted that self-efficacy formed a ‘vicious circle’: that if someone doesn’t have self-efficacy to try something new they can’t develop skills to become confident and proficient.

Engagement with the reflective data challenged my assumptions regarding the dichotomous nature of the factors surveyed via the self-efficacy survey. A vivid example concerned the two variables ‘encouragement by others’ and ‘use by others’. In both cases previous research had assumed that the individual’s reference group could positively influence self-efficacy and outcome expectations through verbal persuasion and that observation or behaviour modelling is a powerful means of behaviour acquisition (Compeau & Higgins, 1995b). My initial assumption was that such influences would relate to positive self-efficacy judgements. While these factors were certainly perceived by the majority of students to be influential, the reflective journal data emphasised that this impact was not always in the expected direction. For some students, seeing others who had well developed computer skills, or used computers regularly, diminished their self-efficacy: ‘Just when I think I know enough about IT to get by, another person does or says something that makes me feel incompetent’ (Student 41). Similar reactions were voiced by Student 9, who noted that ‘social pressures detract from my self-efficacy when I notice that other students are way ahead of me’. Another student related a story of her sister living in Sweden. Despite the many advantages for communicating with her family via e-mail her sister refused to
touch her computer: ‘...since most people around her seem to know more about the use of computers than she does she feels intimidated and stupid. Instead of reacting positively to pressures around her she chooses to avoid it completely’ (Student 135). The variable ‘support’ raised similarly disparate responses, being described as both detrimental and beneficial: ‘I know people who feel that when they are offered support they are being told that they are incompetent’ (Student 72). Several students also drew a connection between support and reinforced dependency, an area I return to in cycle 3.

6.4.2.1 Was there Value in Reflecting on Social Cognitive Theory?

The capacity of social cognitive theory to promote cognitive self-appraisal and self-management is borne out by the reflections of a significant number of students, but particularly those experiencing difficulties with computers: ‘Knowledge of the role of self-efficacy... strongly influences how I approach learning new skills, since I can pinpoint the factors that stop my self-efficacy from developing higher’ (Student 148). At face value the survey was a source of data; at a somewhat deeper level it was a stimulus for reflection. However at a third and deeper level it was a direct source of personal growth for students and myself alike, challenging initial assumptions regarding the role of social cognitive theory in computer learning contexts:

There was actually a distinct disparity between how I viewed myself in general terms regarding self-efficacy and attribution, and how I had answered the survey...
For me the major characteristic of my responses to this survey reflect an unwillingness to admit to computer competence or the likelihood of such competence, until I had concrete proof for myself that I could learn skills’ (Student 28).

These sentiments are again expressed by Student 4: ‘This survey also encouraged me to believe that I have more confidence in myself than I perceived myself to have’. While a small number of students perceived little value in completing the self-assessment survey (a figure perhaps greater if we consider non-return/response rates) most students seemed to perceive value in reflecting on the theory itself. The fact that students were prepared to challenge the dichotomy of the factors reinforces the value of the reflective activity both for the individual student and the macro-research.

I began to see the complexity of the interaction of the factors at the individual level, and was prompted to reconsider the emphasis being placed on psychological and metacognitive constructs. Was I, as one student had pointed out, making it seem more complicated than it was? I return to this issue in section 6.7.2. While, overall, the self-assessment survey had been of significant value, there was little doubt that the self-scoring structure had not been utilised by many students and, for those who referred to it, it only served to complicate the survey process. Given the capacity of students to reflect on their survey responses without the self-scoring instrument, it seemed logical to omit this component in future cycles.

6.4.3 Reflections on Attribution Theory

As outlined in chapter 5, students were presented with a brief overview of attribution theory as part of the Thinking module. Together with their own responses to the self-assessment survey, they were encouraged to reflect (in their journals) on the relevance of attribution theory to themselves, as learners and future teachers. The goals were two-fold:
to determine whether attribution theory was a beneficial tool in the metacognitive teaching approach and to triangulate the reflective journal data with that of the attribution surveys.

Attribution theory was the least well understood theory and evidently required better explanation on my part. While many students did engage thoughtfully with the concept, others either omitted or brushed over its discussion. A small but significant portion of students misunderstood the theory, making statements such as ‘I generally attribute things to stability but internal/external attribution and generalisability of attribution were not too far behind’ (Student 53). A couple of students were outwardly disapproving, such as Student 68: ‘I don't find this relevant at all - talking nonsense’. Student 15 viewed attribution theory as ‘misrepresenting’ the terms ‘faith in oneself’, ‘ability’ and ‘responsibility for oneself’. Other students pointed out difficulties experienced in completing the survey (for example, Students 5 & 131). Few students reflected on stability and generalisability, although some were able to connect these characteristics to the learning process in terms of openness to change. Despite these qualifications, the reflective journal data did reveal valuable reflections on attribution theory and its role in computer use and learning from a sizeable portion of students.

Consistent with the survey data, students predominantly reported strongly internal locus of causality. In reflecting on this, they tended to identify with one of three different perspectives.

**Perspective One**: That internal attribution is intrinsically more appropriate to computer learning contexts. These students perceived a range of advantages associated with internal attribution, including: willingness to tackle new software or problems (Student 39); determination to learn (Student 72); realisation of individual responsibility to pursue knowledge (Student 19); confidence in ability to produce good results in new situations (Student 37); and a tendency to spend more time trying to succeed when having difficulty (Student 153). This perspective is well summarised by Student 4: ‘This is an empowering process as it means I am in charge of my own learning’.

**Perspective Two**: That both internal and external attribution have advantages and disadvantages. Internal attribution was identified as detrimental, as students tended to blame themselves, rather than consider, for instance, technical problems: ‘Whether I succeed or fail I always consider myself to be the causing factor. This occurs even more so when I fail. I rarely stop to think that there might be something wrong with the program I am working on’ (Student 65). Students also highlighted the disadvantages of external attribution (for instance, Students 27, 39 and 72), primarily the lack of responsibility individuals take for their own learning: ‘I’ve seen some people within the computer labs at University getting really upset and angry because something hasn't worked or they’ve lost work. Most of them swear and curse at the computer as if it was the computer’s fault’ (Student 27).

**Perspective Three**: That successful situations warranted one attribution and non-successful situations warranted a different approach. I came to refer to this perspective as ‘selective attribution’. This approach was less a rationalised position on the theory as an account of existing personal patterns. Some students, for instance, tended to attribute success externally and failure internally. Others reported the opposite. For some this
selectivity was conscious. For others these attributions were revealed to them through the reflection process: ‘I blame myself for any failures and tend not to humbly accept praise if I am successful. I will put it down to the computer working well’ (Student 113). Student 165 described himself as apprehensive and had avoided using computers throughout his degree. This student came to recognise that he had been making internal attributions when things went wrong and yet external attributions when something was successful: ‘my success is due to the help and assistance I have gained from others’. Selective attribution did not just affect inexperienced computer users, although opposite attributional patterns were more likely to be displayed by confident computer users. Student 122 described himself as a ‘computer nerd’ and went on to reflect that ‘if everything is working on the computer and I am getting the results I want, then I tend to think that it is due to my skill level. However, if something goes wrong, then I blame it on the computer because I feel I know how to work it and I am becoming familiar with the little ‘hicups’ it often makes’. A similar attitude was succinctly expressed by Student 17: ‘I am arrogant enough to think that everything that goes wrong is outside of my control’.

Emerging from both the students’, and my own reflections was a fourth perspective: that which I termed ‘appropriate attribution’. Many of the less confident students were experiencing considerable difficulties identifying the sources of their computer problems, often attaching internal attributions to problems which were quite probably out of their control. Students who were more confident, however, seemed to possess quite different attributional styles: ‘if I can understand and identify what has gone wrong then the problem is internal… my own fault… If I do not understand what has gone wrong then the problem is external - I could not avoid it’ (Student 164). Interestingly, very few students explicitly mentioned or discussed the notion of appropriateness in attribution. By ‘appropriate’ I refer to a process of actively employing cognitive strategies to analyse the situation before making attributional statements or forming attributional beliefs. The reflection of Student 13 represents this fourth perspective: ‘When I encounter difficulties with computers I usually assume that there is a problem with the program, but of course I always check that I’ve done my part correctly’. Here the student explicitly acknowledges the need for situational analysis before making attributional judgements. This approach represents a move away from attribution as a ‘style’ toward using understanding of attribution as a cognitive strategy and I return to this concept in chapter 7. On reflection I believe that this latter perspective might not have been discussed by students because of the dichotomous nature of the theory, and the hypothetical format of the survey, which precluded personal analysis of the situation. While useful as a tool to prompt engagement with attribution theory, further content was required to assist students to progress from cognitive self-appraisal to self-management.

6.4.3.1 Was there Value in Reflecting on Attribution Theory?

Attribution theory proved to be transformational for many students. Student 112, for instance, identified that: ‘I am very hard on myself, and as a consequence this is damaging to my self-efficacy and confidence’. She went on to reflect that ‘if something has not worked out then I will learn from the situation so that it should not happen again’. Student 8, who attributed both successes and failures to stable internal factors, initially stated that she did not believe she had the capacity to change her internal causality but later reflected that she could change with effort. For some students, reflection on attribution theory evoked cognitive self-appraisal but this did not translate into self-management strategies: ‘I
come to expect failures to occur in situations I am unsure about. I believe that I have little control over these failures and therefore tend to try and avoid them. I don’t really see that the situations will change so I prefer to stick to what I know’ (Student 176). However, for other students the theory challenged their metacognitive judgements, beliefs and choices. Student 133, for instance, exhibited ‘selective’ attribution, yet reflection provided an avenue for potential change in learning approach:

In one way this attitude probably helps maintain my high computer self-efficacy because I attribute good results to my own skills and bad results to something out of my control. But in another way this attitude probably holds me back in my learning... when I encounter a problem I am more likely to give up if I believe that the problem is beyond my control.

Even where students’ reflections were less ‘transformational’, such insights represented a first developmental step. Student 5, for instance, documented her realisation that effort was required to produce change (instability) and that her attitude to the situation, in particular whether it was worth investing time, was most influential on achievement of an outcome. Student 164 realised that she had trouble remembering her computing successes: ‘I find that I just take them for granted and don’t see it as success, rather the computer has finally done its job and the right thing’. The capacity of reflection in assisting students to challenge their own pre-conceptions is also revealed in the following extract:

As part of my belief system and the law of averages I thought it was realistic to believe that in any situation there is a 50% chance that things will go in any particular way. However in relation to the survey I realise that this is a fairly self-defeating attitude. I can see that my tendency to over generalise gives me a feeling of loss of control in relation to using the computer. I now affirm that I have at least 75-90% chance of causing changes in relation to my computing skills and solving problems because practice gives me more experience to draw on (Student 105).

As an educator and researcher, my own reflection on attribution, and my interaction with students, significantly challenged my assumptions. Consistent with the literature, I had perceived internal attribution as positive. I also had assumed that there would be a role for me as an educator in assisting individuals to favour internal locus of causality. My assumptions were confronted on both accounts, as my own reflective journal reveals:

Attribution theory seems to be making less and less sense the more journals I engage with... my whole attitude toward internal attribution has changed! The key for people is to be able to determine what is within their ability to change and what isn’t. If we can help people reach this discovery I think we can dramatically reduce anxiety and enhance self-efficacy (October, 2000).

I realised that many students with low self-efficacy already had internal attribution and that this was impacting negatively on their computer use. I also realised that rather than any particular attributional tendency being better than any other, there was value in assisting students to adopt strategies to identify ‘appropriate’ attribution in each computer context. Student 72, who reported strong internal attribution, provides one such example:

While I may always have some degree of control over situations it is virtually impossible to always control every situation. I need to acknowledge this and accept that sometimes when things don’t go exactly as planned there may have been little else that I could have done to change the result.
Student 179 provides yet another example of the value of reflecting on appropriate attribution: ‘I began this course believing… that I held the key to all things happening. However… I have now accepted that there are times when I do not have control over situations; that I am not personally responsible for network down time or someone else adjusting settings’. Reflecting on these comments, I was challenged to consider whether it is possible to assist people to make more accurate and appropriate attributions, and saw this as an issue to pursue in subsequent research cycles.

6.4.4 Reflections on Learning Style Theory

As outlined in chapter 5, students were presented with a simplified self-assessment instrument to self-diagnose their learning style according to Kolb’s model. They were then presented with a brief outline of the literature and research surrounding learning styles and computer use. It was not the intention of the study to collect data on students’ preferred learning style(s), but rather to focus on their reflections on the theory and whether it could support their learning. Students were also prompted to consider which learning style(s) they considered to be most beneficial in using computers. The majority agreed that abstract conceptualisation and active experimentation were important. However, these responses were likely to have been influenced by students reading beyond the prompt and engaging with the research that connected these styles to computer use (see section 4.6.2). A number of students took a different approach, providing an outline of how and/or why they felt all learning styles had their place in computer learning. Students 109, 111 and 123, for instance, drew from the strengths and weaknesses of each style, highlighting the characteristic strengths that would be of benefit in using computers. Student 110 pointed to specific computer applications which would be of interest to each learning style disposition and Student 113 analysed the type of learning approach that might be employed by computer users from each style.

6.4.4.1 Was there Value in Reflecting on Learning Style Theory?

While many students found the survey to be both interesting and beneficial (see case study six, section 6.6.1), a number were critical, mentioning the potential for individuals to respond as they would like to be, rather than as they are (Students 6 & 109); the difficulty of making generalisations regarding learning approaches (Students 9 & 110); that responses would change over time (Student 109); and that it may have been better to present computer-context specific questions (Student 28). The most passionate critique stemmed from students who resisted type-casting individuals into one category, despite my explicit statement that ‘although most people develop a preference for one particular learning style, effective learning requires the ability to draw on all four modes’. At least one of the most vocal objectors (Student 68) changed their views when they read my statement: ‘This survey did not help me one bit and was a waste of time. I was going to go on a big spill out about how everyone is unique and individual… However you have made a point of saying down the bottom that it takes all four modes for effective learning’ (Student 68). Evidently, in presenting the learning style material I needed to be more careful to ensure that students were prompted to view the theory in its intended context.

For many students, Kolb’s model did provide an opportunity for cognitive self-appraisal and reflection on strategies for self-management. As stated by Student 109, ‘it becomes easier to know the areas… in which we may improve’. Student 74 also demonstrated the potential for students to reflectively challenge their preferred learning approach: ‘I need to
make a conscious effort in bringing up the accommodator and assimilator in myself'. Similarly, Student 15 rose to the challenge stating that: 'I will have to endeavour to expand my horizons and accommodate this type of learning’. My initial assumption was that active experimentation was a highly advantageous approach in relation to computer use and that fostering active experimentation would assist individuals to become more ‘capable’ computer users. Students’ reflections challenged me to reconsider these assumptions and gain a greater appreciation of the role and importance of all styles.

Of the theories incorporated in the metacognitive approach, learning style theory seemed the least beneficial for students. On reflection, I felt this was due to my presentation of the theory. I also noted that some information provided about Kolb’s theory and its application had been counter-productive, drawing students’ attention away from the potential of the model to invoke cognitive self-appraisal. I resolved to modify the presentation of this theory in future cycles and the subsequent results are explored in section 7.3.1.

6.5 Reflections on Computer Learning Contexts

As previously noted, students were provided with three types of stimulus for reflection on computer learning contexts: past learning experiences and ‘pathways to learning’; a variety of learning and teaching methods via the tutorials; and exposure to a range of other learning experiences throughout the semester, such as the challenge assessment. In this section I present an analysis of the three approaches and reflect on the value of each as a component of the metacognitive approach.

6.5.1 Reflections on ‘Pathways to Learning’

As noted in section 5.4.1, students were prompted to reflect on their past computer learning experiences and, in particular, the strengths and weaknesses of group instruction, individual instruction, peer-group learning and self-directed learning.

Group Instruction

Most students had engaged in group learning, either at school (occasionally primary but mostly secondary), TAFE or most commonly from earlier years of tertiary study. Reaction to group approaches was generally reliant on contextual factors such as the teacher/tutor or the student’s computer self-efficacy at the time. Many acknowledged that group learning was beneficial for new skills and programs, with the advantages of logical sequencing, relevant content coverage and a sense of support and motivation. Many negative factors were, however, noted including boredom (when the skill or knowledge was already known), inappropriate pace, confusion from unclear instructions and minimal opportunities (or encouragement) to explore and experiment. Almost universally, as students’ experience and confidence levels grew, their opinions regarding group instruction changed and their preference for self-directed learning increased: ‘I prefer to have minimal guidance and work it out for myself’ (Student 6). While such reactions were consistent with my expectations, what was more surprising was the strength of negative reaction to group learning contexts by ‘beginner’ computer users. While by no means unanimous, students provided a very strong picture of the detrimental effects of this learning pathway on their self-efficacy, confidence and often ongoing attitude to computers: ‘In a group instruction situation I feel pressured to ‘keep up’ and this negatively affects my self-efficacy and my ability’ (Student 4). Group learning contexts provided students with the ability to conceptualise their capability and skill in relation to ‘the group’ with both negative and
positive implications: ‘It was comforting to realise that some other students hold low self-efficacy’ (Student 4). This student–student comparison, almost competition, arose frequently as an issue, leading some students to favour streaming, despite counter-recognition of the benefits of peer tutoring. Other negative comments included a reluctance to ask teachers to repeat directions for fear of looking stupid (Student 79) and poor retention of learning through minimal opportunity for consolidation (Student 104). Beneficial aspects of group contexts included the ability to maintain a sense of anonymity, providing ‘the freedom to make mistakes without feeling as though I am being supervised or under scrutiny’ (Student 15). Some students (for instance Student 5) reflected that group contexts were good initially to get basic concepts and hints, and were best followed up by self-directed learning and then group or individual advanced sessions.

**Individual Instruction**

As expected, a number of students indicated a preference for individual instruction. Arguments generally centred upon its ability to address specific needs, to provide immediate and constructive feedback on questions and to cover more content. Observation and self-pacing were also noted and Student 4 pointed out that ‘I usually discover more than my initial question asked’. The source of the individual instruction was, of course, critical. Student 20, for instance, compared the assistance received from friends to that from help desk staff. Friends ‘usually could explain things the way I would understand’ whereas the help desk staff ‘would blow me away with their technical jargon. Often (they) would fix what ever had happened to the computer but I still would not understand’. More unexpected, however, were the significant number of students who voiced either discomfort, or a strong dislike, for individual instruction. Student 13, for instance, noted a ‘reluctance to admit any lack of knowledge’ and Student 109 reflected that they found this approach intimidating: ‘I sometimes indicate that I understand just because I feel as though I am taking too much time’. Again, such sentiments were voiced by Student 113: ‘What I don’t like about this approach is that someone is there watching over my shoulder. I like to learn independently and do not like to be directed unless I can’t explore any further on my own and I need assistance’. Student 28 termed the effect ‘proximity paralysis’.

**Peer Group Learning**

Peer group learning was rarely mentioned, something which in itself was quite interesting. Throughout the semester, however, a number of students chose to learn with fellow students, mostly in informal and impromptu contexts. Student 133, for instance, describes working with a friend using a combination of self-directed learning and individual instruction: ‘One of us learnt something through self-directed learning, and then became the “expert” and gave individual instructions to the other person’. This student described the approach as beneficial, as they were able to work at their own pace and use their preferred style of self-directed learning while still maintaining the benefits of support from a peer.
Self-Directed Learning

It was in relation to self-directed learning that the research provided significant insights to inform change. My initial assumption was that students would prefer to be directed in their computer learning. However, I was surprised by the number of students who stated that self-directed learning was their preferred means of learning, many providing rich and thoughtful accounts of why this was the case. Two themes predominated. The first concerned retention of information; as stated by Student 6, ‘maybe it is the act of discovery that places the information in long term memory’. These sentiments were reinforced by Student 104: ‘I find that if I can stumble and fumble my way around and discover something I remember it for the future more easily’. A second theme was the enhancement in self-efficacy or confidence through successful self-directed learning: ‘When I achieve an objective individually, my confidence increases and I am incrementally willing to attempt to learn new concepts’ (Student 4). Student 104 spoke of ‘a sense of achievement’ and Student 72 mentioned enjoying the self-responsibility: ‘I like to know that I am in control of any given situation including my learning. I find it easy to identify where I am at and where I would like to be by the end of a given period of time. As a result of this I manage my time effectively’. These comments are cognitive in their focus and again indicate appreciation of self-directed learning by those engaged in conscious self-management.

Despite the significant number of students relating positive experiences with self-directed learning it is important to focus on those who did not like learning independently. Themes to emerge included issues of self-discipline, self-motivation and persistence. Student 65 drew on Gardner’s (1993) theory of learning style, stating: ‘I am a visual learner and when shown I will succeed and feel more confident, rather than trying to learn on my own from reading and experimenting’ (Student 65). Other factors mentioned included reluctance to take risks, the need for reassurance (Student 113) and support (Students 105 & 110) and fear of doing something irretrievably wrong (Student 33).

Time was seen as the principal source of frustration and discouragement from employing self-directed learning, a point expressed even by some students preferring this approach (for instance, Students 104 & 110). Self-directed learning was acknowledged as a double-edged sword: ‘When I have studied in this way and achieved I’ve felt very satisfied. There have also been times when no matter how long I try to work something out I feel unhappy with myself and start to question my level of intelligence. These experiences are quite destructive to my self-esteem’ (Student 112). Students noted that, although self-directed learning was valuable, there frequently came a point where further assistance was needed to progress their skills and keep ‘pushing the boundaries’ (Student 133): ‘You never know what you need to know until you need it’ (Student 135). This statement further highlights the importance of perceived need and usefulness and the critical balance between independence and support.

Another key theme emerging from student reflections was the issue of readiness for self-directed learning. Some students indicated that, while they now preferred self-directed approaches, other earlier forms of learning had enabled them to now adopt this approach: ‘Self-directed learning requires students to possess a confidence with, and at least a limited prior knowledge of, or experience with, IT’ (Student 144). There were a number of
students however, who spoke of learning computer skills almost entirely independently, and in some cases they were now highly competent, and in cases more ‘capable’ computer users. I return to issues of readiness in cycle 3.

6.5.2 Reflections on the Tutorial Approaches

The second approach to prompting reflection on learning context was to utilise a variety of teaching methods in a sequence of tutorials, as detailed in section 5.4.2 and in Phelps (2001). Data on each of the teaching methods was obtained through a structured evaluation sheet (appendix 8) completed by students at the end of each tutorial, a copy of which was retained to prompt further reflection via their journal. To reiterate, the five teaching approaches were individual instruction, verbal direction, observation and abstract conceptualisation, cognitive modelling and exploratory learning and these ranged from highly directive to non-directive.

The students’, and my own, perceptions of the strengths and weaknesses of the four teaching approaches have been documented in detail elsewhere (Phelps, 2001). In summary, the key findings from this analysis emphasised that students strongly value hands-on learning contexts. Verbal directions (a technique used widely in training) had major limitations in meeting multiple needs and the potential to impact significantly on self-efficacy. Cognitive modelling had good potential in influencing cognitive strategies but required considerable skill and practice to effectively conduct: ‘...it seemed to be working toward instilling a love of learning in the students rather than actually worrying over the actual computer skills each individual student has’ (Student 58). Exploratory approaches provided potential for increased retention, increased confidence and personal goal achievement, as well as catering for individual abilities and learning styles and students recognised that exploratory approaches fostered independence and empowered them as learners. The data also emphasised the value of teaching students to use ‘help’, as expressed by Student 131: ‘Learning to use the ‘help’ menu was one of the most rewarding experiences that I have had’.

6.5.3 Reflections on Other Learning Experiences

Students also reflected on a range of other learning experiences encountered during the semester, including the computer skills chart, the challenge assessment, and moving between Macintosh and Windows platforms. In this section I briefly consider their reflections.

In section 5.4.1.2 I questioned my inclusion of the Computer Skills Chart and the Challenge Assessment. As in cycle 1, the skills chart was positively received and fairly universally utilised, principally as a tool for preparation for the Challenge Assessment. The skills chart also provided unforeseen benefits in promoting self-efficacy, as students realised that they possessed more computer skills than they previously thought. Several students, however, pointed out difficulties in understanding the terminology used in the Skills Chart, noting that once the statement was clarified they could perform the skills. These comments raised issues relating to the role of terminology in the learning and teaching process and I realised this was an issue needing further consideration in future cycles. My concerns regarding the Challenge Assessment were also countered by the almost universally positive reactions of students. Some students mentioned the benefit of...
‘being forced to learn’ (Student 6). Others reflected on the benefits derived in terms of positive reinforcement: ‘The challenge assessment was one of the most rewarding experiences I have had in computerland. I felt, after completing it, that my skills were much greater than I had given myself credit for. To be required to perform so many different tasks was very satisfying’ (Student 21). Such comments were repeated by a number of students including Student 112: ‘I feel this assessment has positively influenced my learning and motivation. I did not experience “outside” pressure and as a result I was thinking clearly and able to trouble-shoot problems that occurred during the assessment’. Student 23 expressed similar sentiments: ‘I found it very self-motivating as I read through the sheet and as I completed each one it made me feel like this course had really taught me something’. These experiences are also reinforced in Case Study Five (section 6.6.1).

A third learning experience which proved beneficial for students was that of moving between computer platforms. Students had been encouraged (although not required) to try a computer platform which they were less familiar with. Although I had not given it a lot of thought initially, I later realised that students’ reaction to this new context was an indicator of flexibility and hence computer capability. Of course, as an optional activity, preparedness to ‘give it a go’ cannot, in itself, be underestimated. Some students, rather than undertaking the activity, reflected instead on past experiences. Significant contrasts could be seen in individuals’ reactions as illustrated through the following two contrasting statements. Student 15 stated: ‘I did what I thought I had to do and found that the two platforms are actually quite similar’, while Student 35 stated that: ‘I am so used to using a PC that using a Macintosh was like speaking another language. I was lost... Even shutting down was difficult’. As will be discussed in section 6.6.2, flexibility in moving between computer platforms became a reference point for me in identifying capability.

6.5.4 Was there Value in Reflecting on Computer Learning Contexts?

Overall there were significant benefits to both students, and myself as an educator, in reflecting on computer learning contexts. While the ‘learning pathways’ framework was not in itself a strongly transformational tool, it did prompt students to validate the wide range of learning contexts available to them. The activity was beneficial in increasing my understanding of students’ reactions to various learning contexts, and the strengths and weaknesses of the approaches. In particular, it highlighted the widespread negative reactions to group and individual instruction. Several themes from cycle 1 re-emerged in cycle 2, including the value of independence, memory and retention and knowing what was possible. Two further key themes might be added here, namely readiness for independence and preparedness to seek help, themes taken up in cycle 3.

The majority of students were interested in, and supportive of, the evaluative approach taken to the tutorials. As future teachers, they saw value in reflecting on different learning and teaching approaches and, for many, the experiences prompted self-realisations about their own learning. Illustrations of this are cited elsewhere (Phelps, 2001). Section 6.5.1 highlighted that few students reported having used peer-group learning. Through the metacognitive process students became more aware of the value of co-operative and collegial learning while acknowledging the benefits of trying to do something independently before asking for assistance. A small number of students were confronted (almost antagonised) by the abstract conceptualisation and exploratory learning approaches. Discussions with two such individuals in week 3 revealed their expectations
that a course of study should (or could) ‘teach’ them all they needed to know about computers. This dialogue reinforced my concerns regarding the tendency of traditional ‘training’ contexts to reinforce dependency.

Comments made by a more significant number of students, however, reinforced the potential success of a metacognitive approach in fostering computer capability. One student, for instance, was prompted to reflect on her early schooling where she could recall learning computer skills through directed teacher instruction: ‘The teachers taught us how to perform basic functions… but the one thing that they didn’t teach us was the ability to become an all round capable computer user. We were totally dependent on the one type of computer and the same computer programs’ (Student 43). Quite a number of students came to the realisation that they could learn computer skills independently. This is well expressed by Student 97:

I think the best way to tackle concepts and skills on the computer is definitely a trial and error process and to go from what you know and then delve into the unknown. The attitude you should take is one of curiosity and dive in and have a go. This is how most people I think solve problems they encounter on the computer, although a little knowledge in each area is a help but overall the willingness to have a go. Then to improve in each area is to take the time and play on the computer and the program you are actually working with. Throughout these nine weeks I think this is the most valuable aspect of computers I have learnt – have a go and you will learn things that you would never had known if someone had taught you.

Such realisations are likely to have a significant impact not only on these individuals as learners but on the students they will have in their classrooms as future teachers. As one individual stated, ‘It is much more important that students are taught how to find answers to their questions rather than the answers themselves’ (Student 31). As an educator I was encouraged that my teaching in this cycle was beginning to break down patterns of dependency. Many students’ comments indicated that they were moving along pathways toward lifelong and independent learning, as is evident in the following quote: ‘Often sitting a student at a computer with no (or very little) instruction can be the greatest learning experience’ (Student 85). A statement by one student in particular sums up the potential of prompting engagement in exploratory learning: ‘…the most challenging for me to consider as a learning concept, and yet paradoxically was the most fun and least stressful mode of learning – and now a preferred method’ (Student 28).

### 6.6 Case Study Analysis

A number of participants presented rich and illuminating stories which warranted in-depth exploration. Case studies were selected to illustrate two research agendas: firstly, the influence of the metacognitive approach on individual students’ learning; and secondly, individual manifestations of capability. The data used to compile these case studies is self-reported, drawing from reflective journal and survey data, together with (in some instances) my own reflections from interaction with the students. Reference is also made to these students’ self-assessment survey data (where available) and is provided in appendix 18. Six case studies of metacognitive engagement are presented, followed by a brief synopsis of the learning gained from this analysis. Six case studies of capability are then presented, three in full and three in summary, again followed by a brief synopsis.
6.6.1 Case Studies of Metacognitive Engagement

By focusing on individuals’ indications of both cognitive self-appraisal and cognitive self-management a picture can be established of the potential for learner empowerment and transformation through the metacognitive approach. The six case studies in this section draw on the framework of Paris and Winograd (1990), as detailed in section 4.5. Cases were selected on the basis of ‘richness’ or ‘interest’ of the story they told, the contrasting or ‘divergent’ data they presented or, in the case of Students 108 and 161, due to their outlying (low) self-efficacy scores. It was necessary to draw from journal data which was at least moderately ‘rich’, and the case studies are acknowledged as representative of students who were capable or willing to present ‘deep’ written reflections.

Case Study One: Growth through Necessitated Independent Learning

Student 108 was an external student studying the Unit while overseas. Prior to commencing, she used computers minimally for e-mail and locating an occasional Web site. While she did type university assignments, her survey indicated that she preferred to hand write them. Her frequency and duration of use were well below the cohort mean, as was her perception of encouragement by others. This student stood out in terms of her self-reported attitude, feelings and learning confidence, indicating that she would not choose to use computers in her teaching, that she was worried about breaking computers and that she would lack confidence learning, even with someone showing her how to do it. Her pre-semester self-efficacy data, in comparison to the cohort median and mode, is presented in appendix 18. Unfortunately, no post-semester survey data was provided.

Reflecting on her attitudes and feelings, Student 108 noted that her motivation to use computers had been hampered by perceptions of computer use not being fun, interesting or enjoyable, attitudes influenced by a family member modelling socially-stultifying computer use. The heavily jargon-ridden instruction by her school teacher(s) was also seen as diminishing enjoyment. When prompted to reflect on her past learning experiences, Student 108 demonstrated considerable aptitude for engaging in cognitive self-appraisal. She reflected that the ‘sink or swim’ nature of group instruction had caused her (notable attributional comment) to lose interest in computers. She identified a need to devote more time and practice to computers for effective learning, and that, as a strong accommodator, she needed concrete experiences to ‘remember and store new ideas and concepts’. This self-appraisal prompted cognitive self-management and action as she resolved to pursue learning contexts involving individual instruction and peer group learning. Student 108 paired up with a friend who ‘knows a little more than me’. Her journal documents her learning progress: ‘I have been working hard on my skills. I am pleased to say that I know a lot more about IT than I thought I did. I am also realising that it is easier than I thought it was. A lot of it all just seems to come back to common sense and logic’. This extract provides evidence of the student’s cognitive self-management and her resultant adjustment in self-appraisal. She notes that the peer interaction was affirming and provided more accurate personal feedback than group learning contexts had. This learning strategy also met her need for a ‘model’ for enjoyable computer use.

Initially Student 108 did not have ready computer access; however, mid-way through the Unit she purchased a laptop, describing this as a ‘wonderful learning experience’. Her decision evidenced commitment to self-improvement, as she took steps to address her
identified need for regular practice. Student 108’s comments on the value of the ‘10 tips’
section of the Unit provide further evidence of her aptitude for cognitive self-management:

‘Don’t panic’ sounds easy enough to do but is a lot harder to practice. Ever since the
time I can remember I have always panicked when using computers... I fast learnt
that if I did not panic the problem seemed so much smaller and even possible to fix.
What also helped the situation with not panicking was the discovery of the ‘Help’
button. This made my time working on the computer so much easier.

This journal extract emphasises this student’s capacity to adopt suggested strategies and to
make metacognitive choices and actions based on relevant approaches.

Student 108’s confidence was diminished towards the end of the semester when, working
in isolation from tutors or fellow students, she felt she could not complete the Web-site
assignment. When the student returned to Australia for a brief visit, a face-to-face meeting
was possible, during which we both realised that despite going about things in a slightly
different way she had, in fact, almost completed the Web site in a successful, but just
somewhat different, manner. This episode revealed not only her capacity for self-directed
learning, but also emphasised that despite her strong capacity for cognitive self-appraisal
and self-management, Student 108 was still quite vulnerable to lapses in confidence. In
reflecting on my own engagement in this situation, I became conscious of my need to be
more open to acknowledging diversity in approach to achieving tasks. My initial response
to her self-doubt had been one of concern that she had gone about things ‘differently’, and
hence, I assumed, ‘unsuccessfully’. Rather than having strong faith in her abilities, and our
capacity to work through the problems remotely, I was influenced by her exaggerated sense
of self-doubt, a reaction heightened by the difficulties of support at a distance. On deeper
reflection I realised that my reactions were coloured by a personal imperative to ‘assist’,
even though such offers of assistance sent messages of lack of faith in the students’
capacity to problem-solve themselves. On reflection, I realised that I needed to have greater
faith in students’ abilities, even when they were expressing a lack of such faith themselves,
and to reach a clearer understanding of their situation before offering approaches for
progression. Student 108’s reflections in summing up her experiences with the Unit
evidence the importance of reflection: ‘I have thoroughly enjoyed working through this
course. As I draw closer to the end of it I feel a real sense of achievement as I feel I have
conquered my fear of IT’.

Case Study Two: Discovering a Sense of Enjoyment
Student 161 described herself as having ‘fairly basic computer skills… enough just to get
by’. She had ready computer access in her home as a child, something she reflected on with
mixed emotions. As with Student 108, Student 161 indicated that her negative attitudes
toward computers were a result of experiences in Year 11 that ‘put up a big wall for me’.
She reflected that her efforts to adopt a positive approach to computers didn’t always ‘last
long’. This statement certainly seemed consistent throughout her journal. When engaging
in self-appraisal she consistently downplayed her abilities. Attitudes and anxieties, ‘not
wanting to learn and being afraid to learn’, lack of adequate skills and social pressures
(‘when others can perform tasks with ease yet I find the same task difficult’), together with
a convergent learning style were all seen as negative influences. Her ‘lack of focus and
scattered thoughts’, impatience and a desire to be doing more physical activity were also
mentioned. Time and again these impediments were cited with little or no indication of a
transition from self-analysis to self-management. Even when identifying that peer group
learning was a preferred learning mode, Student 161 insisted on focusing on its disadvantages: ‘When others find things easy and charge on ahead I become really disillusioned’. No steps, for instance, were taken to pair up with compatible others.

Student 161 explicitly stated that she had little confidence in her ability to learn through self-direction, yet went on to document her discovered a sense of enjoyment from independent learning, something which took her by surprise: ‘This Unit is amazing me more and more each time I visit... I’ve realised that it can be quite fun’. This was the response I had aimed to evoke. While never really confronting her cognitive strategies, the Unit had challenged her to experience different learning approaches and to discover her own capacity, and liking, for self direction. Most importantly, Student 161’s journal documents changes in her attitudes and values as is indicated in this final quotation: ‘More and more I’m seeing all the great stuff IT has to offer. I just wish it was easier to learn all about it... I have found this Unit to be very challenging yet I have learnt a lot. Computers will definitely have their place in my career.’

Case Study Three: Experimentation with Cognitive Self-Management Strategies

No pre-semester survey data was received from Student 4. While she described her skills as ‘quite basic’ she spoke of using a wide range of programs (word processors, Photoshop, Eudora and the Internet). She explicitly stated that the necessity to use computer skills in her teaching ‘adds pressure to understand the concepts’, and recognised her principal motivation as to be able to help others use IT. Support was important to Student 4, yet she seemed to realise the precipitous balance between help-seeking and independence. Not being satisfied to perceive these influences at face value, she stated that: ‘The majority of the time I try a few things and if they do not achieve the desired result I ask for assistance... My weakness is a lack of perseverance’. Here we see this student self-appraising the limitations to her learning (patience and persistence), but more importantly moving toward self-management: ‘I prefer individual instruction… however this is very impractical and it is necessary to progress to self-directed learning’. Student 4 provided repeated evidence of her growing independence, such as an increasing readiness to access ‘help’. Not stopping at implementing action, Student 4 evaluated her learning approach: ‘When I achieve an objective individually, my confidence increases and I am incrementally willing to attempt to learn new concepts’.

Throughout her journal, Student 4 demonstrated a number of strategies for structuring her metacognitive reflections, such as a list of factors identified as increasing and decreasing her anxiety levels. She also developed four personal goals, the first three of which were related to cognitive self-management:

- attempting to achieve individually first, rather than requesting help first and then trying it out secondly as this decreases my self-regulation/ motivation;
- spending more qualitative time at the computer, rather than quantitative experience in a familiar program. I need to try innovative methods of publishing/searching; and
- critically evaluating my strengths and weaknesses regarding information technology.
Somewhat contrary to these goals, but indicative of Student 4’s preparedness to experiment with learning strategies based on her reflections and cognitive insights, she then sought out a small group to work with in preparation for the Challenge Assessment. Again, Student 4 evaluated the successes of these small group learning strategies, stating that: ‘Peer sessions have allowed me to share and extend my knowledge, contributing to my positive feelings surrounding the use of computers as a teaching and learning device’. Student 4’s case study thus depicts a student engaging in sound metacognitive reflection and being prepared to experiment and evaluate different learning approaches, the outcome of which is best expressed by Student 4 herself: ‘I believe that I would try anything on a computer now just to see what would happen. As my confidence increases so does my motivation to attempt new and different things’.

Case Study Four: A Need for Externally Imposed Self-Management Strategies
Student 58 referred to herself in the first week of semester as ‘technologically stagnant’ and knew she would be on a steep learning curve. She had not used the Internet for assignments and was daunted by the prospect of creating a Web page. Her survey indicated consistently lower scores on all factors except attitude. Most obvious was her high anxiety level, as indicated in appendix 18. This student had used computers since primary school and had had home access since early secondary school. She had engaged in exploratory learning, as she describes: ‘This way of learning *did* work for me… I found it fun to use. No pressures, no duties, non threatening environment… honestly, I have never felt like that since’.

Although electing computer studies in years 9 and 10, a less than positive experience with the teacher and a sense of perceived irrelevance had soured her attitude to computers. Reflecting on a first year Unit in computing at University she reported that this group learning situation had not been effective. Tutorials in this Unit were described as ‘fast paced, overwhelming, highly pressured, impersonal, stressful, intimidating and humiliating’ and she had left tutorials one week in tears. ‘I am still scared to log onto the computers in the lab and I failed the last assignment, which required successful interaction with the Internet’. Reflecting on these experiences she stated that: ‘Perhaps I felt this way because the teacher is so advanced in IT that I feel that I am out of my league’.

Like Student 161, Student 58 tended to focus solely on the problems impacting on her learning. The first tutorial went too fast for her, she felt lost and was ‘beside myself with panic’. She also cited instances of feeling ‘under-challenged and condescended to.’ Like Student 56 she noted having trouble writing down notes in tutorials and then ‘blamed’ things on her inability to ‘remember’ steps. Interestingly, this student used a different word processing program at home and transference of directive steps would not have been appropriate anyway. Again, this was a source of ‘blame’ for an inability to practise and re-enforce learning. While evidence was present of cognitive self-appraisal, this student provided few examples of self-management. For instance, while identifying herself as ‘a perfectionist’ she provided no resolve to address these judgements and beliefs through strategic action. Student 58 continued that she was ‘suffering totally from the internal pressure I put on myself to succeed as well as the anxiety I suffer for not being a competent user of the Internet, Web or e-mail’. Again she developed no strategies nor resolved to change the situation.
It was evident that this student’s attitudes were not confined to computers or the Unit when she indicated that she hated University. A further clue here is her apparent resistance to self-directed learning: ‘I have always been one of those students who like to be directed by the teacher. I need teacher input as I am more a passive kind of learner than active’. Again, no cognitive self-management is proposed, which is an interesting contrast to Student 8 in case study six. The closest indication of a movement towards self-management comes in the following statement: ‘I still feel an element of hopelessness when I am in the tutorials however I feel that I am now stronger, I am now ready to break the barriers that I feel have been restraining my learning so far and take the risks necessary to tackle this new technological phenomenon’. Here Student 58 has identified ‘risk taking’ as an important learning strategy, although her reflections seem a little shallow and without personal conviction, written perhaps to provide what she felt I wanted to hear. The survey indicated that her self-reported attribution was internal, something that surprised even her! While at first describing herself as ‘an internally unstable basket case’, on deeper reflection she stated that ‘I feel that maybe I am in more control over my life than I had previously believed’. This statement is interesting, indicating that she was conscious of her tendency to level blame for her difficulties. It also provides evidence that the inclusion of the attributional content in the Unit was successful in challenging individuals to self-manage their attributional beliefs.

Although emphasising her dislike of having to participate in the Unit, there were a number of aspects she identified as positive. These included: the challenge assessment, after which she was ‘satisfied with her improvement’; the exploratory word processing tutorials: ‘I really enjoyed trying to conquer the mission… I really enjoyed learning in this way’; and the cognitive modelling tutorial which ‘...seemed to be working toward instilling a love of learning in the students rather than worrying over the actual computer skills each individual student has’. It is fitting to conclude this case study with Student 58’s own reflections in summing up her involvement in the Unit. ‘Having this Unit online has forced me to face this fear... As much as I hated Renata at the beginning of the semester it did help me… the change I will make from this result is more courage and determination to hold my head higher, to face the Internet, Web and e-mail and conquer them all’. Here we can see that the metacognitive approach to the Unit can prompt students to see benefits in their learning ‘struggles’ – to take on challenges and realise that they need to be active participants in the learning process.

Case Study Five: A Need for Un-Pressed and ‘Leisured’ Learning Contexts

Prior to attending University Student 7 had had no contact with computers and ‘no inclination to change that situation’. When deciding to return to study she ‘realised that things would have to change’. She had attended a preparatory computer course but ‘couldn’t even control the mouse’. Strong in resolve she had decided to have private computer lessons. Attending only one, she reflected that ‘I think that I was too scared and not having my own computer made these lessons a waste of time and money’. Like a number of other students she had participated in a first year computer unit at University which she ‘scrapped through amid tears and total frustration. It was the only time in first year that I ever touched a computer’. She hand wrote assignments in first and second year and paid to have them typed: ‘I hated computers with a passion’.

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It was not until her third year at University that Student 7 started using computers a little more, ‘purely on a need to know basis and in situations where it was being practically applied. I was not being overloaded with excess terms or techniques’. A visit to a family member in that year increased her skills, knowledge and confidence. Her relatives convinced her of her inability to damage the computer and provided her with a ‘home made’ computer that she could take home. This visit marked a critical point of change for Student 7 who began upon ‘a steep learning curve that is going from strength to strength... you can play around at your leisure and learn along the way, this takes away a certain degree of pressure and anxiety’. Student 7’s responses to the self-assessment survey are presented in appendix 18. Interestingly, the quantitative data does not adequately represent the ‘story’ being told, particularly in terms of family support. Responses regarding perceived usefulness, attitude, anxiety (feelings) and learning confidence were all well below cohort mean.

Student 7 did engage in cognitive self-management, although perhaps not to the same degree as Students 108 and 161. However, she did acknowledge that she was building strategies for seeking support and for minimising her sense of anxiety:

Don’t get me wrong, I am no expert and realise I still have a lot to learn. And yes, I make mistakes, am still prone to panic when things go wrong but I have a more positive attitude. If the computer can’t help me there are people who can make it… I can now actually say that I like computers, they are useful and not as difficult to learn as I once believed. That is a statement 4 years ago I would never have thought possible!

It was not just the Unit that assisted her to make these attitudinal transitions; however, aspects of the Unit certainly assisted in the journey. The Computer Skills Chart, for example, was seen as a positive inclusion, assisting her to realise what she could do, and the Challenge Assessment was also viewed as empowering: ‘This was unlike any test I have taken before. I’m fairly certain this was related to the fact that you had three attempts to pass… It certainly wasn’t a breeze (at least not for me) but it wasn’t as difficult as I anticipated. There were times of slight panic but nothing like I imagined’. One of the most insightful statements made by this student, and one which indicates her growing learning independence was the following: ‘At this rate I won’t need to do a night computer course next year’.

Case Study Six: Transforming Attitudes and Approaches to the Unit

Case study six powerfully depicts the potential influence of the metacognitive approach on computer learning. Student 8 began his journal in a most confronting manner. He was ‘up front’ about not having done much work on the Unit until week 9. He was critical of the lack of contact time and the ambiguous expectations (as he described them) of the Unit. He cited having come to one tutorial and having learnt to do one new thing in the time: ‘It felt like it had been a waste of my time, so I didn’t go to any more’. As he further commented: ‘I have found the fact that the course is so open and unstructured has meant that the demands of other subjects with more structured time, contact with tutors and explicit expectations often get put before this subject’. As I started reading his journal I felt, of course, quite confronted, although by no means perturbed. I was grateful for his honesty and critique, both of the Unit and his own reactions.
Student 8 described himself as ‘moderately computer literate but not too devoted to checking e-mails and not very interested in the World Wide Web’. He did, however, have a unique ability for reflection and an intense capacity for cognitive self-appraisal. Up front he acknowledged that: ‘I find the idea of an online unit off-putting because there are no tactile resources. I don’t like sitting in front of computers for long hours and my only access to computers is in the University computer labs.’ What makes Student 8’s story so relevant is his appreciation for, and growth and change through, the Thinking module, which he states ‘greatly helped develop my thinking and understanding of this Unit and the issues involved with technology and education’. Unlike many other students, Student 8 gained a great deal from the learning styles section, identifying himself as strongly divergent and assimilative: ‘On reading the strengths and weaknesses of the four types I could see a lot of truth to this’. Not content to settle with his identified tendency to be ‘paralysed by alternatives’ he reflected:

This is a very significant point and explains to some degree why on the Web and in online learning situations such as this Unit I feel totally overwhelmed by information and options. I feel overloaded... with the proliferation of different sections, pages and sites and the endless links leaving me feeling just that – paralysed by alternatives.

Progressing beyond this cognitive self-appraisal, Student 8 identified his need to develop ‘some qualities and abilities that don’t come naturally – take risks, get things done, solve problems and reason through things, and of course start to become more comfortable with making mistakes and learning from them’. Speaking further about hyperlinks he stated:

Being aware, for instance, of how hyperlinks confuse learning for me can help me to act in ways to minimise this, such as not clicking on every hyperlink that comes up but reading through the text and ignoring them until I am comfortable with my understanding of the information on the page. This may alleviate the distress caused by being forced to make decisions every paragraph or so.

Identifying these issues as contributing to his difficulties in interacting with the Unit materials, Student 8 noted that he ‘would find it easier if there was a sequential flow of things that have to be done.’ Having identified the issues he went on to talk about an alternate structure and to draw an image map for himself of how he should work though the materials. As Student 8 continued through the semester, his journal documents some profound and transformational cognitive realisations, as evidenced in the following extract:

I have become aware through my teaching practice how passive I often am as an individual and a learner... In many activities I am reluctant to participate, to try, to experiment, to be active and to take initiative. This involves a fear of failure, of stuffing up, of not being thought well of, of being ridiculed, of letting others down, of failing to meet expectations or satisfy requirements. It is quite a serious issue that spans my whole life – study, life decisions, career, everyday duties, choices, activities, sports, relationships – and everything else, not just learning about computers. It is important here that I recognise and acknowledge that my difficulty in engaging in computers and in online learning is due to internal factors. I need to make attributions that accept the responsibility for my own learning – with an internal locus of control and seeing the learning as able to be changed. The problem is in me, and I can do something about it. It will be hard. I will have to take risks. I will make mistakes but I will try and keep trying. Hopefully I can develop flexibility and the ability to learn in different ways as best suits the situation, making use of all four cognitive modes and learning style strengths.
Through such realisations Student 8 turned his reflections back to his initial criticisms of the Unit. He acknowledged that he ‘was making subjective statements and not discerning between my own overwhelmed emotional responses and objective analysis of the situation.’ He went on to cite other circumstances which had influenced him at that time. Based on his reflective insights he acknowledged that the Unit demanded ‘initiative and action on the part of the student, and I did not have the energy or vision to see this opportunity and take it.’ In summing up his experiences, Student 8 was again prepared to acknowledge the personal growth that had occurred for him through active engagement, personal struggle and metacognitive reflection: ‘Quite obviously this Unit has been hard (very hard) for me, but I can see that perhaps forcing students to be almost totally on their own may better equip them for ongoing learning situations in IT where this may be the case’.

6.6.1.1 Learnings from the Metacognitive Case Studies
Analysis of these case studies challenged me to re-examine many of my assumptions. In terms of the self-efficacy factors I was prompted to realise that use of computers by others can be a negative influence if these patterns of use are not perceived positively. Past experience, particularly at school, can also have a strongly negative influence. Furthermore, externally imposed imperatives (for example, a requirement to type assignments) is not enough to counter strong anxiety. The case study of Student 58 indicated the need to be aware that negative reactions to computers, or the Unit in particular, may reflect broader issues such as attitude to University or learning more generally. Reflecting on computer learning contexts can influence the pursuit of more appropriate learning strategies and students can change in their appraisal of preferred learning contexts when challenged to ‘experiment’ with alternate approaches. As a teacher, I need to be careful to encourage lateral approaches to achieving goals. The case studies did lend clear support to the potential benefits of the metacognitive approach. Reflection could assist students to perceive benefits and value in their learning ‘struggles’ and could add a transformational perspective to learning challenges. I also realised that some students required external ‘guidance’ to broaden their repertoire of learning strategies. Methodologically the case studies demonstrated that reflective data can sometimes contradict survey responses, and emphasised the importance and value of mixed method approaches.

6.6.2 Case Studies of Capability
In this section three full case studies of individuals who demonstrated characteristics of capability are presented, followed by three brief case studies. In making these selections I drew from the list of characteristics identified by students, as described in section 6.4.1.

Case Study Seven: Assuming Self-Responsibility
Student 19 portrayed many of the traits which might be considered indicative of computer capability. She was, for instance, highly confident: ‘Even though I don’t know how to do everything on the program, I feel confident that I would be able to figure out just about any application’. Student 19 was an independent learner, reflecting that she had learnt most of her word processing skills through exploration and experimentation: there ‘is something about learning to do it yourself that is more valuable’. Later in her journal she explicitly connected exploratory learning strategies with higher retention. The necessity of using IT at University was perceived as a major incentive to her skill development and experiences
such as workshops, assistance from friends, self-directed learning and the purchase of her own computer were acknowledged as contributing to her capability.

Student 19 evidenced a great love of learning new computer skills and knowledge. She cited strategies such as sourcing software updates, reviews, tips and general information: ‘I hope that each time I use a computer I come across something new’. Despite this, she acknowledged the importance of perceived need: ‘there is still much I don’t know about these programs, but have yet to find myself in a situation where I need to know these advanced functions’. Such comments also highlight Student 19’s capacity for cognitive self-appraisal. In exploring this further she explicated her sense of self-responsibility for her learning, linking this to internal attribution: ‘I am a proficient IT user but also realise that there is much I do not know, and that it is up to me to seek it out’. In this student’s case, encouragement by others and frequency of use by others were well above cohort median. Frequency of use, support and attitude were fairly ‘average’ and feelings were somewhat below cohort median, as indicated in appendix 18.

Case Study Eight: Confidence and Self-Direction as Central

Student 39 provided a further case study of capability. She had studied computers in Year 7-10 and had gone on to learn and teach family and other adults. In her overseas school placement (while studying this Unit) she had been embraced as the school’s computer ‘trouble-shooter’ and had networked the school through trial and error, having never been involved with networking previously. Using the platform test of capability (see section 6.5.3) Student 39 was most familiar with PCs and knew very little about the Macintosh platform: ‘I don’t find it that difficult to change from one to the other. It’s just that some options are in different spots’. Effort and perseverance were most evident in this student’s journal, and this was depicted through her description of learning to use the University databases:

I learnt how to use the University’s Library databases the hard way I guess. I got online and just played around until I figured out what exactly I had to do to find something. It took me the first half of first year but by the end of that year I had mastered it. Then the University changed it a little so I had to re-learn bits. I had tried one of those sessions where they teach you but I found that not very beneficial because of the way I learn so I just tried and tried until I got the results I wanted.

While she did identify herself as being ‘capable’ she reflected that: ‘I personally don’t think I’m that great. What I think everyone else sees is that I can sit at a computer, think critically and logically about the problem and solve it... I’m not afraid of doing something that may “break” the computer’. Confidence and a willingness to try new things were seen as critical: ‘I believe anyone that has confidence in their ability can use computers effectively’. Student 39 also saw herself very much as a self-directed learner: ‘I learn by using and investigating various programs and software. I learn from mistakes, use the ‘help’ or read manuals that come with programs... and observing others’. Her comments were consistent with my own perceptions that independent learning was highly effective in computer learning contexts: ‘most proficient IT users learn by self-directed learning’.

Student 39’s story provides important insights into the factor of support. While still significantly above cohort mean she saw support as detracting from her self-efficacy, as indicated in appendix 18. For her, it was easier and less time consuming to learn or problem solve from manuals or ‘Help’ and, as she emphasised, ‘most people come to me
for help’. This highlights that capable individuals are perhaps more likely to report lack of support, as they may themselves be the ones offering support to others and may not themselves have others to turn to. That said, Student 39 did agree that the self-efficacy factors were influential in developing capability: ‘I can clearly see that having confidence in my ability, having positive attitudes and feelings and some form of support behind me has meant that I have been able to succeed in becoming a proficient IT user’.

Case Study Nine: Enjoyment of Independent Learning

Student 37 was an adept independent learner. Aside from a brief introductory course at the beginning of his University degree, he had learnt his skills over three and a half years of self-directed learning: ‘There is no denying that group and individual instruction has been very important in the initial stages of developing my computer confidence, but the greatest steps have been via self-directed learning’. This student was an advanced Macintosh user who met the challenge of transferring to a PC during tutorials, reflecting that it ‘felt very strange to begin with, but by the end I was able to apply general computer logic and find my way around easily’. He later described his successes as ‘really very gratifying’.

This student’s journal expressed an enjoyment gained through experimentation: ‘I often set myself little challenges and spend time finding solutions even if it is not really relevant in terms of speeding up certain operations. I have always been interested in the why and not just the what, and this is why I think self-directed, discovery type learning works for me’. Here again the student is engaging in cognitive self-appraisal, acknowledging the value and importance of his own active role in learning: ‘I need to reconstruct the whole process myself before I am confident in my understanding of it’. This is not to say that assistance was never required; what characterises Student 37’s story is his ability to recognise when help was needed, even if that was a ‘rare occasion’. Indicative of his capacity for self-appraisal and self-management was his comment that: ‘Even if I do rely on someone to tell me what does what I am not satisfied to accept it as just an arbitrarily assigned command and will make sure that I can derive some sort of logic within the sequence before moving on’. Student 37’s journal provided some deep reflective insights into his self-perceived metacognitive judgements, beliefs and choices. For instance, he identified that much of his approach derived from ‘an element of self-sufficiency’ in his personality. ‘I simply do not want to rely on others in an arena where change is so rapid’. Student 37 generalised from his experiences stating his belief that computer technology ‘is one such area that requires an individual (especially one that lacks experience and confidence) to just sit down in front of a screen and play around for a good while’.

As indicated in appendix 18, this apparently capable individual was significantly below cohort mean in terms of encouragement by others and slightly below cohort mean on frequency of use by others. He commented directly on this in his journal stating: ‘If I had felt force then I don’t think that I would have adapted to technology quite so well’. Student 37’s responses were slightly below cohort mean in terms of perceived usefulness and attitude, yet in his journal he emphasised the value of technology in his lifestyle. What was evident in this case study were significantly higher than cohort mean responses in relation to support, feelings (anxiety) and learning confidence. Student 37 acknowledged the importance of support noting that: ‘Having the ability to find out the necessary information is more useful than having an in depth knowledge in a limited range of fields’. Student 37 expressed mainly internal attribution, but later reflections were congruent with the
Other Capability Case Studies

Three other students merit reporting on briefly to highlight contrasting and divergent data relating to computer capability. Student 79’s case history depicts high capability despite no home access and no explicit teaching at school. As with other students, group instruction at university was perceived as ineffective with low retention and transference and she had learnt though ‘play’, exploration and self-direction, drawing on friends for support and assistance.

Student 89 had been a computer analyst/programmer for a large financial institution. She did not see herself as a ‘wizz’ and acknowledged there was much she didn’t understand, while still seeing herself as ‘capable’. This student did not have the broad base of experience which others had and was only just beginning to use Windows, e-mail and Internet, having avoided e-mail ‘as I did not understand its uses or capabilities’. This was significant in that, despite her level of learning capability, her skill development was still reliant on perceived need.

Student 41’s journal also depicted a ‘capable’ computer user but highlighted a further issue, namely the level of prior knowledge required for effective learning: ‘I have usually found that I need only be shown once how to perform a task on the computer and I can remember how to do it at a later date. Also, I can usually work out through deductive reasoning the best way to go about performing a task, provided I am generally familiar with the basic set-up of the program at hand’.

6.6.2.1 Learnings from the Capability Case Studies

These six case studies are indicative only and a number of other individuals’ stories could have been presented. How do these stories develop our understanding of the nature of capability? Firstly, and perhaps most importantly, we see little discernible pattern in these individuals’ background and history. Not all had exposure in their youth, not all had supportive families or encouragement from others. For some, support was perceived as low and they had learnt to rely more on their own efforts; for others, support had been a significant contributing factor. Seemingly capable computer users could provide low responses in areas such as feelings or anxiety. Frequency and duration of use were high for most individuals, but notably not for Student 79. The one factor that did seem to be consistently high, reinforced through both the survey and the journal data, was the importance of perceived usefulness. Even for individuals who had an intrinsic love of learning, ‘perceived need’ was still critical. As in the metacognitive case studies, these stories emphasised the value of both qualitative and quantitative data and the importance of individual case histories in understanding the complexity of factors that influence an individual in their computer use and learning.
6.7 Was the Metacognitive Approach Successful?

Thus far this chapter has presented the action and observation phases of cycle 2 and has incorporated reflections on the data throughout. This section reflects on the overall success of the metacognitive approach in cycle 2, challenging my own assumptions about the cycle according to the following reflective prompts:

Section 6.7.1 What has changed since cycle one?
Section 6.7.2 Was it at the expense of skill development?
Section 6.7.3 Was it at the expense of adequate support?
Section 6.7.4 Can metacognitive reflection change behaviour?
Section 6.7.5 Will the metacognitive approach influence teaching processes?
Section 6.7.6 What was the value of the self-assessment survey?
Section 6.7.7 Was reflection itself a limitation?
Section 6.7.8 How did this research compare to others’ approaches?
Section 6.7.9 How might I improve the approach in subsequent cycles?

6.7.1 What had Changed Since Cycle One?

Having engaged with the reflective journals, there was little doubt that significant changes had occurred between cycle 1 and 2 in students’ reaction to the Unit and in their approaches to computer learning. At one level this transition was only to be expected given my inclusion of the theory and reflective prompts in the Thinking module. While only a small number of students in cycle 1 had included reflections on psychological, cognitive or strategic influences on their engagement with computers, in cycle 2, almost all students did so, although notably with varying degrees of depth. Even more notable was a more general change in student reaction to the Unit. It will be remembered that functional issues were a major concern for students in cycle 1. However, in cycle 2 such issues were rarely mentioned, and where they were raised they were often considered in a more pro-active or positive light. This change in student reaction might be attributed to successful modification to the Unit design, as summarised in section 5.4. At another, perhaps intuitive level, I felt that a fundamental change had occurred in students’ preparedness to accept challenges, to be positive about experimenting with new learning approaches, and to view these as opportunities for personal growth. Time and again students spoke of taking responsibility for their own learning. They were less likely to allocate ‘blame’ for any difficulties encountered but to seek solutions and implement strategies to deal with these issues themselves. The following quote is worth citing at some length as it illustrates this fundamental transition:

I have had to extend my repertoire of skills to encompass a whole new way of learning. I found this a really difficult task. There were often times when I had serious setbacks in my progress because I had come to a place where it got a little difficult. When I first started to go through the material in this Unit I almost didn’t start because I found it difficult to find the pages. I didn’t have the patience to sit and keep trying until I had found the right part. I needed to use a few of the other
learning styles in order to find where the material was. This is just one example of where this course has extended me. I have had to continually move away from a place where I felt comfortable, to a place where I have had to take risks and risk being wrong (Student 176).

This preparedness to accept challenges was fostered by the explicit framework of metacognition and, in particular, awareness of learning independency and its relationship to computer capability. ‘This lack of confidence I feel is due to my reliance and dependence upon other people to solve my computer problems and my reluctance to take the initiative towards my own exploratory and self-motivating learning experiences’ (Student 154). Another significant difference between cycle 1 and 2 was that a greater percentage of students spoke of computer learning as a lifelong endeavour. Whereas in cycle 1, students’ primary concern had been to meet the requirements of the Unit, students in cycle 2 were talking about their learning into the future: ‘This Unit is just the beginning of a continuous learning curve’ (Student 160).

6.7.2 Was it at the Expense of Skill Development?

It was important for me to consider Derry’s (1990) comment that approaches to learning procedural knowledge which are focused on reflection ‘may tempt some into viewing procedural skills as lowly routine performances that are relatively easy to learn and that should take a back seat in modern curricula to the so called higher-order thinking capabilities’ (p.366). Was I falling into such a trap? Perhaps by placing emphasis on cognitive and affective factors and learning strategies I was decreasing the capacity of the Unit to deal directly with skill development. In reflecting on this issue I was reassured by what had not been said by students, as much as what had been said. No students raised this directly, and only a small number raised it indirectly. Student 33, as quoted earlier, stated that: ‘The more skilled you become, the higher confidence you have to try new tasks using these skills’. Indirectly this student might be seen as asserting that skill development should be of primary focus in computer education. In searching for the dissenting voice, the only other students I could locate were those with whom I had verbal discussion with, as described in section 6.5.4.

The more resounding view expressed by students supported the value of the metacognitive reflection process. Student 17, for instance, reflected that ‘people’s attitude towards technology is their biggest enemy, rather than their lack of natural ability’ and Student 15 noted that ‘developing an attitude towards computers that doesn’t place too much importance about how skilful you are in their use has lead me to the position I’m in now that I don’t feel pressured or anxious’. The metacognitive approach had potential in fostering higher self-efficacy, as evidenced by Student 159:

Before starting this Unit I believed my computer ability to be a direct reflection of limited skill. However from analysing the responses to the self-assessment survey I now know my level of self-efficacy is influenced more by attitude and anxiety rather than skill. Subsequently I feel that my learning would be best approached through activities that focus on providing positive learning experiences rather than those that focus on fostering specific IT skills.

These and many other statements reinforced my initial belief that a focus on psychological and cognitive dimensions offered potential for a more long-term influence on students’ capability as opposed to competency. These views are well supported by Student 105:
If I believe that technological literacy is not about acquiring specific skills, but rather learning ways of thinking and operating to deal with new situations... then I have more chance of becoming an effective computer operator and teacher of IT... I agree that if I am able to change my attitude and beliefs about my own limitations and develop strategies like persistence, flexibility and ability to follow my intuitive insights, then I will become more capable and less anxious about the process of teaching (and learning). From my own experience I understand that in order to gain long-term results, metacognitive strategies are more empowering rather than learning to follow directions by rote... Already as a result of this course I trust my feelings more and feel less fearful. I hope to develop these skills so that I feel capable and competent to use IT in my teaching, despite not having reached the highest possible level of technological proficiency.

6.7.3 Was it at the Expense of Adequate Support?

Confronting as it was, I also needed to consider whether my focus on fostering independent learning was at the expense of providing adequate support. It was not my intention to leave students feeling isolated, and I took every opportunity to emphasise that support was available to students if they required it. What I came to realise, however, was that although many students were seeking and receiving that support, some, for whatever reason, did not seek assistance or convey to me that they were having difficulty. Statements such as the following also made me confront just how difficult it was for some students to engage in independent learning:

I have had to work so hard on this Unit, my self-confidence was shattered, and I even considered quitting the course. It was only after reading about self-efficacy, and applying the principles to myself that I was able to continue... I reframed the hard work I was doing in terms of my goals. I knew that I had a poor skills base when I started, and had determined to change that. The effort needed to do this was greater than I had anticipated, and it was demoralising to witness the ease and confidence of… many fellow students.

I acknowledged that I needed to confront my beliefs about the value of self-directed learning as well as to understand better why some students were seeking support and assistance and others were not. These were challenges addressed in cycle 3.

6.7.4 Can Metacognitive Reflection Change Behaviour?

The question of whether metacognitive reflection can promote change in behaviour was perhaps the most challenging issue to emerge for me in cycle 2. I was prompted to reflect upon the statement by Mezirow (1991a) that ‘reflective discourse and its resulting insights alone do not make for transformative learning. Acting on these emancipatory insights, a praxis, is also necessary’. As was indicated in the introduction to this thesis, a major limitation of this research was my inability to engage with students in a longitudinal sense, or determine long-term change in learning or computing practice. I was mindful of Paris and Winograd’s (1990, p.21) comment that ‘the significance of what subjects report about their own self-appraisal and self-management can be deeply significant or epiphenomenal depending on the impact it has on their own behavior’. I acknowledged that students may be reporting change if they perceived that this was what I wanted to read and also that increased computer engagement throughout the Unit may not translate into long term change or increases in computer use overall. I was, however, also prepared to accept that students’ reflections on the need for change in action, or their identification of strategies that they might adopt in future, at least represented a first step in a transition in practice. Mezirow (1991b), for instance, notes that reflective interpretation can correct distortions in
our reasoning and attitudes, testing consistency between actions and values, assessing progress toward goals or confirming or dis-confirming our interpretations.

The Unit *did* provide ample opportunity for students to experience alternate learning approaches in active ways. It prompted students to experiment independently and decide upon strategies and contexts for learning. Some students were already effective independent computer users and for these individuals there was not the same imperative for change. The level of engagement with the Unit and the metacognitive approach also varied considerably between individuals (as explored in section 6.7.7). Students who engaged in more shallow reflection generally provided less evidence of change in computer learning behaviour. That said, the journal data *did* provide ample evidence that many students were trying new approaches, reflecting on them and making decisions about how they would adapt and change their learning approaches in the light of their experiences. In many respects it was advantageous not to over-emphasise behaviour change; as Mezirow (1991b, p.358) recommends, ‘transformative learning includes learners making informed decisions of how and when to act upon their new perspectives’. Although the metacognitive approach may not have evoked behaviour change for all individuals equally, the benefits for those it did influence justified the approach.

6.7.5 **Will the Metacognitive Approach Influence Teaching Processes?**

I would argue that the data were overwhelmingly supportive of the *potential* of the metacognitive approach in influencing teaching practice. Student 168, for instance, went through a similar process to me in realising that the way she had taught computers in her third practicum was far removed from her preferred mode of learning: ‘Lessons I taught were teacher directed and little time was given for exploration… In the future, however, I intend to allow children to have more exploration time and discussion time’. Many students drew on their own learning challenges to shape their espoused teaching values: ‘I believe teachers need to remember the need for their students to be challenged in order to maintain interest’ (Student 31). What was most refreshing were the number of students who spoke of their desire to foster self-directed learning approaches and computer capability amongst their own future students. To quote student 31: ‘It is much more important that students are taught how to find answers to their questions rather than the answers themselves’; and again, Student 85: ‘Often sitting a student at a computer with no (or very little) instruction can be the greatest learning experience’. Such statements are strong indications of the success of the metacognitive approach and its potential to prompt students to challenge traditional teaching approaches through critical reflection.

6.7.6 **What was the Value of the Self-Assessment Survey?**

While the quantitative data collected via the self-assessment survey was beneficial in establishing a ‘snapshot’ of the students reactions at a particular point of time, the reflective data revealed a far more complex picture of the influence of these factors on the individuals themselves. The subjective interpretations and personal histories which students brought to the learning context influenced how they perceived the factors ‘measured’ in the survey. Examples of this included the challenges presented in section 6.4.2 to the dichotomous nature of factors such as support and encouragement by others. While the analysis of correlation had been interesting and worthwhile, the inconsistencies in meaning behind the data, as revealed though the journals, rendered this data a simplification. The
survey had proved beneficial in case study analysis, enabling me to describe an individual in relation to the cohort and had also been useful in analysing pre- and post-semester data, to better understand the nature of the change occurring for individuals. The real value of the survey, however, had been as a reflective prompt for students themselves. While I was not convinced that statistical analysis of the data need occur in subsequent cycles, I did see value in retaining the survey as a reflective prompt.

6.7.7 Was Reflection Itself a Limitation?

While the approaches which were employed in cycle 2 did appear to have had an influence on the learning of a significant number of students, the capacity and inclination of students to engage in either cognitive self-appraisal and/or cognitive self-management varied significantly. Two factors appeared to be influential: firstly, the student’s depth of engagement with the metacognitive content of the Unit; and secondly, the student’s level and depth of self-reflection. While many of the students, including those quoted throughout this chapter, did engage at a deep level, there was a notable portion of journals that were minimalistic and contained a very shallow level of reflection. It was necessary for me to consider a range of issues that might have impacted on this. Either these students were not capable of reflecting at a deep level or they were simply not prepared or motivated to do so. Perhaps they were not willing to open up to me as a lecturer. As a written journal, reflection relied to at least some extent on writing ability and the self-discipline of making time to reflect. A further limitation I could perceive was the lack of dialogue inherent in the process. As stated by Mezirow (1991a, p.354) ‘it is through dialogue that we attempt to understand – to learn – what is valid in the assertions made by others and attempt to achieve consensual validation for our own assertions’. In any case I realised that I hadn’t placed enough focus on assisting students to reflect. As Mezirow (1991a, p.359) continues, ‘it is not that some adults are inherently incapable of thinking abstractly, becoming critically reflective, or making reflective judgments. It is only that they have not learned how to think in these ways’. I had made an assumption that the student group, predominantly fourth year BEd and DipEd students, would be experienced in, and capable of, reflective learning. These were assumptions I needed to re-examine.

Turning to a more thorough engagement with the literature, I became acutely aware that I had adopted the reflective framework almost ‘blindly’ with little self-questioning as to the assumptions underlying my decision, or the potential problems and difficulties likely to be encountered. As was outlined in section 3.1.2, I was familiar with the tradition of reflection in teacher education and adult education more broadly, and I had considered it consistent with the philosophical, pedagogical and methodological approach to the Unit and the research. While I had read about the use of reflective journals, and had considered the ethical issues surrounding their use as a source of data, I had not embraced the literature documenting the potential difficulties entailed in promoting reflection (Boud, Keogh & Walker, 1985a; Campbell-Evans & Maloney, 1998; Graham, 2001; Hatton & Smith, 1995; Main, 1985; Paris & Winograd, 1990; Schön, 1987). Engaging with this literature I realised my approach had been naive and simplistic. As Candy (1985, p.114-5) has stated, ‘reflection is not facilitated simply by allowing time for it, or even by offering questions to encourage thinking and critical awareness’.

Interactions with colleagues at this time led me to realise that others were struggling equally with such concerns, and that the literature revealed there were no easy solutions.
Three of my ‘critical friends’ were also engaged in reflective teaching processes and were encountering similar issues surrounding the level and depth of reflection from students and research participants. I began to engage with my colleagues more closely in seeking strategies and ‘answers’ (points I return to in Chapters 7 and 9). I was prompted to realise that I had not really defined what I saw as ‘good reflection’ and I acknowledged, like Bennett-Levy (2002, p.193) that ‘depth is easy to recognise in written reflections, but difficult to define’. This acknowledgment was particularly concerning as I read Ixer’s (1999) argument that learners become vulnerable in the assessment relationship where concepts of what constitutes reflection are poorly formed and may not be consistent with the understanding of students. As I moved into cycle 3, I realised that I had not provided any real examples of metacognitive reflection to the students. While I had done this in a small way by including an extract of my own reflections which had led me to the research, I had not demonstrated a range of reflections which might be included with specific reference to the requirements of the assignment and the Unit. One of my concerns lay with the ‘written’ format of the journals. This approach might be considered as lacking the social dimension identified by a number of writers as important in supporting reflection and metacognition (Henderson & Cunningham, 1994; Ixer, 1999; Kemmis, 1985; Newman, 1994; Paris & Winograd, 1990): ‘Group discussions, dialogues and shared articulation of problems, frustrations and fears allow teachers to diagnose students’ processes of thinking and decision making and allow students to understand each other and become aware of alternative problem-solving strategies’ (Newman, 1994, p.294). These were issues I needed to consider in planning cycle 3.

6.7.8 How did this Research Compare to Others’ Approaches?

In section 4.5.2 I noted the co- incidental similarity between my research and teaching approach and that employed by Ropp (1997; 1998) in her own work with pre-service teachers. It will be remembered that Ropp explored five individual characteristics: attitude toward technology and computers, technology competence, computer anxiety, computer self-efficacy and computer coping strategies. This section briefly outlines the similarities and differences in our studies and findings.

Ropp’s student group (n=50) was similarly drawn from primary and secondary sectors (in almost identical proportions) although Ropp’s sample had a higher proportion of males (36% compared to my 27%) and a higher proportion of students under the age of 30 (86% compared to my 69%). Ropp’s research employed mixed method approaches, including psychometric surveys, evaluative surveys (termed ‘fast writes’ by Ropp) and interviews. Most salient in Ropp’s study was that 50% of students indicated that most of what they knew about computers was self-taught. Over half of Ropp’s students reported never having seen their K-12 teachers using computers and 23% of students reported never having observed their college teacher using technology. This latter result is in marked contrast to the high level of computer use by lecturers at Southern Cross University. Ropp’s study indicated that almost all the individual characteristics were significantly interrelated. As in my own research, gender was not significantly related to any of the characteristics measured, and age was only related to ease of computer access and number of K-12 teachers that preservice teachers remembered utilising computers.

Of greatest interest, however, were Ropp’s findings regarding the use of the survey instrument as a pedagogical and metacognitive tool for students. Ropps ‘fast write’
technique revealed that 60% of students moderately agreed or agreed that they gained an increased awareness of technology in education from completing the survey (22.2% disagreed or strongly disagreed). Eighty-one percent (81%) of students moderately agreed, agreed or strongly agreed that completing the survey increased their self-awareness of computer anxiety, self-efficacy and attitudes (11.3% disagreed). Ropp also utilised a class discussion approach based on the data from the survey instruments. Unlike the self-analysis prompted in my Unit’s Thinking module, Ropp’s study involved students reflecting on their relationship to the group based on the aggregated student data. Through this approach, 91% of students became more aware of others’ experiences and attitudes while 60% became more aware of their own experiences and aptitudes. More interestingly, 72% of students indicated that the class discussions initiated plans for helping others to use technology in teaching. In terms of the post-test, Ropp’s students reported having used more computer coping strategies by the end of the semester, and changes were greatest for students who were least confident at the beginning of the semester. This is consistent with my own research findings. Ropp’s study documented no significant change in students’ attitudes to technology, their computer anxiety or their computer attitudes. Like other researchers already cited (McInerney, McInerney & Sinclair, 1994; Rosen, Sears & Weil, 1993), Ropp questioned whether increased experience with computers actually reduces computer anxiety. My own research, however, documented significant changes in computer anxiety and attitudes, quite possibly due to the combined influence of the type of experiences and the metacognitive framework which provoked reflection on these factors.

While much of Ropp’s research was quantitatively based, she does acknowledge that measures of central tendency tend to mask the very real and personal experiences of some students for whom working with computers is highly stressful. In this statement, Ropp is acknowledging, as I did, that it is important, as a teacher, to focus on the ‘outliers’. Ropp’s research, like my own, emphasised the importance of taking individual diversity into account.

6.7.9 How Might I Improve the Metacognitive Approach in Subsequent Cycles?

In retrospectively examining the metacognitive approach adopted in cycle 2, I considered what might have been omitted and, consequently, what might productively have been included. Such considerations were essential in moving into the planning of cycle 3. Four issues in particular seemed to warrant further investigation: play, help-seeking, retention of learning and reflection.

In my continued engagement with the literature throughout cycle 2, I had become aware of a body of literature surrounding ‘play’ in computer use (Martocchio & Webster, 1992; Webster & Martocchio, 1992; 1993). Revisiting the data I realised that students who might be perceived as capable frequently referred to ‘play’ themselves, while other students were far from feeling at ‘play’ with computers. Student 6’s definition of play, for example, was in close accordance with those adopted by writers in this area: ‘What I mean by playing is looking, finding, discovering, realising and not being too conscious of not getting serious work done’ (Student 6). The literature regarding cognitive playfulness, I felt, might beneficially inform the metacognitive approach.
Memory had emerged as a learning issue in cycle 1 and was raised again by several students in cycle 2: ‘I have just finished my tutorial and am trying to remember all of the activities that we did today so that I can practice them once more, and write down some notes so that I don’t forget’ (Student 12). At other times, students mentioned memory and retention as a differential variable when comparing various learning approaches and strategies: ‘Controlling my own learning was empowering and… I easily retained what I had learnt’ (Student 28). I hadn’t prompted students explicitly to consider issues surrounding memory and retention but acknowledged that this was an area to pursue in cycle 3.

In section 6.6.1 (case study 3) I alluded to the issue of ‘help-seeking’ and active pursuit of support. This was an area I felt needed to be incorporated into the metacognitive approach as it was integral both to capable computer use and to self-directed learning more generally. In section 6.7.7 I discussed at length my perception that a primary limitation of the metacognitive approach lay in the depth of reflection which students engaged in. A major challenge for subsequent cycles was to investigate ways of supporting deeper reflection. It was with these areas of potential improvement in mind that I moved into cycle 3.

6.8 Stepping Back and Moving On

Chapter 6 has traced the acting, observing and reflecting phases of cycle 2. It has provided an analysis of the quantitative self-assessment survey data, alongside students’ and my own reflections on this data. Despite overall high self-efficacy and outcome expectations amongst the student cohort, around 23% of students indicated a significant level of computer anxiety, around 13% indicated lack of computer learning confidence and around 9% held low levels of perceived usefulness. Students’ reflections reinforced my perceptions regarding the distinctive character of a ‘capable’ computer user and were shown to be consistent with the capability literature. Capable computer use was perceived to be more to do with metacognitive/metalearning factors than technical skill. The metacognitive approach was demonstrated to have potential in prompting students to challenge the assumptions upon which their learning approaches were based and to identify those factors which impeded their learning. The approach also stimulated many students to adopt more appropriate learning strategies. In implementing the metacognitive approach in cycle 2 a number of limitations were identified and areas for potential improvement were revealed. Chapter 7 will discuss how the metacognitive approach was strengthened in cycle 3, and the changes which this brought both to the Unit’s design and my practice as a teacher.
Chapter 7 - Encountering Turbulance: Postcards from Cycle 3

Chapter 7 presents an exploration and synthesis of the planning, acting, observing and reflecting phases of cycle 3. The chapter opens by describing the pragmatic, theoretical and methodological impacts on the cycle, including an overview of the issues and themes pursued. The pertinent actions, observations and reflections from cycle 3 are then presented in three sections: learning engagement, refocusing causes to solutions, and finally, consolidating the metacognitive approach. By the time I began this cycle, complexity theory (for instance, Doolittle, 2000; Eve, Horsfall & Lee, 1997a; Waldrop, 1992) had begun to influence my teaching actions, research decisions and the meaning I generated from these. I have, however, chosen to forego discussion of complexity until chapter 8, when I review the research as a whole from a complexity-based perspective.

7.1 The Emerging Itinerary: The Intensified Interplay of Theory and Practice

A number of pragmatic and personal factors impacted on cycle 3 and are important to mention briefly. Firstly, in order to decrease the number of students in the Unit at any one time, the School of Education decided to offer the Unit in both semester one and two (2001). Later, a Christmas intake was initiated, enabling the Unit to be moved to an earlier position in the BEd course structure, from fourth year to third year, with future plans to move it to second year which was its more logical position. While this year-round offering enabled me to remain engaged in the teaching process and to immediately act upon my learnings from cycle 2, it also limited the time available to plan and make more considered or significant changes between cycles. A second unforeseen impact on cycle 3 was my extended period (6 weeks) of leave due to unforeseen medical circumstances, necessitating modification of some teaching and research plans.

The intensification of the planning, acting, observing and reflecting phases in cycle 3 inevitably brought a closer ‘knitting’ of my research and teaching, resulting in a more dynamic interplay between theory and practice. As Winter (1996) has described, theory and practice became interdependent and complementary phases of the change process, each containing elements of the other. Cycle 3 was also characterised by more subtle and personal transformations in my day-to-day interactions with students and my reactions to their learning needs. These changes are difficult to present in a thesis; however, this and the following chapter will attempt to depict the overall influence on my practice. The three student intakes to the Unit will be referred to as cycle 3a, cycle 3b and cycle 3c, as illustrated in figure 5.

For the purposes of this thesis, collection and analysis of data ceased in cycle 3b and this chapter concludes with my plans and actions in redeveloping the Unit in preparation for cycle 3c. This re-development represented a consolidation of the metacognitive model and an integration of the research findings and processes so as to achieve sustainability of the teaching and learning approach without my direct ongoing involvement. As argued in chapter 9, the change inherent in action research never really ends, and although this
research, by necessity, needed to reach conclusion, I did not perceive this as the end of the learning and development process.

![Figure 5](image)

**Figure 5  The structure of cycle 3**

### 7.1.1 Overview of the Data and Chapter Structure

As in cycles 1 and 2, students were required to keep a reflective journal and were invited to share this as part of the research. Students were also asked to complete the self-assessment survey. This served as a prompt for reflection and the data were not analysed as part of this research. Cycle 3a also involved a more intense interpersonal interaction with thirteen students in two small groups. This small group process is explained in detail in section 7.2.1. Participation rates for the two cycles are indicated in Table 12.

<table>
<thead>
<tr>
<th>JOURNAL PERMISSION</th>
<th>Yes</th>
<th>No</th>
<th>No Response</th>
<th>Withdrawn</th>
<th>Small Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 3a</td>
<td>64 (70%)</td>
<td>4 (4%)</td>
<td>11 (12%)</td>
<td>11 (12%)</td>
<td>13</td>
<td>92</td>
</tr>
<tr>
<td>Cycle 3b</td>
<td>79 (46%)</td>
<td>7 (4%)</td>
<td>75 (44%) *</td>
<td>9 (5%)</td>
<td>-</td>
<td>170</td>
</tr>
</tbody>
</table>

* Note that 51 of these students were from the Coffs Harbour campus and were working primarily with another tutor. Their journals were not collected for pragmatic reasons.

Many of the metacognitive components of the Unit introduced in cycle 2 were retained, with previous findings triangulated or member-checked with cycle 3 students. Data analysis thus entailed a search for divergent or dissenting data. Further to this, some ‘new’ constructs were added to the metacognitive approach, and a more grounded engagement with the data was adopted, explicating emergent themes, but again seeking the ‘dissenting voice’. Table 13 depicts the concurrent pursuit of these various issues and themes across cycles 3a and 3b and into cycle 3c, summarising my actions and the impact of these on both the research process and the development of the Unit.
Table 13  Summary of issues and themes pursued in cycle 3

<table>
<thead>
<tr>
<th>ISSUE OR THEME</th>
<th>PRE-3A</th>
<th>CYCLE 3A</th>
<th>POST-CYCLE 3A &amp; PRE-CYCLE 3B</th>
<th>CYCLE 3B</th>
<th>PREPARATION FOR CYCLE 3C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Efficacy</td>
<td>Evaluation of incorporation in cycle 2</td>
<td>Survey retained but used solely as prompt for reflection</td>
<td>Some rewording of Thinking module including prompt to consider dichotomy of the factors and strategies to enhance self-efficacy</td>
<td>Survey retained 'Member checking' of cycle 2 findings with small groups.</td>
<td>Survey abbreviated and integrated into Thinking module.</td>
</tr>
<tr>
<td>Attribution</td>
<td>Evaluation of incorporation in cycle 2</td>
<td>Survey retained</td>
<td>'Appropriate' attribution perceived as valuable to student learning</td>
<td>Prompted to consider strategies to enhance appropriate attribution</td>
<td>Survey abbreviated and integrated into Thinking module. Non-hypothetical scenarios substituted.</td>
</tr>
<tr>
<td>Learning Style</td>
<td>Evaluation of incorporation in cycle 2 (issues identified in section 6.4.4)</td>
<td>Revision of theory presentation (see section 7.3.1)</td>
<td>Reflection on small group experience</td>
<td>Computer specific survey incorporated Refocusing on learning strategies and on the cyclical process of experience, reflect, theorise and apply</td>
<td>Learning style omitted in favour of clear focus on learning strategies (see section 7.3.1)</td>
</tr>
<tr>
<td>Models of Computer Capability</td>
<td>Evaluation of incorporation in cycle 2</td>
<td>List of defining characteristics fed back to small groups and full student cohort for 'member checking'.</td>
<td>List of primary characteristics confirmed by small groups and wider student cohort</td>
<td>List of primary characteristics incorporated into Thinking module Explicit discussion of differences between competency and capability</td>
<td>Tighter integration of the characteristics and explicit prompts to use as 'model'</td>
</tr>
<tr>
<td>Pathways to Learning</td>
<td>Evaluation of incorporation in cycle 2</td>
<td>Retained with minor modifications</td>
<td></td>
<td></td>
<td>Incorporated explicit section on pathways to learning (see section 7.3.1)</td>
</tr>
<tr>
<td>ISSUE OR THEME</td>
<td>PRE-3A</td>
<td>CYCLE 3A</td>
<td>POST-CYCLE 3A &amp; PRE-CYCLE 3B</td>
<td>CYCLE 3B</td>
<td>PREPARATION FOR CYCLE 3C</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Cognitive Playfulness</td>
<td>* Emerged as characteristic of capability in cycle 2</td>
<td>* Theory utilised as reflective prompt with small group and full student cohort</td>
<td>* Theory retained with minor modification</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Engagement with literature</td>
<td>* Incorporation into ‘Thinking’ module (see section 7.3.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Identification of issues of ‘readiness’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory and Retention</td>
<td>* Emerged as issue in cycle 2 (see section 6.7.9)</td>
<td>* Exploration of issues with small groups</td>
<td>* Engagement with literature and with written reflective journals</td>
<td></td>
<td>* Explicit section added (see section 7.3.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Trial use of metaphor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Help-Seeking and Problem-Solving</td>
<td>* Emerged as issue in cycle 2 (see section 6.7.9)</td>
<td>* Observation and discussion of issue with small groups</td>
<td>* Engagement with literature surrounding help-seeking and learned helplessness</td>
<td></td>
<td>* Explicit section added (see section 7.4), including section on buddying</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engagement in Reflection</td>
<td>* Emerged as issue in cycle 2 (see section 6.7.7)</td>
<td>* Trialling of small group process (see section 7.2.1)</td>
<td>* Analysis of the small group process (see section 7.2.2)</td>
<td>* Examples of reflection provided</td>
<td>* Strengthening of reflective prompts and stronger connections to action learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Examples of reflection provided (mid cycle 3a)</td>
<td></td>
<td>* Small group reflection encouraged as an option to students</td>
<td></td>
</tr>
<tr>
<td>Adaptability to Online, Self-directed and Flexible Learning</td>
<td>* Observations and discussion of issues with small groups (see section 7.2.3)</td>
<td>* Included additional content on the value of learner independence</td>
<td>* Some students referred to the study schedule but many still left their learning engagement to last moment</td>
<td>* Explicit section added on the nature of online, flexible and independent learning (see section 7.4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Introduced suggested study schedule</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation, Goal-setting and Volition</td>
<td>* Identification of issue in cycle 2 (see section 7.2.3 and 7.2.4)</td>
<td>* Discussion with small groups</td>
<td>* Prompted to consider motivation ‘up front’</td>
<td>* Explicit section added (see section 7.4)</td>
<td>* Redevelopment of ‘Using’ section (see section 7.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>* Strong focus on goal identification, in conjunction with Skills Chart</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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The written presentation of cycle 3 proved awkward, given the iterative pursuit of understanding regarding these issues and themes across the cycles and their overlapping nature. These considerations, together with the pragmatic issues mentioned earlier and the more dynamic interplay of theory and practice, created a sense of turbulence, not only in my teaching and research, but in how to present this chapter. In the interests of flow of argument and continuing the narrative of the research ‘story’, the chapter was finally structured into the following three sections:

**Section 7.2 Learning engagement**, including an introduction to the small groups, issues of reflection, adaptation to online, self-directed and flexible learning and issues of motivation and goal-setting;

**Section 7.3 Refocusing causes to solutions**, including styles to strategies, playfulness and exploratory learning, readiness, appropriate attribution, help-seeking strategies and memory and retention;

**Section 7.4 Consolidating the metacognitive approach**, including the summative changes to the Unit resources and the resultant metacognitive model.

### 7.2 Learning Engagement: The Experience of the Small Groups

In cycle 2, depth of reflection was identified as a potential limitation to the effectiveness of the metacognitive approach and I noted that the written format of the journals, and the lack of social interaction in the process, were potential contributors to this lack of depth. In cycle 3a I was prompted to explore the influence of a small group process, both as pedagogical tool to foster deeper reflection, and as data collection method. It was also envisaged that the small group process would provide a more dynamic and interactive engagement with individuals, enabling checking of data from cycle 2 and the identification of other influences on students’ computer learning. The small groups revealed some startlingly contrasting ‘pictures’ of students’ engagement (or lack thereof), not only with reflection but with the Unit in general. This section introduces the small groups, describes how they were formed and provides a profile of the individuals involved. The small groups are then used as a foundation for the exploration of issues surrounding learning engagement, namely: depth of reflection (section 7.2.2), adaptability to online, self-directed and flexible learning (section 7.2.3) and motivation and goal-setting (sections 7.2.4 and 7.2.5). The small group process also informs the discussion of other issues throughout this chapter.

#### 7.2.1 Introducing the Small Groups

During week one tutorials (cycle 3a), students were offered the option of a small group process as a verbal alternative to the written journal. Although open to anyone, it was emphasised that the group approach might be of particular benefit to students who felt low in computer confidence. Twelve students volunteered and were initially divided equally into two groups. However, a number of students requested variation and, as a consequence, Group One ended up with four participants while Group Two had eight participants. All volunteers were asked to read and complete the consent letter provided in appendix 19. Small group participants were required to complete the self-assessment survey, to read the Thinking module, and to engage with the online content and learning activities in the same way as the general student cohort. Their reflections, however, would be shared through weekly discussions, structured to include a ‘check-in’ (25mins), reflections on tutorials
(20mins), reflection on Unit content and issues (45 mins), goal-setting (15 mins) and a session debrief (15 mins). It was initially envisaged that I would attend and facilitate both groups for the eight sessions that they were required to meet. However, due to unforeseen personal circumstance (mentioned earlier), it was only possible for me to attend in weeks 2-4 and then again in the final week (week 10). The groups both indicated that they wanted to continue in my absence. I arranged to provide them with a weekly sheet containing prompts for reflection. They were asked to tape their sessions, and I listened to these each week, returning questions and activities to prompt further exploration of issues, or clarification of points made the previous week. These weekly sheets thus varied somewhat between groups. Students were also allocated roles in the group process, namely facilitator, timekeeper, attendance checker, devil’s advocate and equipment checker.

A profile case study of each of the small group participants is provided in appendix 20. As was detailed in appendix 1, pseudonyms are used for these twelve students. These profiles are derived from students’ accounts and reflections, supplemented by my own observations and reflections. The reader of this thesis is strongly encouraged to engage with these case studies as they provide a rich representation of the diverse issues impacting on individuals’ experiences with computer learning. They will also be referred to throughout this chapter to illustrate issues of relevance to the research. For ease of reference, however, these individual profiles are summarised in table 14.

**Table 14**  **Summarised profiles of small group participants, cycle 3a**

<table>
<thead>
<tr>
<th>GROUP 1</th>
<th></th>
<th>GROUP 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Katy</strong></td>
<td>Initially lacked in confidence and was a dependent learner. Resolved to change, for her own and her pupils’ sake, and underwent considerable development in skill and confidence once she realised the value of ‘learning by doing’.</td>
<td><strong>Leon</strong></td>
</tr>
<tr>
<td><strong>Yvette</strong></td>
<td>Saw herself as experienced, but acknowledged she would only do things she had to. Didn’t respond positively to tutorials or independent learning and didn’t achieve well in the challenge assessment or Web site.</td>
<td><strong>Jill</strong></td>
</tr>
<tr>
<td><strong>Gary</strong></td>
<td>Some use of computers in past employment but lacked confidence. Little evident transformation in attitude or overall skill level.</td>
<td><strong>Matt</strong></td>
</tr>
<tr>
<td><strong>Peter</strong></td>
<td>Undertaking the Unit for the second time and continued to experience difficulties. Wanted to be told exactly how to do things. Not very confident but began to ‘play’ after purchase of new computer.</td>
<td><strong>Catherine</strong></td>
</tr>
<tr>
<td><strong>Sharon</strong></td>
<td>Lacked confidence in abilities and was highly reliant on her husband. Had previously enrolled in a highly directive TAFE computer course which she didn’t complete. Strove ambitiously to develop skills and tried to increase her independence.</td>
<td><strong>Carol</strong></td>
</tr>
<tr>
<td><strong>Sally</strong></td>
<td>Quite anxious with computers despite high level of family use, encouragement and support. Seemed to encounter more than her fair share of difficulties. Finally unpacked her Christmas computer in week five. Remained unmotivated until became aware of music software. At end of semester spoke of wanting to do a computer elective.</td>
<td><strong>Bradley</strong></td>
</tr>
<tr>
<td><strong>Sandra</strong></td>
<td>Had a computer at home but disliked their use due to social concerns. Responded well to the Unit and to reflecting on her attitude and approach to learning. Actively adopted strategies to enhance her learning.</td>
<td></td>
</tr>
</tbody>
</table>
Self-assessment surveys were provided by ten of the thirteen small group participants and there data are summarised in appendix 21.

### 7.2.2 Reflecting on Depth of Reflection

In chapter 6 I noted that depth of reflection is easy to recognise but difficult to define (Bennett-Levy, 2002). In analysing the level and depth of reflection that occurred in the small groups a framework was required. Several models were considered (for example, Ecclestone, 1996; Hatton & Smith, 1995; Smyth, 1989). The framework of Campbell-Evans and Maloney (1998), however, seemed most relevant to the context and content of metacognitive reflection (as opposed to critical reflection). These authors identify four levels of reflection:

1. reporting or describing an incident, event, feeling or lesson;
2. reviewing or refocusing on a situation or incident by considering alternatives, reworking outcomes and making plans for future action;
3. analysing by questioning, comparing and evaluating an incident or situation; and
4. reconceptualising or reworking personally held views and ideas (and, in the metacognitive context, I add here learning strategies).

The first three might be considered as increasingly sophisticated levels of cognitive self-appraisal, while the fourth represents cognitive self-management.

Initially I intended to analyse a sample of small group sessions and tally instances of students’ reflection according to these four levels, with the aim of comparing this to similar excerpts from a sample of written journals. However, in attempting this analysis, I quickly realised that such an approach over-simplified the dynamic process occurring within the small groups and under-represented the nuances and ‘events’ that prompted reflection at each of the levels. Not all students in the group commented on any one issue and it was thus not easy or reliable to compare individual written reflections to individual verbal reflections. Although the group discussion, at various times, led one or two students to progress to cognitive self-management (level 4), this did not mean that all individuals in the group were engaged in a similar depth of reflection. Furthermore, the group reflection process was more dynamic than written reflection. Conversation would rapidly change focus, unlike the (generally) more structured written journals, making it difficult to isolate comparative segments. My own role in guiding and focusing the discussion also inevitably coloured the level of reflection occurring. On re-listening to the tapes, I realised that the prompts which moved the discussion toward levels 2 and 3 were often made by me (either personally while present or through the weekly sheets mentioned earlier) as I challenged students to question their responses and compare these with previous incidents or reactions.

Rather than continue analysis by tallying occurrences at each reflective level, I instead focused on analysing my own reflections, realisations and learnings.

The small group process did provide a context for collegiality and support and an opportunity to debrief and share experiences, reinforcing to participants that they were capable of learning new skills independently. It assisted students to recognise diversity and commonality in their approach to computers and provided them with supplementary viewpoints on theory, enriching reflection and prompting them to challenge their
assumptions. Group interaction also provided opportunities for students to motivate each other, to share ‘perceived usefulness’ and to reinforce the need for computer skills in their future teaching career (outcome expectations). In Group Two in particular, there was a high level of discussion about the application and relevance of both computer technology and the metacognitive approach to schools and classrooms. These occurrences were not, however, unique to the group reflection context and students in previous cycles had drawn on interactions with peers in similar ways, reflecting on these in their written journals.

Significant differences emerged in the dynamics between the two groups, emphasising the unpredictable outcomes of the group process, a point I discuss in the following section in relation to complexity. Group Two developed a supportive and cohesive dynamic, despite its large size. There was a consistent depth of engagement with metacognitive issues and the participants seemed positive about the Unit and the approaches being taken. Members of Group One, however, seemed less positive about the group process and, in general, were more resistant to deep reflection, focusing rather on descriptive and directional aspects of their computer use. An interesting comparison, for instance, might be made of discussion following the challenge assessment (week 9). Group One tended to describe what they could and couldn’t do in the assessment (level 1) and whether it was easy or hard (level 1), touching only briefly on issues of strategy use (level 2). Group Two, however, discussed how they felt before the assessment (level 1), what strategies they used to complete the task (level 2), whether it was a valuable learning activity (level 2 and 3) and whether they would use such an approach in their classroom (level 2), including its relationship to outcomes-based learning (level 3). A few students in Group Two noted how engagement with the assessment had given them more confidence in their abilities to solve problems independently (level 4) and that it had proved to them that they could do more than they previously thought they could do (level 4). The different group dynamics were inevitably influenced by the personalities and personal experiences of individuals within the groups. The contrast between Jill’s influence on Group Two and Peter’s influence on Group One (as described in the profiles, appendix 20) were indicative of such potential variant group dynamics.

In re-engaging with the data, I acknowledged that the group process was no more consistently effective in engaging students in a deep level of reflection than the written approach. Students who demonstrated transformations in their learning seemed to do so regardless of the group process. It was interesting to consider Sandra’s extra written reflections, provided to me at the end of semester. Although Sandra was one of the students who, during the semester, did reconceptualise and self-manage her approach to computer use, her written reflections were far deeper than her verbal reflections, revealing personal insights that she might not have felt comfortable to raise in the group or might have required more considered time to produce.

As McGill and Weil (1989, p248) point out, facilitators ‘play a key role in enabling learners to reflect critically on their experience’. In my interactions with the groups I had aimed to achieve a balance between ‘leading’ the discussion toward research issues and letting the students shape the direction of the discussion themselves. While present, I had played ‘devil’s advocate’, challenging students’ assumptions, prompting them to consider alternative learning strategies and hence guiding reflection toward levels 2, 3 and sometimes 4. The presence of a stronger student facilitator (Carol) in Group Two meant
that my absence had less effect than in Group One. The quality of student reflection, written or verbal, was, however, at least partly reliant on the facilitation provided via reflective prompts, whether these were provided by a facilitator or in a written format as part of the Unit resources. Strengthening these prompts within the Unit, to enhance their capacity to promote reconceptualisation or reworking of personally held views or learning strategies (level 4 reflection), provided a means to enhance not only group, but also individual reflection.

I also needed to consider the ongoing feasibility of the group reflection process. My intense involvement with small groups was not sustainable, due to staffing and financial constraints. In any case, if my goal were to foster capable computer users who would continue to engage in cognitive self-appraisal and self-management long after completion of their university studies, then intensifying my role would not assist achievement of this goal. Students needed to adopt self-regulatory learning strategies themselves. Palmer, Burns and Bulman (1994) note that the depth of reflective engagement can be influenced by past learning methods and traditional attitudes toward education. Interactions with a colleague and critical friend in the School of Education at this time were important in shaping my understandings and future directions. This colleague had, like me, encountered significant differences in students’ capacity for reflection. Her own work had brought her to a realisation of the importance of fostering reflective ability and the necessity for this to become an explicit and integral part of teacher education (Graham, 2001). Her greater awareness of the pedagogical approaches employed throughout the BEd degree structure helped me to realise that students had, to date, gained little exposure to reflective approaches to learning. On becoming aware of this, I acted to provide students with further examples of reflection, a collation of these being distributed via the online discussion area toward the beginning of cycle 3a. These embraced a range of ‘types’ and levels of reflection, included those relating to the Thinking, Using and Applying modules. This, however, represented a somewhat superficial response and I recognised that my efforts to foster reflective ability could not occur in isolation from the wider School’s activities. My further collaborative actions with this colleague are outlined in chapter 9.

While considering issues of reflection in cycle 3, I began to question my expectation that all students should engage in reflection. I later read of Carson’s (1997) similar dilemmas and self-doubt. Two students’ comments at the time emphasised to me that, just because students weren’t documenting rich reflections didn’t mean that they weren’t occurring: ‘My reflections are getting shorter, though I seem to be learning more’ (Student 28, cycle 3a) and ‘I would like to have placed more reflections in the diary, but when I read at University then make the entry in the diary when I get home, a lot of the thoughts went missing’ (Student 104, cycle 3a). One key insight in an otherwise superficial journal could represent a significant metacognitive breakthrough for the individual, as indicated by Student 8s (cycle 2) reflections on his own passivity and struggles when faced with learning alternatives. Furthermore, Walker (1985) notes that there are people who, even with special help, may not reflect effectively. Campbell-Evans and Maloney (1998) suggest that the first two levels of reflection are common, the third is less frequent and the fourth rare. They indicate that reconceptualisation may require substantially more experience and professional knowledge than is expected at undergraduate level, comments echoed by Hatton and Smith (1995). In reflecting further on my position and assumptions, I heeded Dewey’s (cited in Ixer, 1999) emphasis on the importance of problematic and perplexing
material, which presents ‘felt difficulty’, and Ellen, Bearden and Sharma’s (1991) comment that depth of reflection is determined, to some degree, by the level of satisfaction with current or existing behaviours. In my own research, those students who were unhappy with their current computer usage were more likely to engage in deeper reflection, moving from cognitive self-appraisal to cognitive self-management. Significant change was experienced by Katy, Jill, Carol and Sandra, all of whom were highly dissatisfied with their level of computer confidence. Leon, Bradley and Yvette had perceived little discomfort with their current computer use, and thus had little incentive to engage in cognitive self-management. While for some students, such as Leon, this might indicate that their learning strategies and affective state were already appropriate for effective computer learning, this was not always the case, as shown by Bradley and Yvette. While Laffey and Musser (1998, p.238) warn of viewing ‘all students as our prototypical preservice teacher who is anxious, has little experience, and really hopes that computing will not change schooling and teaching too drastically’, there were evident dangers inherent in assuming students’ capabilities.

A further consideration was the centrality of experience as an impetus for reflection (Boud, Keogh & Walker, 1985a; Candy, Harri-Augstein & Thomas, 1985). The reflective prompts provided throughout the Thinking module encouraged students to return to past experiences, harness positive feelings, remove obstructive ones, and integrate new knowledge into their conceptual framework, consistent with the findings of Boud, Keogh and Walker (1985a). Those students who predominantly remembered positive experiences had less stimulus for reflection. Furthermore, although there were reflective prompts throughout the Using and Applying modules, these did not consistently reiterate the metacognitive focus. Again, this was an area for further development.

Perhaps most important was my realisation of the inseparability of depth of reflection from considerations of motivation and learning engagement more generally (Borkowski et al., 1990; Boud, Keogh & Walker, 1985a; Ixer, 1999), as well as the need for instruction and inspiration to develop skills of reflective journal writing (Campbell-Evans & Maloney, 1998). As Graham (2001) has stated, ‘Reflective thinking processes must be valued if they are to serve a useful function’. Energy and willingness to learn, together with a commitment to developing professional practice, are undoubtedly vital attributes for effective reflection (Palmer, Burns & Bulman, 1994). Many of the students in cycle 2 and 3a who provided shallow reflections were simply engaging at a minimal level with the Unit, hoping to get by with a pass, while expending little time and effort. While, in cycle 2, I had been quick to perceive this as an issue concerning reflective capacity, I increasingly recognised the necessity of considering issues of motivation and learning engagement more broadly. These are issues addressed in the following sections.

7.2.3 Adaptability to Online, Self-Directed and Flexible Learning

Engagement with the small groups revealed significant differences in the extent to which participants were engaging with the Unit. While some were working closely with the Unit resources, others were not interacting with them at all. The group reflection context seemed to provide a camouflage for minimal engagement. Participants were able to attend each week and join in discussion without preparation or follow-up activity during the week. In this section I refer to five small group participants: Jill, Carol, Matt, Peter and Bradley (as profiled in appendix 20), whose stories highlight the contrasting levels of engagement and
non-engagement experienced by students in adapting to online, self-directed and flexible learning.

Jill’s highly positive experiences while working independently with the Unit materials depict the advantages of self-directed computer learning over group interaction for some students. Admittedly, Jill was at a point of readiness to take on the learning challenge. While she claimed to have minimal computer skills and confidence at the beginning of semester, she had resolved to be pro-active in changing her situation and was prepared to take some personal risks and tackle problems and difficulties to achieve change. Jill’s motivation was thus strongly internal: ‘You just have to be motivated... get this idea out of your head that you can’t do it. It’s all in your mind’. Jill advocated strongly for the benefits of self-directed learning, emphasising how the approach had transformed her attitude to computers. For instance, when Carol mentioned her lack of confidence to learn independently and her need for step-by-step directions, Jill emphasised: ‘I’ve been like you, but I’m fed up with feeling that way. That’s why I took on the challenge to learn it for myself’. Carol doubted her readiness, but Jill retorted that she had felt that way at the beginning of the semester. Jill’s constant praise of the benefits of self-directed learning initially seemed to have only minimal, or subtle, impact on other students. However, the value of her influence was portrayed when, in the later weeks, Carol spoke of engaging with the Creating module to learn to Web publish, and had found it surprisingly easy: ‘I’m not confident... but I thought I’d do a Jill and try it’. Carol found this learning surprisingly easy. Ironically, Jill decided to attend tutorials to learn to Web publish. Jill and Carol’s story clearly illustrates the ‘readiness’ factor as identified by Grow (1991) and discussed later in this chapter, as well as the potential benefits of ‘peer pressure’, or modelling of successful computer learning strategies, in influencing individuals’ learning approaches.

Matt, in contrast, was not internally motivated. Furthermore, externally imposed imperatives, such as the requirement to type assignments or do assessment tasks requiring computer skills, had not significantly influenced his computer use. Matt’s avoidance behaviour illustrates just how easy it is for students to evade computer use if they are anxious, emphasising the importance of addressing affective dimensions. For Matt, the directive nature of the tutorials was an important stepping stone along a path of independence, and his willingness to engage in follow-up practice, and to take responsibility for reinforcing his own learning, was a first step toward greater autonomy.

Peter’s story depicts a student struggling to engage with the online resources, and to deal with learner choice and the lack of ‘direction’. His comments indicate his expectation of a defined body of knowledge and his difficulty in adapting to the choice of content ‘pathways’. Peter’s story parallels that told in case study 6 (Student 8, cycle 2). Both Peter and Student 8 held expectations of being told exactly what to do, and the flexible learning environment provided an uncomfortable level of choice and freedom. Peter blamed his discomfort on the Unit resources, demonstrating external attribution and contrasting sharply with the personally confronting and transformational reflections of Student 8. Peter’s withdrawal from the BEd the following semester may, however, indicate broader learning and/or motivational issues. While Peter didn’t seem to realise it himself, he did, during the semester, make a fairly radical transformation toward self-directed and independent learning. While this transformation was not directly related to the Unit, or the Unit resources, Peter’s realisation of the importance and value of technology in learning
and teaching prompted his computer purchase and subsequent engagement in exploratory learning.

Bradley’s story (appendix 20) depicts the potential dangers inherent in the self-directed and flexible learning environment if students do not take on appropriate and also ambitious goals. The Unit relied on students accurately self-diagnosing their learning needs, or at least being challenged to realise the limitations of their current knowledge. The computer skills chart went some way to support this, but could not overcome inaccurate self-assessment. Observations of Bradley’s non-engagement led me to realise that the Unit needed to challenge and motivate confident learners in more active ways, prompting them to self-test their skills and knowledge. Bradley’s story also emphasised the need to be wary of more confident and experienced students and that frequent or continuous use of computers alone does not build capability. As expressed by Long (1990, p.31), ‘There is a vast difference between a person having ten years of experience and one year’s experience ten times’.

I was prompted to acknowledge my assumption that students would be motivated to learn, and an even greater assumption that they would be willing to, and capable of, adapting to a flexible learning environment. Underlying this was a belief regarding the value of self-directed learning, which was identified at the beginning of this thesis as coloured by my own learning preferences and professional and personal history. While I acknowledged the struggles which some adults have when given more autonomy, responsibility and flexibility (Grow, 1991; 1994; Long, 1990; Rieber, 2001), particularly when they are used to reproductive approaches to learning (Simons, 1993), the research had documented a number of cases (such as Jill’s) of the empowering and transformational potential of the approach. I was not willing to relinquish my beliefs about the importance of fostering and promoting learner independence and self-responsibility, particularly from the perspective of developing computer capability. I needed to determine ways of supporting students having difficulty adapting, without compromising my ideals. Peter had suggested a need for a study schedule and I could see many benefits in this. However, somewhat ironically, the small group structure had provided such a schedule and in many respects this became a disadvantage for students, requiring them to cover set work each week so as to discuss certain issues and/or topics in the session. This imposed schedule provided less opportunity for them to accelerate, catch up or to cover topics in a personally relevant order, as students engaging in written journals were able to do. However, there were benefits in providing this study guidance, particularly for students less adept at self-regulated learning. In cycle 3b I introduced a suggested study schedule setting out topics for each week. This was done, however, in conjunction with the addition of a component in the Thinking module which prompted students to reflect on issues of time management and its connection to personal priorities.

Students’ adaptability to, and acceptance of, online learning is an area warranting study in its own right. While I heeded the issues raised in this literature and acknowledged that such considerations further complicated the teaching and learning context in which I worked and researched, it was beyond the scope of this thesis to venture further into this area. The work of Coomey and Stephenson (2001) might, however, be mentioned, in particular their discussion of learner control. Referring to the work of Oliver (1998, cited in Coomey & Stephenson, 2001) they highlight the differential responses of students to learning
environments which vary along continuums of locus of control and task specification. These were the issues which emerged for some students in my own teaching context, such as Peter.

Interacting with the small groups also emphasised a key difference underpinning students’ learning engagement - their goals. Students who responded most positively to the Unit’s flexibility were those who embraced personally relevant and meaningful goals, and were motivated to achieve them. While I had touched on issues of motivation in cycles 1 and 2, I was drawn to a more intense examination of these metacognitive considerations in cycle 3.

### 7.2.4 Further Exploring Issues of Motivation and Goal-setting

Issues of motivation and goal-setting were integral to the theoretical foundations of the metacognitive approach, in particular self-regulation, expert learning and social cognitive theory (Bandura, 1981; Harper & Radloff, 1999; Schunk, 1994; 1994a; Schunk & Zimmerman, 1994b). However, until cycle 3, the Thinking module dealt only briefly with these concerns, principally through discussion of perceived usefulness. Very little research has been done on motivation and computer use (Coffin & MacIntyre, 1999). One of the few studies by Davis, Bagozzi and Warshaw (1992) supports the findings of cycle 2 of this research with regard to the critical role of perceived usefulness and perceived enjoyment. Coffin and MacIntyre’s research indicates that ‘the more students become aware of the value of learning to use computers the more likely it is that they will develop an intrinsic orientation in learning to use them, and eventually become more comfortable, confident and skilled in using them’ (p.566). The small groups provided a valuable opportunity to observe, discuss and seek greater understanding of issues of motivation and goal-setting in the computer learning context.

Jill’s story illustrated the potential of student interaction in enhancing motivation. Numerous other examples could, however, be cited (for example, Bradley’s Internet travel bookings, Leon’s enjoyment of scanning pictures and several other students’ accessing of lesson plan resources). In week nine, when Sandra reflected that she would never enjoy spending time on the computer, Sally described how, that weekend, she had discovered a music program: ‘It was so much fun you couldn’t get me off it and I would never have thought I’d say that’. Such interchanges reinforced the importance of perceived usefulness for engaging students, particularly the most reluctant, and the importance of harnessing both the professional and recreational benefits of computer use.

Reflection on the characteristics of capable computer users also became a source of motivation, offering a long-term goal, or what Borkowski and Pressley (1990, p.84) refer to as a ‘future possible self’ that ‘can provide energy for behaviors that reduce the distance between the current true self and the possible self that one aspires to become’. The potential benefits of such an approach were reinforced in Carol’s realisation that she didn’t need to know everything to be capable. In another exchange, Group 2 came to consensus about the importance of external motivation, stating that, although students might initially dislike it, they should be made to use computers regularly throughout their teacher education course. All agreed that issues such as access shouldn’t be seen as a limitation and that computer skills were important enough to insist that all students use them: ‘If you have got to do it you will find a way’. Somewhat ironically, the active ‘avoiders’ of computers (Matt and Sally), were the most vocal in supporting this idea.
The small groups also challenged my assumptions regarding the role of computer access and ownership as an influence on computer use. All thirteen participants had computers at home; yet, despite this, only Leon and Bradley consistently used them for diverse purposes. Katy, Peter, Carol and Sandra used their computer basically for typing while Leon, Jill, Matt, Sally and Sharon indicated having avoided using their home computer almost all together. Both Sally and Leon had had ready access to computers most of their teenage years but rarely if ever used them, despite family encouragement and support. In both their cases it was not until they became self-motivated, through perceived need, that their attitude toward computers changed. These findings in relation to the unpredictable influence of computer ownership or school access on approach to computers was supported in my later reading of Laffey and Musser’s (1998) and Sheffield’s (1998) research. Laffey and Musser question whether ‘less anxious people become owners of computers or whether owning a computer leads to less anxiety’ (p.237). My research suggests that neither suggestion paints the full picture. Sharon, Matt, and Carol all provided examples of students who purchased computers despite quite high anxiety and Matt, Sally, Sandra and Sharon demonstrated how computer ownership can have little influence on computer anxiety. These students might be contrasted with Peter who purchased a newer computer during the course of the Unit and only then was motivated to explore the computer’s features.

Achievement goal theory (Meece, 1994) emphasises the active role which individuals play in choosing, structuring and interpreting their achievement experiences and helped inform my understanding of motivational and learner engagement issues. According to this theory, individuals who pursue learning-oriented (or task-oriented) goals seek to improve their level of competency or understanding, whereas individuals who pursue ego-oriented (or performance-oriented) goals seek to demonstrate high ability or gain favourable judgements of their abilities in relation to others. It is thought that learners who pursue task-oriented goals are more likely to choose challenging activities that allow them to learn new skills, whereas ego-oriented learners tend to choose activities that allow them to demonstrate competence, even if they don’t learn anything new. The relevance of this theory to our understanding of computer capability and lifelong learning should be immediately evident. Although ego-orientation may motivate students over short periods or on easier tasks it will not sustain self-regulation (Schunk, 1994). Learning-orientation, in contrast, fosters more adaptive learning strategies and higher intrinsic motivation (Schunk & Zimmerman, 1994a).

It is generally thought that individuals expend greater effort in attaining difficult goals than easier ones. While learners initially may doubt whether they can attain ambitious goals, working towards them builds self-efficacy. In this respect, it is posited that lower self-efficacy can lead to greater effort and better learning than high self-efficacy. ‘Assuming that learners feel efficacious enough to surmount difficulties, harbouring some doubt about whether one will succeed may mobilize effort and effective use of strategies better than will feeling overly confident’ (Schunk, 1994, p.81-2). The ability to set ambitious but achievable goals is thus an essential ingredient for success (Long, 1990). Also, proximal goals (those that can be attained within a short period of time) and those that are specific or discrete, are more motivating, since that motivation is more easily created and sustained (Schunk, 1994). Achievement goal theory proved valuable as a basis for analysis of the
motivational characteristics of the small group members. While discussion of issues of motivation and goal-setting formed an important part of the group process, it should be noted that the analysis provided in table 15 occurred retrospectively and was not collaboratively derived, or member-checked.

This analysis suggested that ambitious ‘big picture’ (long-term and learning-oriented) goals were the most important in evoking significant changes in students’ computer learning. Those with greatest self-doubt (low self-efficacy) were most active in setting such goals and seeking solutions and strategies (see, for instance, Katy and Jill). Those who perceived themselves as already competent or who held high self-efficacy beliefs (for example, Leon, Bradley and Yvette) tended not to actively set goals, let alone ambitious ones, and thus did not challenge themselves to move outside their comfort level. Yvette, for instance, stated that she couldn’t find anything challenging in the Unit, nor did she identify alternate learning goals. The Web site she produced was one of the least ambitious ones submitted, contrasting with that of, say, Carol. Yvette seemed to want her goals to be defined for her, perhaps a reflection of her ego-orientation and the desire to know exactly what was required to pass the Unit. This approach contrasted with that of students such as Katy, Carol and Jill who were learning-oriented, wanting to improve their level of competency so that they could meet ego-oriented goals in their future classroom. Several commented on the need to have skills at least comparable to their students.

Taking this analysis further, I reflected that goal-setting had rarely been mentioned as a characteristic of the capable computer user (see appendix 17); only one category C comment, ‘clear about what they want to achieve’ might be seen as relevant. Rather, capable individuals were more likely to let their learning emerge, meeting challenges as they presented themselves, or to have a general learning-orientation goal to take on new challenges. Skills-based sub-goals were likely to be identified and achieved in action, through experimentation and play, in a context of incidental rather than planned learning. Sally’s chance encounter of music writing software might be cited as an example of an effective motivator for capability-based learning. At no point were either short-term or long-term, ego or learning, goals identified. Rather, the motivation and the actual use of the software concurrently emerged, with little thought to the skill development occurring. The influence of this type of learning was potentially dramatic and more far-reaching than any externally imposed or planned learning goals. Interestingly, the learning objectives listed at the beginning of the Using and Applying module topics were rarely, if ever, referred to by students. I began to question their relevance and value to the learning experience, issues I return to in relation to complexity in section 8.5.4.

As an educator, these observations and reflections presented a profound challenge. Capable computer learners, it seemed, were not necessarily actively goal-oriented. Rather, their skills and achievements emerged because they were prepared to be open to embracing learning opportunities and challenges as they arose. Furthermore, externally imposed objectives did not seem to provide a great deal of support for learners and, as was mentioned earlier in relation to the skills chart, ran the risk of defining minimum standards.
Table 15  Motivational characteristics of the small group participants

<table>
<thead>
<tr>
<th>STUDENT</th>
<th>COMMENTS REGARDING MOTIVATION OR GOALS</th>
<th>MOST CONSISTENT GOAL ORIENTATION</th>
<th>PROXIMITY</th>
<th>LEVEL OF AMBITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katy</td>
<td>Goal 'not to rely on other people for every step' and a focus on being able to assist students in her classroom.</td>
<td>Learning-oriented Ego- for classroom</td>
<td>Long-term</td>
<td>High</td>
</tr>
<tr>
<td>Yvette</td>
<td>Focus on the value of the tutorial and unit in providing new skills which she didn’t already know. Looked to the tutorials to deliver new skills, rather than identifying personally relevant goals.</td>
<td>Ego-oriented</td>
<td>Short-term</td>
<td>Low</td>
</tr>
<tr>
<td>Gary</td>
<td>Low emphasis on specific goals. Commented that any learning that was not tested was not relevant to him. Immediately relevant goals such as inserting a picture into an assignment.</td>
<td>Learning-oriented</td>
<td>Short-term</td>
<td>Moderate</td>
</tr>
<tr>
<td>Peter</td>
<td>Low emphasis on specific goals</td>
<td>Learning-oriented</td>
<td>Short-term</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td>Leon</td>
<td>Motivated by recreational pursuits. Low emphasis on specific goals</td>
<td>Unclear</td>
<td>Short-term</td>
<td>Unclear</td>
</tr>
<tr>
<td>Jill</td>
<td>Determination to become more confident so she could effectively integrate computers in her classroom.</td>
<td>Learning-oriented Ego- for classroom</td>
<td>Long-term</td>
<td>High</td>
</tr>
<tr>
<td>Matt</td>
<td>Low emphasis on specific goals</td>
<td>Learning-oriented</td>
<td>Unclear</td>
<td>Unclear</td>
</tr>
<tr>
<td>Catherine</td>
<td>Wanted to be able to do more with her computer but non-specific with her goal-setting.</td>
<td>Learning-oriented</td>
<td>Unclear</td>
<td>Unclear</td>
</tr>
<tr>
<td>Sharon</td>
<td>Strong focus on achieving skills (at times ambitious ones, for example her Web site) but reliant on assistance to achieve them. Desire to use computers effectively in her classroom.</td>
<td>Learning-oriented</td>
<td>Long- and short-term</td>
<td>High</td>
</tr>
<tr>
<td>Carol</td>
<td>Desire to use computers effectively in her classroom.</td>
<td>Ego- for classroom</td>
<td>Long-term</td>
<td>High</td>
</tr>
<tr>
<td>Sally</td>
<td>Initially low task motivation and minimal goals. Emergent motivation and goal/motivation to do an elective</td>
<td>Learning-oriented</td>
<td>Short-term</td>
<td>Initially low, but later intermediate</td>
</tr>
<tr>
<td>Bradley</td>
<td>Motivated by recreational pursuits. Low emphasis on specific goals</td>
<td>Learning-oriented</td>
<td>Immediate</td>
<td>Low</td>
</tr>
<tr>
<td>Sandra</td>
<td>Initially to ‘pass the Unit’ but an increasing emphasis on the classroom. Resolve to ‘improve, succeed and graduate’.</td>
<td>Initially Ego- , later task</td>
<td>Initially short-term. Later long-term</td>
<td>Initially low, but later high</td>
</tr>
</tbody>
</table>
Integral to this process was a capacity to self-identify what they didn’t yet know, or what might be possible, something which might be conceived as goal-setting, but which seemed to be a much more fluid process. The importance of this cognitive realisation or openness to new learning was expressed by Student 93 (cycle 3a), whose journal identified that her learning had become stagnant because her skills were sufficient for her purposes:

I could not see any way forward, nor did I even consider that it might be useful or even vital to make this forward progress. I was (subconsciously) satisfied with my level of competency. Seeing new options, applications and ways of doing things has really undermined this perception, perhaps permanently... it challenged me to adopt an attitude where I am more open to, and interested in, finding out more than I already know... I have more curiosity and excitement and I am more willing to investigate possibilities.

Student 93 went on to reflect that through this Unit something ‘has changed’, that it ‘really has changed’, and she noted her realisation that most of education is really only surface learning. It seemed that, in the computer learning context at least, Meece’s (1994) analysis of the strengths and weaknesses of learning-oriented and ego-oriented goals represented a simplification. A balance of both seemed most effective in prompting capable computer use; although goal-orientation itself might decrease as capability increased. Furthermore, an orientation of seeking long-term maintenance of performance might be consistent with a desire to maintain lifelong learning. This discussion of fluidity in goal-setting is returned to in chapter 8.

Like Long (1990), I believed that we are unable to motivate other people but, rather, the role of the educator is to provide an environment in which people can motivate themselves. These views are also expressed by Simons (1993, p.295):

Only learners themselves can be the active participants in the learning process. Only they know the prior knowledge that should be used cumulatively. Only the learner himself can be constructive... Only learners can be the diagnostics of their own learning. An outsider (like a teacher) can never have access to the inside of the learner that the learner himself can have. Only a goal that a learner himself strives for counts. One can never force people to have goals they don’t want to have.

Assisting students to reflect on such issues as an integral part of the metacognitive process seemed to offer the potential for further fostering capability. Returning to the literature concerning self-regulation (Biggs, 1985; Borkowski et al., 1990; Entwistle, 1988; Newman, 1994; Schunk & Zimmerman, 1994a; Zimmerman, 1994), I found strong support for the role of metacognition in the motivational process. Zimmerman (1994), for instance, differentiates between self-motivation and intrinsic motivation; intrinsic motivation is derived from the task itself, whereas self-motivation is derived from self-efficacy perceptions and use of self-regulatory processes such as goal-setting. Self-motivation might thus be fostered through meta-motivation, and to this end I planned the addition of an explicit section on motivation and goal-setting in the Thinking module (see section 7.4). I return to a more theoretical engagement with the complex issue of goal-setting in section 8.5.4.
7.2.5 Actions to Support Meta-Motivation and Foster Learning Engagement

I thus came to recognise that an important aspect of my role as a computer teacher was to prompt students toward a state of discomfort with their current skills. While the skills chart performed this function to some extent, as well as being a valuable affirmational tool (see section 6.5.3), it was evidently very easy for students such as Bradley to self-assess that they could perform a skill (such as double spacing) without realising the limitations of their knowledge. The learning activities in the Unit had a major role to play in challenging those students who considered themselves to be competent and prompting them to realise there was more learning they could do, and in fact needed to do, to become effective computer users. The activities also had an important role to play in inspiring students and conveying the potential for computers in enhancing learning and teaching. A more subtle change occurred for me, however, in response to these observations and reflections. I found myself focusing more strongly on intrinsic motivation: essentially, I wanted the learning experience embraced by the Unit to be fun! I later read of Rieber’s (2001) struggles to find the ‘right word’ to describe his philosophy toward stimulating learning. Rieber chose the word ‘excite’, incorporating emotional aspects of learning, higher levels of energy and involvement and embracing natural human curiosity. Rieber’s approach was one that I also wanted to adopt — I wanted to ‘excite’ students to engage in computer learning. It was this sense of excitement which I felt was critical to capable computer use.

With these considerations in mind, in preparation for cycle 3c, I conceptualised a new structure for the topics of the Using module. The new structure wrapped around five learning ‘windows’: facts, skills, activities, use in schools and reflection. The graphic interface that supported this structure is presented in appendix 10.

7.3 Refocusing from Causes to Solutions

A number of computer learning issues were considered in cycle 3 and subsequently embraced within the metacognitive approach. In summary, these concerned learning styles and strategies, playfulness, readiness, appropriate attribution, problem-solving, help-seeking and memory and retention. While these issues might be perceived as quite disparate, discussion in this section will demonstrate a common theme. Cycle 1 had emphasised the potential benefits of students reflecting upon, and identifying, the influences on their computer learning, including the causes of their anxieties, concerns and difficulties. Cycle 2 had demonstrated the potential of the metacognitive approach in supporting this process. A strong focus of cycle 3, however, was to facilitate students’ movement from the identification of ‘causes’ to the development and implementation of ‘solutions’. It is this theme that forms a common thread throughout this section.

7.3.1 Styles to Strategies

In cycle 2, I questioned the value of the learning styles component of the Unit, but had not determined how to improve the approach beyond some re-wording to emphasise the potential of the model in invoking cognitive self-appraisal and self-management (see section 6.4.4). The small groups were an opportunity to collaborate with students in determining whether this inclusion was valuable and, if so, how it might be refined. After completing the learning style survey, students in both groups reflected that they adopted different styles when using computers than in other learning contexts and, like one student
in cycle 2, Group Two, suggested that there might be benefit in a computer specific learning style survey. To this end I re-developed the survey (see appendix 22) and the students completed the second version two weeks after the first. Appendix 23 compares student responses on the two surveys. A higher level of reflective observation was revealed on the computer specific survey and there was a unanimous feeling that the computer specific survey was more relevant and beneficial than the general one.

However, the activity still seemed to lead to little cognitive self-management for the small group participants, perhaps with the exception of Katy. In reflecting on this, and re-engaging with the literature (Boud, 1989; Henry, 1989; McGill & Weil, 1989; Packham, Roberts & Bawden, 1989; Weil & McGill, 1989), I realised my espoused belief in the importance of all four modes was at odds with the literature which suggested that computer learning was best approached through active experimentation (Birkey & Rodman, 1995; Bostrom, Olfman & Sein, 1990). In cycle 3b I thus utilised the computer-specific questions but placed greater emphasis on the importance of all four approaches and downplayed the emphasis on active experimentation.

Despite these changes, the learning style component of the Thinking module was not prompting significant cognitive self-appraisal and/or self-management for many students. It seemed that students’ preconceived ideas, representing the dis-empowering perspectives on learning style theory, as discussed in section 4.6.3, were not being challenged. Students were still speaking of their preferred learning style as a ‘cause’ of their computer learning issues, rather than recognising this personal insight as a potential ‘solution’. After extensive reflection and re-engagement with the literature (for example, Derry, 1990; Di Paolo, 1999; 1988a; Schmeck, 1988b; Shih & Gamon, 1999), I recognised the need to place greater emphasis on learning strategies, rather than learning styles.

McKeachie (1995) notes that what we term ‘learning styles’ are preferences and habits that have been learned, and that, regardless of their ‘style’, students can adopt strategies that enable them to be effective when taught by any method. Shih and Gamon (1999) similarly suggest that students’ use of strategies can be controlled and changed through teaching. My own approach was not, as implied by Shih, to ‘control and change’ students’ learning strategies but, consistent with the metacognitive approach, to empower students to make such changes and adjustments themselves. In my interactions in cycles 3a and 3b, I increasingly found myself assisting students to move beyond self-understanding (cognitive self-appraisal) toward a clear focus on learning strategy formulation (cognitive self-management); refocusing their attention away from their existing preferred ‘style’ toward refinement of their learning ‘strategies’. The following sections elaborate on a number of components added to the metacognitive approach to assist students to refocus on solutions to their computer ‘problems’.

7.3.2 Playfulness and Exploratory Learning Strategies

Cycle 1 and 2 highlighted the varying aptitude and willingness of individuals to engage in exploratory learning. ‘Play’ was mentioned time and again by students who were confident in their computer use and it had emerged as a learning strategy adopted by capable computer users (see section 6.4.1). Cognitive playfulness and flow theory had been applied to the computer context by a small number of researchers (Fisher, 1999; Martocchio & Webster, 1992; Webster & Martocchio, 1992; 1995). Cognitive playfulness is defined in
these studies as a situation-specific tendency of an individual to interact spontaneously, inventively and imaginatively with computers. When left to their own devices, individuals high in cognitive playfulness are more likely to explore the features of computers and experiment with the options than individuals low in playfulness. Cognitive playfulness thus implies learning strategies embracing choice, self-direction, exploration, active involvement, curiosity, intrinsic interest, internal motivation and freedom from externally imposed rules (in part derived from Martocchio & Webster, 1992). Research suggests that the capacity to treat computer ‘work’ as play is a key characteristic of successful computer learners and problem solvers (Fisher, 1999; McInerney, McInerney and Sinclair, 1990, cited in Hemby, 1998; Webster, Heian & Michelman, 1990; Webster & Martocchio, 1993).

My own research in cycle 2 reinforced these claims and a major aim of cycle 3a was to prompt students to self-analyse their disposition toward play, with a view to fostering exploratory learning strategies. This was consistent with the metacognitive refocusing from causes to solutions.

In cycle 3a I integrated a brief section on computer playfulness into the Thinking module, asking students to reflect on how playful they considered themselves to be with computers; what influenced their ability to be playful and what might help them, or others, to develop a more playful approach. These questions were posed to the small groups, as well as the wider cohort. Play was also utilised as a teaching strategy in the synchronous communication (chat) tutorial, where, after a brief discussion, students were given free rein to explore the ‘virtual classroom’, a text- and graphics-based environment.

When reflecting on these concepts and experiences, some students readily perceived their learning as play and their play as learning (for instance, Student 92, cycle 3a), whereas others seemed to find these concepts incompatible. Those finding play difficult frequently mentioned ‘time’ as a conceptual barrier, stating that they wanted instant or fast results from their learning (for instance, Katy, Gary, Sandra and Students 7, 24, 42, 54 & 104, cycle 3a) and that learning through play was a time-waster (Students 16 & 54, cycle 3a). Other constraints included concern that they would ‘stuff up’ the computer (for example, Students 20, 22, 31, 66 & 89, cycle 3a); general lack of interest or satisfaction (Students 15 & 10, cycle 3a); and a preference to spend leisure time outdoors (for instance, Sandra and Students 7 & 72, cycle 3a). Some students commented that it was easier to be ‘playful’ with computers belonging to someone else, such as the University (for example, Student 20, cycle 3a), but these views were counteracted by others who indicated that playfulness was easier with the privacy and the motivation of their own computer (examples here include Peter, Sally, and Student 42, cycle 3a). The majority of students, both within the small groups and the wider cohort, were supportive of the value of cognitive playfulness and the importance of encouraging their own pupils to engage in active experimentation, exploration and play as valid computer learning strategies. ‘I think that playfulness is essential to becoming a proficient and capable user of IT. In my opinion, many people who lack that “play” degree of their learning become frustrated or at least slow their own learning’ (Student 32, cycle 3a). Student reflections thus reinforced my beliefs about the importance of a ‘playful’ disposition in becoming a capable computer user, but also the barriers which some students self-imposed on their preparedness to ‘play’.

The small groups also provided important insights into students’ capacity and preparedness to adopt exploratory learning strategies and the potential for doing so. Katy’s resolution to
become more playful was perceived by her as transforming her computer use and attitude, illustrating how the explicit integration of play theory could prompt cognitive self-appraisal and self-management. Peter initially had not seen himself as playful yet, after purchasing his own computer, his level of ‘play’ and exploration increased significantly. In Peter’s case the change was not a result of conscious self-management but was prompted by altered environmental factors: his purchase of a new computer, which in turn was prompted by perceived usefulness. Similarly, Sally’s discovery of music writing software quickly encouraged a playful state and powerfully transformed her general perception of computers. Thus, a teaching strategy that focused on evoking curiosity and intrinsic motivation, while providing ample opportunity and encouragement for exploration, held the potential for challenging traditional approaches to computer learning.

The incorporation of play theory thus proved valuable in the metacognitive approach and was retained as part of the Thinking module in cycle 3b and 3c, with some minor modification of wording.

7.3.3 Reconceptualising ‘Basic Skills’ as Strategies

Despite my beliefs about the benefits of exploratory learning, and my observations of the value of such strategies to students such as Katy, Sally, Peter and Jill, interaction with a number of students prompted me to continually re-examine my assumptions and keep such approaches in perspective. While many students found exploratory learning easy and natural, others found it problematic (preferring instead a ‘quick fix’) and ran the risk of becoming frustrated (for example, Student 66, cycle 3b). A small number of students asserted that exploratory learning was wasting their time. This was quite disturbing for me as an educator and initiated consideration of matters of efficiency and effectiveness of exploratory learning. Jill’s story provided an interesting perspective on these issues. Jill indicated that she would spend half to one hour working independently through each topic, even those requiring considerable learning on her part. Jill continually mentioned how being able to control the pace of her learning made such a big difference to her confidence: you ‘don’t have any stuffing around’. While I could share Jill’s comments with other students, only personal experience could lead to similar insights, and this required students to reach a position of openness and confidence to ‘try’. There was, admittedly, a ‘readiness’ factor involved, and as an educator in the university context with limited student contact, it was difficult to identify that point of readiness for each student.

However, consistent with the metacognitive approach, I believed that students could be assisted to identify their own point of readiness. Helping students to become aware of the potential of exploratory learning, helping them to become aware of appropriate strategies and allowing them to make the decision as to whether they were ready for such an approach, was more congruent with my goal of fostering lifelong learning. Even if students weren’t currently ready, in the future they might return to their trialing of such strategies and realise their capacity for learning independence. The optional computer tutorials, which had been offered as part of the Unit since cycle 1 provided opportunities for students to experiment with this point of readiness.

The issue of readiness was discussed with the small groups at various points throughout cycle 3a, in relation to play, problem-solving and capable computer users. Students in both groups agreed that a ‘generalised framework’ was what helped computer users to solve problems. This led to a discussion within Group Two as to whether it was possible to
identify some of the core understandings underlying ‘readiness’: the understandings that were foundational to their computer learning. The resultant list included saving, resizing windows, changing page views, undoing, exploring menus, doing cut, copy and paste, right clicking the mouse button, watching how the cursor changes in different places, using shortcuts, portrait and landscape, having windows behind other windows and holding the mouse over icons. Participants also mentioned understanding terms such as ‘file’, ‘menu’ and ‘desktop’; however, there was less unanimous support for terms such as ‘RAM’ or ‘function’. Some of these ‘understandings’ were easy to take for granted as a teacher. Cycle 3a was the first semester I had emphasised ‘basic’ computer skills, and I realised just how beneficial this had been. Understanding these ‘basics’ was potentially more empowering than understanding specific applications, and the transferability of these understandings enabled students to adapt to unfamiliar contexts. In the cycle 3b tutorials, I strengthened the emphasis on these basic skills, but focused strongly on how these skills could be perceived as learning strategies: how exploring menus, right clicking and carefully watching how the cursor changed, could be utilised for exploratory learning in any computer context. In subsequent cycles in 2002, an explicit section was added to the Using module to translate these tutorial techniques into an independent learning format.

7.3.4 Revisiting Appropriate Attribution and Problem-Solving

The concept of ‘appropriate attribution’ arose from the data in cycle 2 (see section 6.4.3). Further reading in cycle 3 highlighted the parallel between appropriate attribution and Seligman’s (1990) notion of ‘flexible optimism’. Seligman points out that optimism, while positive, may help some people evade responsibility for failure. Success requires persistent application of effort despite setbacks and performance-related anxiety and preoccupation that potential calamity might interfere with performance (Cervone, 2000). Research, such as that by Brockner and Guare (cited in Gist, Schwoerer & Rosen, 1989), indicates that when low self-esteem participants are able to make external attributions about task failure their performance improves. From such a basis, Seligman promotes the empowerment of informed ‘choice’: ‘What we want is not blind optimism but flexible optimism – optimism with its eyes open. We must be able to use pessimism’s keen sense of reality when we need it, but without having to dwell in its dark shadows’ (p.292). This perspective echoed the position on appropriate attribution discussed in chapter 6.

A number of ‘stories’ from cycle 3a confirmed the relevance of appropriate attribution and its impact on individuals’ everyday computer interaction. Matt’s troubles with his modem and Catherine’s problems with her new computer’s motherboard illustrated the difficulties that occur when students blame themselves for problems beyond their control. Many students genuinely believed that computer ‘problems’ only happened to them, or at least happened to them far more frequently and seriously than to other computer users (for example, Sally). At one stage, Group Two found themselves sharing ‘horror stories’ of problems with computers. Laughing off the realisation that they had all encountered ‘illegal operations’, Carol asked me why computers did those things. After pausing to consider the most appropriate response I answered; ‘That is what computers are like!! It happens to everyone and part of computer use is coming to terms with the fact that everyone encounters problems.’ While this interchange seemed insignificant at the time, afterwards I realised that I had, to date, made assumptions regarding students’ acceptance of problems as natural. I later realised that this dialogue had been significant in liberating
these students from internal ‘blame’. A similar affirmation of the predictability of computer ‘problems’ was later added to the Unit.

Reflecting further on my presentation of attribution theory in cycle 2, I realised that I had placed a strong focus on attributional style and insufficient attention on prompting students to identify and adopt strategies for making more ‘appropriate’ attributions. Students who employed such strategies were less likely to make generalised attributions, a point emphasised in Student 54’s (cycle 3a) reluctance to provide a response on the general attribution questions, commenting instead in the margin that ‘I cannot reply. I don’t tend to blame myself. I look at what causes the situations and if I have a part to play I take responsibility’. This statement illustrates the role of problem-solving strategies in reaching appropriate attribution.

In cycle 3b, I incorporated appropriate attribution explicitly into the Thinking module, prompting students to reflect on the relevance of the concept, and how they might foster appropriate attribution within themselves, or in their students. The strategies identified were, not surprisingly, mostly concerned with problem-solving and logical thinking. Suggestions included: encouraging reflective learning and self-responsibility (Student 113, cycle 3b), fostering better understanding of technical aspects so that students can determine when the computer is at fault (Student 92, cycle 3b), positive role modelling of attributional responses and problem-solving (Student 58, cycle 3b), encouraging help-seeking (Student 92, cycle 3b), fostering a climate of learning from mistakes (Student 131, cycle 3b), fostering patience and persistence (Student 10, cycle 3b), and problem-solving with students. It is worth reiterating that problem-solving had been identified as one of the key characteristics of capable computer users (see section 6.4.1).

Metacognition plays a critical role in the problem-solving process. It helps the student recognise there is a problem to be solved, decide exactly what the problem is and understand how to reach a solution (Davidson, Deuser & Sternberg, 1994). Again, strategy is central. Assisting students to develop problem-solving abilities in the computer domain is not, however, easy. Simply teaching students strategies does not guarantee that they will continue to use them, nor that they will use the strategies in the appropriate contexts (Schunk & Zimmerman, 1994a). ‘If individuals learn to habitually solve a given type of problem in one way, they may be unable to deal with less common problem variations that require modifications to the procedures as originally learned’ (Derry, 1990, p.365). Furthermore, employing problem-solving strategies requires motivation and volition. Volition refers to willfulness or dogged perseverance in pursuit of difficult goals; in other words it describes the tendency to maintain focus and effort toward goals despite potential distractions. While motivation denotes commitment, volition denotes follow-through (Corno, 1994). There is a clear connection between volition and the qualities of patience, persistence and determination which were identified as characteristics of the capable computer user in section 6.4.1. Volition might also be seen as related to the concept of frustration tolerance discussed by Jonassen and Grabowski (1993). Self regulated learners ‘do not simply possess a bag of tricks or techniques to help them learn’, but, rather, ‘have the will and the wherewithal to deal with situations in which skills are absent’ (Newman, 1994, p.298).
When discussing problem-solving with the small groups we again drew on the students’ capable computer role models, as well as the generalised computer ‘help-desk’ figure. When asked to consider how capable computer users approached hitherto unexperienced problems, a range of strategies were identified, from reading the manual (although some doubted that that would contain the answer) to the importance of logical thinking and deduction. Group Two also discussed issues of volition. For some students, a capable computer user was one who could work things out with minimal fuss. If problem-solving took 7-8 hours some of the students questioned whether this made them capable. For other students (for instance, Sharon) it didn’t matter how long it took: ‘if you work it out you are capable’. For Carol, time remained important; if it took her a long time to work something out it would decrease her confidence. This discussion led to identification and sharing of strategies such as temporarily leaving the problem so as to be able to think of a new approach. This discussion proved beneficial, as individuals in the group realised that computer problem-solving was more about strategy than it was purely about experience.

Student 66 (cycle 3a) expressed similar insights:

At the beginning of this Unit, I had to identify what characteristics make up a proficient and capable IT user and I wrote “someone who knows everything”. This is clearly not the case. It is more the ability to apply that knowledge across all situations... the willingness to try is clearly what makes an expert because as one takes on the challenges of trying, one does become familiar with technology and hence becomes an “expert”. This will clearly be my goal.

Student 66 noted that she observed these attributes in her Unit tutor as he would solve problems side-by-side with her, something she described as ‘in itself a learning experience’. These reflections depict the importance of modelling problem-solving strategies rather than providing ‘answers’ to students’ problems. This was an important learning for me in my quest, as a teacher, to foster computer capability.

By cycle 3c, I was able to further refine and simplify the presentation of both attribution and problem-solving in the Thinking module (see section 7.4). Mindful of Candy’s (1991) criticisms regarding the use of hypothetical situations, and conscious of maximising the relevance of the metacognitive approach to the individual, the original attribution questions were replaced with prompts for students to reflect on real, rather than hypothetical, situations.

### 7.3.5 Reconciling Help-Seeking and Independence

Help-seeking was the ‘invisible’ issue affecting individuals’ success with the Unit and their use of computers more generally: invisible in that I only become aware of individuals needing assistance when they approached me or when their learning issues became evident in tutorials, if they chose to attend. Some students’ difficulties were only revealed through their journals. Other students, such as John in his first attempt at the Unit, chose never to acknowledge their struggles. In cycle 1, ‘support’ was identified as a functional issue: one related to my availability as a tutor and the amount of contact time I had with students. Greater understanding of students’ experiences assisted me, by cycle 3, to see students’ comments regarding lack of support as more to do with their help-seeking behaviour than with my own availability. The challenge for me, then, was to determine how I could prompt students to be more ready to seek assistance while still fostering self-directed learning and problem-solving.
In better attempting to understand the learning experiences of students, I was drawn to a body of literature concerning help-seeking (Corno, 1994; Newman, 1994; 2002). According to these writers, for help-seeking to occur the student must first become aware of a lack of understanding and then consider whether it is necessary to ask for help, what they should ask, how they should formulate the question, and whom they should approach. Initially, identifying a lack of understanding presented evident difficulties if students made inaccurate judgements about their own abilities. In the case of Yvonne and Brett, confidence (high self-efficacy) masked lack of skills and these students did not seek help because they did not realise that there was a problem or that new skills were required. Newman (1994) has identified two parameters impacting on students’ decision to seek help: their self-efficacy level and their confidence tolerance level. The confidence tolerance level is a trait-like attribute which represents the tolerance level below which one feels that help from someone else is necessary and beyond which one feels comfortable relying on oneself. It is relatively low for individuals who prefer challenges, are task-oriented, and are willing to take risks; it is relatively high for individuals who prefer little challenge, are ego-oriented, and are not willing to take risks. Such a summary would appear to apply well to Yvonne. As Newman continues, if the confidence level is exceeded by the current level of self-efficacy, the student perseveres, working independently. If the confidence tolerance level is not exceeded by the current level of self-efficacy, the student decides to seek help. Newman’s research indicates that students who desire and value challenge and mastery of material, rather than simply getting a good grade, adopt self-regulated help-seeking behaviour, and are more likely to ask for hints rather than answers, or to confirm whether or not their work is right, presumably so they can use that feedback for future mastery attempts. The connection to the earlier discussion of goal-setting and motivation will be self-evident.

Related to, but distinct from, the notion of help-seeking is that of learned helplessness (Borkowski et al., 1990; Mezirow, 1991a; Mikulincer, 1994; Ozment & Lester, 2001; Paris & Winograd, 1990). Learned helplessness can be contrasted with a ‘mastery orientation’ where individuals increase effort in the face of challenges. Such a response involves reacting to failure by abandoning problem-solving strategies when intensification or modification of strategic behaviour would be more appropriate. Students who demonstrate learned helplessness are likely to employ self-handicapping tactics such as procrastination and blaming others in an attempt to circumvent personal responsibility for failures (Borkowski et al., 1990). As these authors suggest, individuals experiencing learned helplessness often hold dysfunctional attributional beliefs, believing that ability and not effort is the cause of success. In brief, they fail to ‘help themselves’ and become ‘failure accepting’, to avoid the implication of low ability. In reading this literature, I began to reach a deeper understanding of students such as Yvette and Peter.

Traditional approaches to help-seeking have focused on dependency versus independence, leading to a perception that help-seekers tend to be those who are immature or dependent on others (Newman, 1994; 2002). However, dependence and over-dependence are quite distinct, and effective help-seeking is purposeful and instrumental, not only remedying an immediate problem but also ensuring long-term autonomy through mastery of a task. As Corno (1994, p.237) argues, help-seeking behaviour is an appropriate achievement-related activity, not an indication of dependency. Underlying learned helplessness, then, are issues
of strategy. It is valuable to note that both Borkowski et al. (1990) and Paris and Winograd (1990) pinpoint metacognitive processes as an approach to avoiding learned helplessness, and in supporting and motivating students to actively and consciously adopt appropriate help-seeking strategies. Thus, in cycle 3b, I incorporated a section in the Thinking module prompting students to reflect on these issues (as further detailed in section 7.4).

These theories informed my understanding of students’ computer learning, explaining comments regarding time utilisation in exploratory learning and the role of attribution. This literature also emphasised the potential for misunderstanding of the nature of self-directed learning promoted in the Unit. Although I embraced help-seeking as an integral part of self-directed learning, I realised that many students might hold other beliefs. There was an evident need to emphasise that self-direction did not mean learning in isolation but rather the ability to make conscious and informed choices about sources and strategies for support. In essence, I needed to clarify that help-seeking was a valid strategy to adopt in the context of independent learning and that help-seeking could be an appropriate strategy to deal with distraction, frustration or giving up. Some students’ conception of seeking help was to get an immediate answer while others sought tips on how they could move their own learning forward. Enhanced understanding of learned helplessness provided me with renewed teaching confidence. Rather than feeling perturbed by individuals who resisted self-responsibility for their learning, I gained a new perspective on the influences lying behind their behaviour, and thus how to respond. I acknowledged that students needed to be convinced that effort is a learning investment more than a risk to self-esteem (Borkowski et al., 1990). Failure does not imply low ability, but rather, is part of the normal process of cognitive advancement. Although my teaching approach had previously embraced these values (indicated, for example, through the multiple attempts permitted on the Challenge Assessment), in my interactions with students I strengthened my focus on learning strategies, emphasising the importance of seeing ‘errors’ or difficulties as important sources of learning. Furthermore, my fostering of buddying and peer-supported learning strategies was supported by Riessman’s (1990) arguments about restructuring help so that those who ordinarily receive help can function as producers of it.

7.3.6 Memory and Retention: An Example of Mis-applied Strategy

It will be remembered that cycles 1 and 2 revealed comments regarding issues of memorisation. My initial reaction had been that memorising was an inappropriate strategy for the computer learning context in general, and this Unit in particular, given the absence of an examination and its de-emphasis on technical terminology. Memorising strategies suggested a surface approach to learning, and seemed incompatible with experiential approaches. However, as Ramsden (1988) has stated, a student’s perception of a task’s demands is partly a function of his or her previous experiences of learning and partly a function of the characteristics of the context. Perhaps the inclination of some students to adopt a ‘memorising strategy’ was influenced by their previous experiences of computer learning or their habitual study strategies derived from other learning contexts. Alternatively, perhaps these students held differing perceptions of the requirements of the Unit, or of computer learning generally.

The influence of such perceptions and expectations was emphasised when reading the journal of Student 66 (cycle 3a). This student began by reflecting on her limited experiences with technology. She noted that she had learnt the basic skills required to
complete assignments with individual assistance from her husband, writing down all the steps, or asking him to write them down for her because she could not ‘watch and remember’. Later, in her journal, Student 66 reflected: ‘I spent most of my schooling days memorising facts and figures to be regurgitated for tests. This to me was the only way to “learn”. As an adult I am becoming fully aware of the weaknesses of this particular kind of learning method, especially when it comes to computer use’. Student 66 went on to refer to her reading of Ferdig (1998), which reinforced to her that memorising computer steps was not effective. From this she resolved that ‘as a teacher, I clearly need to avoid drilling steps and make sure I develop in my students their intuition in computer use instead’. This was an important insight for this student. In her summative reflections she notes:

Throughout this unit, I wrote down everything that would help me remember the steps necessary to do various tasks. It occurred to me during tutorials however that this was a waste of time and really not practical. Sure I could write down some things but to write absolutely everything was silly, especially when the computer has the “help” function. This was an eye opening experience.

The metacognitive approach thus held potential for liberating students from using inappropriate strategies. In discussing issues of memorisation with the small groups, I had trialed the use of metaphor, prompting them to compare their approach to computer learning to strategies employed when they had learnt to drive a car. This metaphor seemed to be a valuable reflective challenge and was retained in the Thinking module in cycle 3b and 3c (see section 7.4).

In pursuing greater understanding of the role of memory and meta-memory, I encountered an article which was to significantly influence my understanding of the computer learning context. Bjork (1994), while referring to training contexts generally, provides a well supported argument about the importance of introducing difficulty during training for longer-term retention of learning. Bjork notes that training which speeds the rate of learning acquisition can fail to support longer-term performance, while contexts that introduce difficulties for learners can enhance post-training performance. Rapid progress in training may be reassuring to the learner; however, little learning may actually have taken place and learners may be fooled by their successes. While struggling and making errors is distressing, and may cause trainees to underestimate their own state of learning and comprehension, Bjork points out that substantial learning may, in fact, be taking place. ‘We should probably find the absence, not the presence, of errors, mistakes and difficulties to be distressing – a sign that we are not exposing ourselves to the kinds of conditions that most facilitate our learning, and our self-assessment of that learning’ (Bjork, 1994, p.201). Contrary to conventional training methods, such a perspective advocates training which introduces difficulties and challenges, such as variation or unpredictability, which distributes practice over a longer period of time and reduces feedback to the learner. Bjork notes that durable and flexible access to information in memory is partly a function of the coding of that information and partly a matter of practising the retrieval process. In responding to difficulties and challenges during training, learners are forced into more elaborate encoding and more substantial and varied retrieval processes.

Bjork’s claims confirmed my experiences and the comments of many students in cycle 2 and 3a. It is valuable to recall two cycle 2 students’ remarks regarding self-directed learning. Student 6 (cycle 2) reflected that ‘maybe it is the act of discovery that places the
information in long term memory’ and Student 104 (cycle 2) observed that ‘I find that if I can stumble and fumble my way around and discover something I remember it for the future more easily’. Both Jill’s and Gary’s case studies emphasised the value of difficulty in learning retention. Such a perspective on memory and learning clarified the underlying benefits of the approaches adopted by capable computer users and lent support to the metacognitive approach adopted in the Unit, with its focus on strategy. Helping students to become aware of the value of ‘mistakes’ and investment of time spent on exploratory learning might assist them to perceive the value of, and thus tolerate, a non-error-free training context. I return to the influence of Bjork’s paper on my teaching in the final chapter of this thesis.

7.4 Consolidating the Metacognitive Approach

By the end of cycle 3b, the research had documented a diversity of students’ reactions to, and engagement with, the Unit. The metacognitive approach now in place incorporated a comprehensive array of factors impacting on computer learning. Student journals were no longer revealing previously unconsidered issues; as Murray and Lawrence (2000) describe, the story had become ‘theoretically saturated’. At this point I was ready to move the Unit from a ‘research’ and data collection phase toward a sustainable and more integrated phase; one where my learning from the research was explicitly contained in the Unit’s processes and content and could be maintained relatively consistently, regardless of my level of involvement. Such an approach was consistent with an imperative of enduring consequence described by Bradbury (2001) as a mark of action research’s validity. To this end I embarked on another round of Unit re-development in preparation for cycle 3c, consolidating the presentation of the metacognitive theory and more seamlessly integrating the data-collection tools (in particular the self-assessment survey) into the Thinking module.

To summarise the resultant content, the Thinking module now opened with an explicit invitation to students to work through the module either individually or through small group discussion. The metacognitive approach was introduced and students were prompted to identify their initial feelings, motivations and beliefs about the Unit, including hurdles that they could foresee. A quote was used to focus students’ attention immediately on their future role as a teacher and the importance of teacher attitudes about computer technology in influencing their students: ‘It is teachers’ attitudes towards technology, their beliefs in teaching and learning and their styles of teaching that determine how students use the Web and what sort of learning experience will be acquired (Lai, 1999, p.12). These inclusions thus began to stimulate thoughts regarding perceived usefulness. A brief statement emphasised that student teachers were not expected to become computer ‘experts’ but that their confidence and willingness to learn and continue to learn was of importance to their students. The remainder of the module was presented in three sub-sections.

The first section, ‘feelings, attitudes and beliefs’, prompted students to reflect upon six sections from the self-assessment survey: encouragement by others, use by others, support, perceived usefulness, attitudes and feelings/anxiety. The notion of self-efficacy was introduced and students were encouraged to identify strategies for developing their own, or their students’, computer self-efficacy. After presenting two attributional survey questions (see section 7.3.4), the pros and cons of internal attribution were alluded to with reference to past students’ reflections. Individuals were prompted to reflect on how educators could
assist students to develop appropriate attribution. Motivational issues were then considered, encouraging students to re-examine their responses to the ‘perceived usefulness’ questions. In response to Sandra’s case study, students were also asked to consider any educational or social concerns they might have regarding computers. In response to Thomas and Cooper’s (2000) research, students were prompted to get a ‘taster’ of the value of computer in education by visiting the Australian Web Quest Site: (http://www.occ.act.edu.au/home/itpd/webquests/matrix.htm).

The second section of the module concerned learning strategies and opened with the ‘pathways to learning’ content utilised since cycle 2. The importance of lifelong learning was discussed and the learning strategies component of the self-assessment survey encouraged students to consider their confidence in contexts of dependency and independence. Prompts to identify and reflect upon a capable computer user were retained from cycle 3a, including the list of factors identified in cycle 2; and students were encouraged to consider how reflecting on this role model, along with children’s approaches to computers, might influence their own computer learning strategies. This led on to a brief exposé of the theory of playfulness and students were encouraged to consider strategies that promote play. The role of memory was touched upon by way of the analogy of learning to walk or drive a car and students were prompted to consider the role of note taking and terminology. Mention was then made of the importance of difficulty and effort in enhancing learning retention, with mention of the work of Bjork (1994). A new section emphasised the inevitability of ‘problems’ in computer use and that these ‘happen to everyone’. The importance of balancing problem-solving and help-seeking was emphasised and students were encouraged to reflect on their feelings about help-seeking, and strategies they could use to assist their students to develop such skills. Students were encouraged to consider identifying a learning buddy. The section concluded with the ‘ten tips’ (as introduced in cycle 2) but students were prompted to add other tips, re-focusing them on strategy use.

The third section of the module focused on identifying and achieving learning goals. Students were prompted to consider their ‘big picture’ goals, as well as their sub-goals, and the computer skills chart was included in context to support them to do this. Students were encouraged to consider whether the goals they had set were ambitious or conservative and how they felt about the ‘imposed’ goal of producing a Web site. Within the context of goal achievement, students were prompted to reflect upon their use of time and priority beliefs and to produce a study schedule for the semester. Finally, informed by the experiences of students such as Peter, a section was provided to prepare students for moving on to the Using and Applying modules. 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 Unit that all students had to work through identically, since everyone would have different interests, existing knowledge and skills and therefore different needs. The Thinking module concluded with an emphasis on students having fun.
A further area of redevelopment in preparation for cycle 3c lay in the reconceptualisation and restructuring of the Using module, the skills-focused section of the Unit. As mentioned briefly in section 7.2.5, I developed five ‘windows’ into each of the topics: Facts, Skills, Activities, Use in Schools and Reflection. These windows were accompanied by a bright, inviting and ‘fun’ graphic interface, one which I felt encapsulated an approach of ‘play’. These five windows were designed in response to the recognition that some students required 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. A further design decision made was the removal of the learning objectives which preceded each topic in the Using and Applying module. The rationale for this decision is taken up in section 8.5.4. These redevelopments embodied the cumulative findings of the research, and symbolised the changes in my approach to teaching computer literacy.

7.4.1 Summarising Student Evaluations

To assess the resultant changes in students’ reactions to the Unit as a result of the research, I now return to the student evaluation data (appendix 5) and consider the changes in students reflection since cycle 1.

To firstly consider the student evaluative data, 1999-2001 (appendix 5) it can be seen that, with the exception of cycle 3a, when medical leave curtailed my contact with students, feedback on my teaching became (overall) more positive. Of greatest interest was the stability in responses regarding encouragement of student self-responsibility for their own learning (question 2h). The already high response to this question in cycle 1 indicated that I had conveyed this from the beginning, but the more positive feedback overall indicated that I probably conveyed this in more student-acceptable ways as my teaching practice improved. Table 18, appendix 5, indicated the rising level of self-perceived skill and confidence by students over the three-year period. Given the increasing use of computer technology in society more generally, this might be expected. This might also explain the less significant increases in skill and confidence reported by students as a result of engagement in the Unit. Notably, table 19 indicated that students did not perceive the Thinking module as having as great a value as the Using, Applying and Creating modules, although the mean response of 3.7 still indicated students’ acceptance of it, and the figures from cycle 2-3b documented its growth in perceived value.

The collated qualitative data from the open-ended questions revealed the diversity of students’ reactions to various aspects of the Unit and the futility (and, perhaps, undesirability) of trying to ‘please everyone’. For instance, while some appreciated the self-paced learning and flexibility, others wanted more structure; while some found the Unit too difficult, others wanted more challenging content; while the majority enjoyed designing the Web site, others did not. Most interestingly, a small number of students cited the journal as one of the best aspects of the Unit while others saw it as an areas needing improvement. Notably, several students qualified their comments about the journal with statements such as: ‘too much work however was beneficial to my learning’ or ‘less emphasis but a good idea’.
My subjective impression of students’ reflections indicated that functional issues were rarely mentioned by students by cycle 3a and 3b, an outcome perhaps influenced not only by improvements in access to technology, and the production of the Unit 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 suit 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 Unit 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, I was fostering and capitalising on the sense of excitement revealed by a small number of students in cycle 1 and, from the level of informal and unsolicited feedback from the students in cycle 3c, I could confidently say that students were now more likely to be touched by a sense of ‘fun’ and ‘excitement’ in their computer use.

7.4.2 Representing the Metacognitive Process

The outcome of the research cycles can be represented as the metacognitive approach to computer teaching and learning. This metacognitive approach can be represented in two ways. The first and most tangible representation is the Unit resource itself, as provided on the cycle 3c CD-ROM (appendix 22). While the Thinking module provides the major focus of the metacognitive content, this module cannot be considered in isolation from the structure and learning processes embedded throughout the Unit resource. A second representation of the metacognitive approach is presented in figure 6.

This figure is somewhat complex, containing a number of ‘layers’ that might be unpacked by way of explanation. The figure depicts the drawing together of past and present computer learning experiences with a view toward enhancing future computer learning. Within that broad framework, the model identifies three dimensions requiring consideration: affects (feelings, attitudes, beliefs and assumptions), motivation and strategies.

Positioned along the sides of the triangle are the elements that are incorporated into the metacognitive approach: the elements exposed and investigated through this research. These are located along the continuums between the three triangle apexes, as most logically representing their relationship to affects, motivation and/or strategy. Thus, self-efficacy, anxiety, attribution and learned helplessness are affective in nature, but self-efficacy and anxiety have more to do with motivation than strategies, while attribution and learned helplessness are more closely aligned with strategy use than motivation. Within this framework lies the foundational cyclic process inherent in action and experiential learning: plan, act, observe and reflect. It is this ‘cog’ that drives the learning process forward. All sides of the triadic model are interdependent and cannot be considered in isolation from each other. The ‘glue’ that binds the elements together is reflection, and this underpins the whole metacognitive learning approach.
Figure 6  The metacognitive computer learning process

This figure illustrates the metacognitive computer learning process and the various elements which were demonstrated in this research to impact on the process. The figure illustrates the interplay between an individual’s affects and motivations, derived from their past and present computer use. It also depicts that the journey toward future computer use involves the adoption of learning strategies. The metacognitive process entails individuals actively considering the influence of various factors relating to affects, motivations and strategies through a process of planning, observing and reflecting.
A second and simplified representation (as depicted in figure 7) can also be used to enhance understanding of the metacognitive computer learning approach, drawing on the metaphor of journey used throughout this thesis.

This representation acknowledges that any traveller carries with them luggage; the feelings, attitudes, beliefs and assumptions which influence how they interpret their travelling experiences. If this luggage is heavy and inflexible it can slow the traveller down and impact on their interpretations of the journey. If the traveller is prepared to pack wisely and

**Figure 7** Metaphorical simplification of the metacognitive computer learning process

This figure illustrates the metacognitive computer learning process through the metaphor of ‘journey’. Travellers bring both luggage and a sense of their preferred direction to the journey but require a means of transport and navigation strategies to reach their destination. Along the way they confront cultural encounters which impact on the luggage they bring, the direction they are aiming toward, the navigation that they use and ultimately their journey’s destination.
reassess the content of their luggage along the way, casting off inappropriate ‘possessions’ and replacing them with more appropriate artefacts, the journey will be enhanced. The traveller also needs to know the broad direction in which they are heading and the reasons why they are going in that direction. Without the motivation and conviction that the journey is worthwhile they are unlikely to get far. The traveller also needs some means of navigation: a map to guide their travels. Of course, they may start out with a large-scale map to provide broad direction, but as they progress they will need to refine their map and look more closely at the strategies required to facilitate their journey. It might be noted that the most exciting travelling adventures may start from no real concept of destination beyond adventure itself. What is important is that the traveller develops the conviction and confidence that the journey is worthwhile and achievable. The same might be said of computer learning, where the best learning adventures are seen as having no end or final point. Within this triadic framework is some consideration of the means of transport: the way of progressing through the adventure. The implication here is that all steps along the journey need planning, acting and evaluating, and if one form of transport is ineffective, or one route inaccessible, then another should be chosen. Through reflection on our experiences we learn which approaches are better than others in certain circumstances. So too, in the computer domain, we need to develop understandings of which learning strategies are best employed in each context. The metaphor might be continued, with each element (as identified in Figure 6) being representative of a cultural encounter; an experience gained along the way, which teaches us something about our journey. Finally, what we gain from our journey is a combination of the photos and the memories of our experiences which combine, through reflection, to teach us something about our present situation. These memories and reflections also provide the impetus and excitement to continue our travelling adventure in the future: to become lifelong, capable computer learners.

7.4.3 Stepping Back and Moving On

This chapter has traced the intense and complex processes of planning, acting, observing and reflecting that occurred throughout cycle 3. It has explored the various issues surrounding reflection, motivation and goal-setting and their influence on learning engagement. Cycle 3 exposed the unpredictable influences of a group reflection context while also highlighting further the diversity of individuals’ experiences of computer learning. In embracing and incorporating issues such as playfulness, readiness, appropriate attribution, help-seeking and memory and retention, a clear direction emerged in the metacognitive approach, supporting students to move from ‘causes to solutions’. Emerging from this third cycle, then, was a visual representation of the metacognitive approach to computer learning, supported by the very tangible ‘product’ of the Unit. At various points throughout this chapter I have alluded to an underlying theoretical framework which had begun to assist me to make further sense of the research and my teaching practice: the theory of complexity. In the following chapter I explore this theory and demonstrate its relevance to this research.
Chapter 8 - Complexity as Window on the Research

What has not been depicted in the chronological presentation of the three cycles is a more profound development that occurred for me personally as both researcher and teacher. Here I refer to my ‘discovery’ of, and theoretical engagement with, the literature concerning complexity. My initial encountering of this literature occurred mid-way through 2001 (cycles 3a-b) and, from that point, the concept of complexity impacted significantly on my thinking, reflection and analysis of the macro research, providing a unifying framework that enhanced my understanding of the theoretical, methodological and professional journey along which I had been travelling. As a new and emerging theory, complexity’s application in learning and education warrants a thesis in its own right. This chapter will, however, focus upon the impact of complexity on my teaching and research practice and present an interpretation of the research through the window of complexity. The chapter firstly discusses complexity and its application as perspective on epistemology, on methodology and on education. It then explores my research through the window of complexity, presenting a fresh perspective on competency, capability and metacognition and a re-examination of the Unit’s design. Finally, I offer a critique of my engagement with complexity theory as theoretical underpinning.

8.1 Encountering and Exploring Complexity

The literature surrounding complexity is comparatively recent, owing much of its development to a group of eminent cross-disciplinary researchers, several of them Nobel laureates, working at the Santa Fe Institute in the USA. Complexity theory is essentially a formal attempt to question how coherent and purposive wholes emerge from the interactions of simple and sometimes non-purposive components (Lissack, 1999). At its most humble, it attempts to explain the ‘big consequences of little things’.

Complexity has been described variously as a dynamic non-linear paradigm (Brodnick & Krafft, 1997), as a significant transformation in ontological and epistemological thought (Dillon, 1999), as metaphor (Lissack, 2001; Rosenhead, 1998), as meta-narrative (Doll, 1997-8) and as meta-account (Medd, 2001). Various writers have also explored the notion of complexity as a major paradigm shift (Bossomaier & Green, 1998; Davies & Gribbin, 1991; Medd & Haynes, 1998; Stacey, Griffin & Shaw, 2000), although this has been questioned by others (Gough, 1999; Underwood, 2000). As a relatively new perspective, complexity has not yet formally defined its own theoretical boundaries (Doolittle, 2000) and is ‘less an organized rigorous theory than a collection of ideas which have in common the notion that within dynamic patterns there may be underlying simplicity’ (Lissack, 1999, e.p.). Complexity might be described more accurately as a ‘meta-discipline’ in the same sense that Checkland (1981) described systems theory. There are multiple perspectives on complexity and, while sometimes referred to as ‘complexity theory’, it is arguably more accurate to refer to complexity ‘theories’ (Fleener, in press-b; Gare, 2000; Stacey, Griffin & Shaw, 2000).
While this literature is quite recent, the ideas embodied by complexity have been the focus of philosophers and scientists for some time, particularly those who have challenged Newtonian mechanistic thinking. Complexity has, however, only recently begun to influence and challenge the orthodoxy in a broad range of disciplines from evolution, immunology, architecture and economics to education and psychology. The literature varies greatly in its focus, ranging from the highly technical (Kauffman, 1995; Mainzer, 1997), the heavily philosophical (Dillon, 1999; Medd & Haynes, 1998), the narrative and accessible (Bosomaier & Green, 1998; Davies & Gribbin, 1991; Waldrop, 1992) and, more recently, to the highly applied (here I refer specifically to complexity’s application in the social sciences) (Brodnick & Krafft, 1997; Davis & Sumara, 1997a; Lissack, 1999; McAndrew, 1997; Medd & Haynes, 1998; Rosenhead, 1998; Youngblood & Renesch, 1997; Zhang & Fowler, 1996). Explanations of the theory are thus also highly varied, particularly given the capacity of complexity to be applied in a wide range of contexts and at different levels of discourse. A brief but relatively comprehensive summary of complexity is provided by the Cognition, Technology and Complex Systems Group:

Complex systems or complex adaptive systems involve phenomena which may be characterized by the interactions of numerous individual agents or elements, that self-organize at a higher systems level, and then in turn show emergent and adaptive properties not exhibited by the individual agents. There are also ways that such systems take in data from their environments, find regularities in the data, and compress these perceived regularities into internal models that are used to describe and predict its future. Complex systems exhibit evolutionary processes in that these internal models are subjected to selection pressures in the context of specific environmental conditions resulting in changes to the internal models over time. Finally, the emergent characteristics of a particular complex system frequently form the individual agents in a higher level complex system (Jacobson, 1997, e.p.).

Complexity is related to the more popularly known chaos theory, but is generally considered to be more widely embracing and generalisable across different levels and contexts. A further exploration of the commonalities and differences between complexity and chaos theory is provided by Marion (1999).

### 8.1.1 Key Postulates of Complexity

In developing an understanding of complexity I engaged with a wide range of ‘primary’ sources (for example, Capra, 1982; Kauffman, 1995; Pagels, 1988; Progogine & Stengers, 1984) and ‘secondary’ sources (for example, Johnson, 1996; Waldrop, 1992). This section presents a synthesis of this literature in order to identify and succinctly explain the key postulates. These ideas cannot be considered as isolated from each other, but as collectively representing the underpinnings of complexity thinking. I have refrained from an explicit discussion of the relevance of these ideas to this research until later in this chapter.

**Open, Non-linear Systems**: Complexity is concerned with open, non-linear systems. An open system is one that needs and receives energy to maintain its order and where this maintenance of order places the system in a state that is far from equilibrium. A non-linear system is unpredictable in that, even if one was familiar with all the components of the system, one would still not be able to determine exactly what would happen next. Such a system is thus greater than the sum of its parts. Complexity acknowledges the inability to totally understand the whole through an understanding of the parts but rather aims to
understand the whole by understanding the interaction of its parts. These notions are well explained by Davis and Sumara (1997a, p.114):

...even the most profound knowledge of the subsystems that come together to form a complex system will not help us to predict or to control the behaviors of such systems. The most thorough understandings of hearts, livers, brain stems and skin does not help us much in accounting for the emergence of such complex phenomena as consciousness and identity. Although these ‘components’ all contribute to such phenomena, their interrelation is too complex to understand through a process of fragmented study. It is the relations among them, not the things themselves, that are productive and, as such, of interest.

Inherent Unpredictability and Sensitivity to Initial Conditions: Complexity theory is founded upon alternative conceptions of causality, acknowledging that uncertainty of prediction is inevitable (Eve, Horsfall & Lee, 1997b) and that processes are critically dependent on their initial conditions, conditions that may be unrecoverable or unknowable. This is the essential notion behind the well known ‘butterfly effect’, a term arising from the meteorological modelling of Lorenz (Waldrop, 1992). Sensitivity to initial conditions means that the long term trajectory of a system is highly sensitive to its starting point and that long term behaviour of a system is determined as much by small chance changes as by deterministic laws (Stacey, Griffin & Shaw, 2000). Complex systems are, thus, a-periodic, never settling in a precise pattern because nothing repeats in a systematic way (McAndrew, 1997). This unpredictability does not, as Turner (1997) states, equate to unintelligibility or inaccessibility to understanding, but it does predicate a different type of understanding.

Self-organisation: Self-organisation attempts to understand how a single species organises into an ecosystem, a stock into an economy, a cell into an adult or a snowflake into an avalanche (McAndrew, 1997). Complexity proposes that interacting agents transcend themselves by acquiring collective properties they would not develop individually, and that they do so in the absence of any overall plan or blueprint (Stacey, Griffin & Shaw, 2000). This concept of self-organisation is often illustrated with the example of a growing sand pile, which sustains its shape in a dynamic, self-organising way despite avalanches; the internal dynamics of the sand pile retaining its shape (Bossonmaier & Green, 1998; Kauffman, 1995). The term autopoiesis is used in complexity theory to refer to the patterns of self-generating, self-amplifying and self-maintaining systems. An autopoietic system consists of components whose behaviour or structure is formed by the system itself. Such systems have no task, goal or purpose other than maintaining their own identity (Stacey, 2001).

System Stability and Bifurcation: Systems can be structurally stable or unstable. A structurally stable system is unaffected by minor changes while a structurally unstable system is one in which a minor change results in a major change in the whole system. Bifurcation, or phase transition, is the term used by complexity theorists to describe the branching of phenomena seen during chaotic episodes (Price, 1997). Bifurcation usually results in new but more complex stabilities. There is unpredictability at each bifurcation point since no subsequent state is deducible from the previous one (Stacey, Griffin & Shaw, 2000). Mathematical models of complexity refer to the influence of the strange attractor that both attracts and repels.
The Emergent Nature of Change: From a complexity perspective, development and change is viewed as a natural and evolutionary process which is neither imposed nor random (Doll, 1997-8). Rather, it is the interaction among component parts and the ways that the systems organise, which promote change. Emergent structures are not outcomes in themselves but in turn influence future events, making possible the evolution of qualitatively different kinds of systems (Mihata, 1997). Complexity views change as adaptation stemming from the interaction, alignment and organisation of agents into higher levels of complexity (Lee, 1997). Change thus involves the aggregate behaviour of individual agents, as elaborated in the following point.

Primacy of Agent Interaction: In complexity theory, what constitutes a ‘part,’ or an agent, depends on the level from which one views the ‘whole’. An agent could be a neuron, a neuronal group, an experience, or even a whole person (in a social situation). What is of importance regarding agents, is not the agents themselves; but, rather, the interaction of these agents with each other. Complexity posits that agents function through the use of internal models or schemas. These schemas are actively constructed, self-organised and emergent and are the result of perceived regularities in experience. In other words, complex system behaviour involves adaptation to the environment, based on experience (Doolittle, 2000). Complexity thus embraces postmodernist concepts of the inseparability of the ‘knower’ from the ‘known’, notions I return to later in this chapter. Change is ‘adaptive’ and fed by changes in relationships between component agents, with interacting agents always trying to turn whatever happens to their advantage. Over time, agent interactions feedforward to produce the macroscopic configuration of components that is discernible at any given point. Feedback describes the continual accretion of effects from previous interactions.

To summarise, then, complexity emphasises the importance of acknowledging the whole range of variables impacting on any context and the inability to control such variables while maintaining contextual integrity. Complexity represents a recognition that the world is irreducibly complex, not determinist and predictable, and that the task before us is no longer to identify the simple elements of reality underlying complex appearances, but to work out how to study complexity in its own right (Gare, 2000).

8.1.2 Complexity Theory in the Social Sciences

Increasing numbers of researchers are utilising complexity to enhance understanding of the social world. The publication of *Chaos, Complexity and Sociology: Myths, Models and Theories* (Eve, Horsfall & Lee, 1997a) is testament to complexity’s strengthening theoretical rigour and applicability in social disciplines, as are the increasing number of journal articles drawing on this theoretical basis (see, for instance, *Social Issues*, vol.1, no. 2, Oct. 2001, http://www.whb.co.uk/socialissues/). According to Underwood (2000), complexity provides three key implications for the social sciences. Firstly, it places an increasing stress on self-organisation and a realistic awareness that sociological phenomena often cannot be forecast. Secondly, the theory recognises that all living organisms are self-steering within certain limits and that their behaviour therefore can be steered from the outside only to a very moderate extent. Thirdly, complexity highlights the continuous emergence of new levels of organised complexity within society. In short, ‘the complexity paradigm requires a shift in thinking, although it makes more explicit what many social scientists and practitioners have “known” as they recognized that human institutions are not
Amenable to prediction and manipulation in simple linear terms’ (Brodnick & Krafft, 1997, p.3). The application of complexity theory in the social sciences is not, however, without its critics (for instance, Hunter & Benson, 1997; Medd & Haynes, 1998; Pigliucci, 2000). Criticisms often relate to the use of complexity as a metaphor, an issue returned to in section 8.2.1.

That there is a growing body of literature applying complexity to management and educational contexts is not surprising given its focus on evolving and changing systems, notions central to learning and teaching, as well as organisational change. It is this literature which will be the focus of the remainder of this chapter. The following sections outline how complexity influenced my thinking at a number of levels: epistemologically, methodologically, theoretically, educationally and pragmatically. The discussion is presented through a reflexive framework, an approach justified by complexity itself. Whereas a mechanistic world-view denies the connection between the researched and the researcher, complexity embraces such a reflective approach (Capra, 1982).

8.2 Complexity as Perspective on Epistemology

In cycle 2, I had engaged with the literature concerning mixed methods and mixed mode research. Given this, I was struck by the potential of complexity to unite traditionally disparate disciplines in the natural and social sciences and to reintegrate modernist and post-modernist approaches (Altrichter, 1991; Gold, 2000; Mainzer, 1997; Pagels, 1988). Complexity challenges both positivist and postpositivist thinking, while drawing from both, thus presenting an interesting challenge to the ‘paradigm wars’ (Tashakkori & Teddlie, 1998). Guba and Lincoln (1994, p.116) had noted that ‘a resolution of paradigmatic differences can occur only when a new paradigm emerges that is more informed and sophisticated than any existing one’. Complexity seems to offer such an approach.

The foundations of complexity are inevitably epistemological, as emphasised by recurrent reference to the writing of Bateson (1991). Much of the literature is framed as an examination of the history of science: a philosophical and epistemological journey through Newtonian physics, Cartesian scientific thought and quantum physics (for instance, Capra, 1982; 1996). Fleener (in press-b) views complexity as the narrative of modern society attempting to re-connect with a way of being that is more holistic, relational and meaningful. Complexity represents a shift from a mechanistic to a holistic conception of reality (Capra, 1982): a change in the central metaphors of understanding from the cogwheels and levers of the Newtonian clock to the metaphors suggested by chaos and complexity (McAndrew, 1997). Complexity breaks away from reductionist paradigms and focuses on the interaction of components: a shift towards holism (Davies & Gribbin, 1991). Writers such as Marion (1999) and Stacey, Griffin and Shaw (2000), detail how teleology lies at the heart of many complexity theorists’ thinking, thus challenging the very notion of causality and ‘purpose’. These authors argue that complexity (particularly as represented in the work of Prigogine) is underpinned by transformative teleology, which differs from formative teleology in that there is no sense of a pre-determined form: there is no knowable or ‘ideal’ future.

Several authors have addressed the relationship between complexity and postmodernism (Dillon, 1999; Eve, 1997; Fleener, in press-b; Lee, 1997; Price, 1997), indicating the potential of complexity in supplementing, if not challenging, postmodern thought. While
there are many congruencies between the two approaches, Price (1997) argues that there are foundational differences. While postmodernists avoid all-encompassing explanations, complexity theorists maintain that there are universal principles that work in all dynamic systems. Price also argues that postmodernity and complexity conceptualise transition differently. For Foucault, ruptures occur as historical *a priori* changes, giving rise to new discursive formations, whereas complexity discusses change in terms of transitions and bifurcations. Price also sees complexity as offering a more optimistic view of human agency than is presented by postmodernism. Other writers (Doll, 1989b; Fleener, in press-b) see complexity as a postmodern perspective while Lee (1997) argues that complexity is ‘nonmodern’ in that it is neither concerned with the individual, nor the societal, but is concerned with interrelatedness and interdependence. For others (Rossman & Rallis, 1998), an exploration of complexity as epistemological perspective is in itself problematic, raising issues of whether complexity is an objectivist reality or subjectivist social construct. While such a debate is philosophically interesting, it is not necessary to pursue these distinctions in the context of this research. As has been emphasised by several writers (such as Stacey, Griffin & Shaw, 2000), complexity does not represent the ‘end’ to one type of thinking (whether it be Cartesian scientific thought or postmodernism) and the beginning of another. Rather complexity provides an alternate theoretical perspective which can provide new ways of understanding, opening up new possibilities (Medd, 2001).

One further point might be made relating to issues of both epistemology and methodology: the notion of complexity as metaphor.

### 8.2.1 Modelling or Metaphor? Issues of Validity in ‘Knowing’

Two approaches have emerged in the study of complex systems. One approach, adopted predominantly but not exclusively in the natural sciences, is that of mathematical and computer-based modelling (see, for example, the notion of evolutionary computing discussed by Bossomaier & Green, 1998; or the mathematical definitions explored by Marion, 1992). While modelling is being adopted by some researchers in the social sciences (for example Stroup, 1997), the more commonly employed approach is to use complexity as metaphor. Many writers have written in support of the validity of complexity as metaphor (for example, Fleener, in press-a; in press-b; Gough, 1998; 1999; Reason & Goodwin, 1999), although this approach has been criticised by others (for instance, Pigliucci, 2000). Stacey, Griffin and Shaw (2000) claim that modelling cannot take account of emerging novelty or human freedom and that it provides no assurance that real life will take on the same evolutionary pattern as the model. From such a perspective, models can only be used as analogies, not direct applications. The work of complexity theorists working with such models is valuable in that it lends support and understanding to the nature of complexity itself, but it can never, as Stacey, Griffin and Shaw emphasise, help us to understand a specific system in reality. Stacey, Griffin and Shaw (2000) argue that metaphor (or more accurately analogy) is a more valid approach to complexity than modelling.

My research had already led me to engage with the literature surrounding metaphor and its relationship to the ‘nature of knowing’ (Boyd, 1979; Ortony, 1979; Reddy, 1979; Schön, 1979). Consistent with my constructivist beliefs, I supported Lakoff and Johnson’s (1980, p.184) claim that our conceptual system is inherently metaphorical: ‘we understand the world, think, and function in metaphorical terms, and... metaphors can not merely be
understood but can be meaningful and true as well’. From such a perspective, truth is always relative to a conceptual system that is defined in large part by metaphor. Such a view is inherent within complexity and is consistent with the underlying constructs regarding agents’ internal models and schemas being actively constructed and emergent. In this sense, the literature of metaphor, constructivism and complexity rub shoulders, all founded on the understanding that we understand the world through our interactions with it.

Educational complexity theorists such as Gough (1998; 1999), Fleener (in press-a; in press-b) and Reason and Goodwin (1999), argue that the value of complexity lies in its capacity to encourage new forms of social imagination, new ways of seeing and new language to describe relationships and structures. The issue is whether we can use metaphor in a creative and transformative way, to open up new realities. Gough (1999) continues by pointing out the irony that, from a complexity perspective, we are liberated from the need to find ‘answers’ or ‘predictable solutions’ to our research questions; complexity allows us to reach new understandings that are based more on the realisation of the importance of accepting the unknowable. ‘The question, then, is not whether in applying complexity theory to organizational and social life we are being metaphorical – it would seem that metaphor is unavoidable’ (Reason & Goodwin, 1999, e.p.). The important point is that we can ‘see through’ our metaphors and use these metaphors, rather than allowing them to use us, as have the metaphors of Newtonian mechanistic thinking.

8.3 Complexity as Perspective on Methodology

There are, as yet, no established methodological approaches or specific analytical strategies to apply complexity thinking to the social sciences. In addition to the use of metaphor and mathematical modelling (discussed in the previous section), a range of possible approaches has been suggested, such as the use of grounded theory, constant comparison, rich description and discourse analysis (Bloom, 2001b). Various writers (Greene, 1994; Hase, 2000b; Lee, 1997) have emphasised the need for diverse tools and mixed methods in order to reach more complete understandings. This section considers the methodological implications of complexity. Complexity’s critique of reductionist methods is first presented and it is then argued that action research represents a valid methodological approach given the understandings provided by complexity. Finally, the value of reflective journals as a data collection method within a complexity-based perspective is discussed.

8.3.1 Complexity as Critique of Reductionism

Methodological approaches in the complexity sciences are challenged by alternative conceptions of causality and questioning of the very notion of empirical validation. Rather than focusing on prediction, complexity focuses on explanation (Kauffman, 1995). Statistical analyses are seen by some as making inaccurate assumptions about the dynamics of the systems being modelled and of avoiding the complexities of micro dynamics (Stacey, Griffin & Shaw, 2000). Various complexity theorists have drawn on Gregory Bateson’s remark that, in studying human behaviour, ‘the most elementary requirement of statistics, uniformity of sample, is not met’ (cited, for instance, by Bloom, 1998). Complexity theory emphasises the importance of acknowledging the whole range of variables impacting on any context and the inability to control such variables while maintaining contextual integrity; in complexity terms, the inability to totally understand the whole through an understanding of the parts. Although it is beyond the scope of this thesis to explore these issues in depth, they are relevant to my reflexive methodological critique.
It will be remembered that, in cycle 2, I employed a psychometric survey instrument (the self-assessment survey) to gather quantitative data. At the time of analysing this data, I was unaware of the complexity literature. However, in reflecting on my critical analysis of this methodological decision, I had acknowledged an inability to forego my constructivist position when approaching the data (see section 5.2) and my concerns about causality and unpredictability of meaning inherent in the data. These underlying epistemological foundations are those embraced by complexity.

The quantitative data, which I collected and analysed in cycle 2, can only be viewed as a ‘snapshot’ in time and embedded within it were complex layers of meaning. Higher frequency of use did not necessarily indicate higher self-efficacy, increased support did not necessarily lead to more confident computer use (and could, in some circumstances, undermine it) and encouragement and use by others could be interpreted as counterproductive ‘pressure’. The individual histories of students were too various for their combinations and permutations to be adequately represented by statistical approaches. The reflective data provided by students served to highlight the various initial conditions (histories) of the students and emphasised that the ‘butterfly effect’ (sensitivity to initial conditions) can easily invalidate results (Stroup, 1997). The survey data was thus valid only in deriving a picture of individual students’ perceptions at a point in time and could not necessarily be interpreted beyond that.

### 8.3.2 Action Research as ‘Real Life’ Modelling

Engagement with the complexity literature led me to reflect on the synergies between it and action research. I initially located only a couple of authors drawing connections between the two (Altrichter, 1991; Green, 1999), later becoming aware of the work of Reason and Goodwin (2001), Flood (2001) and Davis and Sumara. (1997a; 1996; 2000; 1997b; Sumara & Davis, 1997a; 1997b). Even before engaging with these latter writers, I noted epistemological, theoretical and methodological connections between action research and complexity, not the least being the mutual foundation in systems theories and an emphasis on participation. What follows is a exploration of the synergies between complexity and action research, drawing on ideas presented in an earlier paper (Phelps & Hase, 2002). I argue in this paper that complexity can provide a valuable theoretical underpinning for action research, and also that action research provides a valid methodological approach to the study of complexity. I do not claim that all action research is founded on complexity, nor that all complexity-based research would benefit from action research approaches; but, rather, that the two provide compatible opportunities for theoretical and methodological cross-fertilisation.

The commonalities between action research and complexity are not surprising, given their shared foundation in systems theory. The connection between action research and systems theory is well documented and discussed (for instance, Davies, 2001; Dick & Swepson, 1994; Flood, 2001; Kemmis & McTaggart, 2000; Medd & Haynes, 1998; Zuber-Skerritt, 2001) and requires little elaboration. The connection between complexity and systems thinking seems to depend on localisation and interpretations of both systems theory and complexity. Writers such as Fleener (in press-b), Marion (1999) and Flood (2001) emphasise a close connection. However, Stacy, Griffin and Shaw (2000) argue that complexity shifts away from thinking of organisations as systems and advocates thinking...
of organisations as complex responsive processes. These writers also note that complexity and systems thinking differ in their notions of causality. The concept of homeostasis underlying systems theory leads to a focus on such things as clarity of roles, task definition and on managers identifying ‘leverage points’ to evoke change and stay in control. Even the most recent developments in systems thinking, they state, focus on ‘improving’ the system so that it moves toward an optimal state. Complexity thinking, Stacy, Griffin and Shaw claim, rejects ideas that there is an optimum or final ‘state’. It is this approach to causality that forms a notable distinction between different ‘schools of thought’ in action research. ‘Improvement’ and ‘emancipation’ are foundational to critical action research (Grundy, 1982; Kemmis, 2001; Zuber-Skerritt, 1996), implying movement toward an ‘optimum state’. Yet not all action research necessarily entails such an objective. All action research is concerned with change, but the notion of change toward ‘what’ differs between research undertakings, and the ideological position of the research. Hence the teleological foundations of action research can be seen as variant. Subsequent sections return to these considerations; however, having noted this potential tension, this section will go on to illustrate the commonalities.

When Lissack (1999) spoke of the application of complexity in organisational contexts, he stated that ‘organization science for fifty years has focused on controlling uncertainty. Complexity science for the past ten years has focused on how to understand it so as to better “go with the flow” and perhaps to channel that flow’ (p.8). Action research, as an approach to inquiry and understanding, does exactly that. Like complexity, action research embraces change and facilitates an examination of the emergent nature of change. Action researchers acknowledge that there are things outside the practitioner’s control which inhibit their practice (Grundy, 1995) and thus they embrace and work with the open, non-linear and unpredictable nature of social systems. Cook (1998), for instance, recently wrote of the ‘importance of mess in action research’ and her dilemma of ‘trying to describe practice without fixing it and making it static’. The focus on participation, which is central to the writing of complexity theorists such as Stacy, Griffin and Shaw (2000), is also central to action research. ‘Action researchers accept that transformations to social reality cannot be achieved without engaging the understandings of the social actors involved’ (Carr & Kemmis, 1990, p.181). A powerful metaphor is utilised by Reason and Goodwin (1999), who describe inquiry groups as exhibiting the qualities of an ‘excitable medium’, finding new patterns emerging from their own dynamics. Action research embraces, and in fact promotes, emergent learning. Many action researchers adopt grounded theory (Glaser & Strauss, 1967), allowing theory to emerge from the action and interaction itself. Action research also meets Gold’s (2000) calls for naturalistic inquiry approaches in complexity research.

The notion of deliberately introducing noise into a system to see what happens (Lissack, 1999) is consistent with the action/observation/reflection phases of action research. The ‘action’ which is inherent in action research actively prompts a state of non-equilibrium. Participants are encouraged to challenge their assumptions (schemas) and to explore and challenge these schemas with other participants (agent interaction). This process, in itself, is introducing ‘noise’ and actively promoting disequilibrium. Wadsworth (1998), in exploring the nature of participatory action research, uses the slogan ‘the future is made, not predicted’ and notes that action researchers see this unpredictability as a goal and ‘the stuff of which “real life” is made or enacted’ (p.7). From such a perspective, action
research is concerned with possibility theory rather than predictive theory (Wadsworth, 1998). These words are reflective of complexity’s perspectives on causality.

Action research explicitly embraces participation and the democratisation of knowledge production and use (Grundy, 1995; Onn, 1998). These ideas are also emphasised by complexity thinkers such as Stacey (2000). Action research is congruent with complexity’s notion that systems’ behaviour involves the aggregate behaviour of agents and that internal schemes are actively constructed through interaction of agents. Action research views humans as willful and capable of both thwarting research predictions and implementing theories they want to see manifested. Conventional science sees this as undesirable ‘contamination’ and ‘bias’, whereas action research sees this as a desired outcome (Wadsworth, 1998). Action research provides a vehicle for researcher and co-researchers (the participants in the research) to seek and to share meanings constructed from shared experience. This represents an acknowledgment that both agent interaction and the schemas of these agents are critical in processes of change. To quote Reason and Goodwin (1999, e.p.), ‘complexity theory suggests to us that these rich interconnections are not simply a way of logically saturating our data in order to confirm that data represent the phenomena being studied... they are the very ground from which new order may emerge’.

While many research approaches have traditionally discounted outlying or disconfirming data, action research has tended to embrace and focus upon it. Greenwood and Levin (2000) note that, in action research, any case that runs counter to a generalisation invalidates it and requires the reformulation of the generalisation. Similarly, Dick (2000) advocates an approach where, if sources agree, then the researcher searches for exceptions in the next cycle; if they disagree then the researcher searches for explanations. The active acknowledgment and study of dissonant views which action research promotes can assist us to understand bifurcation points. It is the dissonance within systems, and the potential consequence of this dissonance, which holds the clues to understanding change processes. ‘Innovation emerges in the amplification of the diversity between participants in the interactive communication, even when that diversity is quite small’ (Fonseca, 2002, p.79). In this sense, complexity reinforced and supported my initial interest in divergent and outlying data, acknowledging the value of variation and how such variation can lead to more complex understandings, as well as being the impetus for change.

Several authors have drawn the connection between reflexivity and complexity theory (Gough, 1999; Stacey, Griffin & Shaw, 2000). Stacy, Griffin and Shaw, for instance, emphasise the centrality, in complexity, of the self-referential and reflexive nature of humans and the participative nature of human processes. Such a perspective brings complexity and action research into close synergy. Feedback and feedforward can be perceived as manifesting in action research through the notion of reflexivity (Shacklock & Smyth, 1998; Tripp, 1998). Feedback provides further justification for the importance of history and tradition as important determinants of social processes (Turner, 1997), notions that have been embraced by action researchers. In a similar way, there are commonalities between models emerging from complexity (for instance, Bloom, 2001a) and the Lewinian cycle common to all action research. Reason and Goodwin (1999) draw connections between Lewin’s cyclical model of plan, act and evaluate, Glaser and Strauss’ articulation of grounded theory as a constant comparative method and Lincoln and Guba’s cycle of purposive sampling, inductive data analysis, grounded theory and emergent design. They
suggest that such iterative processes are congruent with complexity, moving away from establishing linear causal propositions toward explorations of emergence. Reason and Goodwin also argue that the very tendency of action research to allow a precise focus of inquiry to emerge from the process of iterative inquiry itself is in keeping with complexity: ‘It is not possible to set up a co-operative inquiry group with a specified goal; it is only possible to facilitate its emergence’ (Reason & Goodwin, 1999, e.p.).

Action research is consistent with the notion of adaptation to environment, rejecting ideas that one solution can fit multiple situations (Brooks & Watkins, 1994). Generalisability is understood in a non-conventional way in action research, resting in the hands of those who participate or read about the study, rather than in the study itself (Watkins & Brooks, 1994). This represents an explicit recognition of unpredictability, sensitivity to local conditions and the central role of agent interaction. Taking into account Stacy, Griffin and Shaw’s (2000) discussion of the issues surrounding modelling (as outlined in section 7.2.1), action research can be perceived of as ‘real life modelling’. As Flood (2001, p.142) has noted, ‘it is through systemic thinking that we know of the unknowable. It is with action research that we learn and may act meaningfully within the unknowable’.

The ideas presented in this section, in particular the synergies between action research and complexity, arose as I related the more general literature of complexity to the context of my research and to my understanding of action research itself. It is important to acknowledge, however, the work of Sumara and Davis (1997b), discovered later, but whose ideas would appear to echo my own. These authors perceive action research as an instance of ‘complexifying’ the relationship between researchers and research situations. Action research activities, they argue, generate individual and collective identities and thus become instances of ‘culture making’. Later in this chapter I return to these ideas, arguing that this research has represented a ‘real life model’ that makes cultures of capability possible.

8.3.3 Reflective Journals as Methodological Approach to Complexity

If we are to view action research as ‘real life modelling’, then reflective journals might be considered as recording and representing the model. A few comments might be made in relation to the value of reflective journals from a complexity perspective. Firstly, journals allow for documentation of ‘emergence’ and ‘bifurcation’ in action, recording agent interactions and the meanings which individuals personally construct from these interactions. Secondly, journals embrace participants’ involvement in their own interpretation of the ‘data’ but, beyond that, also provide a vehicle and outlet for the organisation and reorganisation of subjective experience, consistent with complex perspectives on learning (see section 8.4.1). Thirdly, journals build up a holistic picture of the interplay of individuals’ history with their current and emerging ‘state’ and thus provide scope for highlighting sensitivity to initial conditions. Fourthly, the open nature of journals reduces ‘control’ over either action or reflection. The process does not restrict what experiences or contributing factors individuals might draw from, and writing is allowed to ‘emerge’ from their actions. As noted by Boud, Keogh and Walker (1985b), reflection is an active process of exploration and discovery which often leads to very unexpected outcomes. In this sense, reflective journaling would seem consistent with Stacey’s (2000, p.207) comment that ‘the nature of thought is movement’. Fifthly, research approaches that employ journals can embrace techniques of promoting systems instability.
For instance, reflective prompts can serve as ‘noise’, introducing new concepts to ‘see what happens’. Such reflective prompts can be designed to challenge participants’ schemas, thus prompting disequilibrium. Journals are, thus, not just about gathering data but of actively prompting change, notions highly congruent with complexity approaches to research. Finally, journals embrace notions of non-linearity. Journals need not represent a logical, sequential argument but can emerge from experience and complex thought processes. Personal narrative, of the type outlined in chapter 1, is a means of presenting one’s own adaptation to environment, one’s own internal modes and schemas and the emergent nature of action and knowledge.

These ideas, while original and emerging from my experience in this research, are paralleled in the research of Bloom (2001a, p.11), who notes that student cognition ‘manifests as circular feedback loops and as spiral patterns that carry ideas and concepts forward. The result is a nonlinear, self-maintaining argument that generates increasingly complex conceptualisations’. Bloom takes this discussion one step further, noting the important role of reflection in promoting connections that aid in the construction of more complex and meaningful understandings. Complexity thus brings to education an emphasis on the cyclical, non-linear nature of learning, notions again consistent with action learning. I return to these issues in relation to my own research in subsequent sections.

### 8.3.4 Reflecting on my Methodological Decisions

So far I have argued that complexity embraces mixed methods, that it is resistant to reductionism, that there are compatibilities between action research and complexity thinking, and, finally, that reflective journals represent a congruent methodological approach to complexity-based research. In this way, it might be said that complexity seems to ‘fit neatly’ with the methodological positions and strategies which I adopted within my research. Such convergence might not be considered surprising given the shared epistemological basis of constructivism. In this respect my ‘encountering’ of complexity theory late in my research cannot be considered detrimental, as the methods employed throughout the research are consistent with complexity thinking. Likewise, many of the ‘findings’ from my research serve to support complexity post hoc; as previously implied, my research represented ‘real life’ complexity modelling ‘in action’.

### 8.4 Complexity as Perspective on Education

A growing body of literature applies complexity thinking to educational contexts. The Chaos and Complexity Theory Special Interest Group of the American Educational Research Association (AERA), is indicative of this growing interest, as are the writings of a range of individuals (for instance Bloom, 2000; 2001a; 2001b; Cronbach, 1988; Davis & Sumara, 1997a; 1997-8; Doll, 1986; 1989a; 1989b; 2002; 1998; Fleener, in press-a; in press-b; Fullen, 2001; Green & Bigum, 1993; Hunter & Benson, 1997; Iannone, 1995; Jorg, 2000; MacPherson, 1995; 1997; Marion, 1992; McAndrew, 1997; Mintz & Yun, 1999; Sawada & Caley, 1985; Zhang & Fowler, 1996). In the following sub-sections I explore the application of complexity to education. I first consider the perspectives which complexity provides on learning, focusing specifically on educational rather than biological perspectives, and exploring in some detail the notion of complex constructivism. I then explore the impact which complexity might have on perspectives of teaching, making mention of the enactivist theory of learning (Sumara & Davis, 1997a). Both these discussions are necessarily brief and serve specifically to justify the value of applying
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complexity to the study of educational issues. Section 8.5 will elaborate on these ideas, focusing on my own research and teaching practice.

8.4.1 Complexity as Perspective on Learning

As already highlighted, complexity is a multi-disciplinary theory and the literature on complexity and learning varies greatly. One body of writing examines learning from the perspective of neural processes, brain functioning and the nature of consciousness (for instance, Bossomaier & Green, 1998). Such biological perspectives on learning are not the focus of my discussion but, rather, the literature stemming from educational theory.

Doll (1986; 1989a; 1998) has focused attention on the connection between complexity and the work of Piaget, specifically Piaget’s notions of assimilation and accommodation, and equilibrium-disequilibrium-reequilibrium. Doll claims that Piaget and Dewey’s work has been misinterpreted by Newtonian educationalists, claiming rather that these theorists were early educational complexity theorists. Complexity provides a perspective on learning based on non-linearity of thought and on variation as a source and outcome of thinking (Bloom, 1998; 2000). Such a view leads to more cohesive and elaborate understandings, an emphasis on meaning rather than decontextualised content, an emphasis on creativity, a sense of connection to learners’ worlds and the development of a sense of ownership over what is learned (Bloom, 2000). Doolittle (2000) sees complexity as an opportunity to adopt a new model or metaphor for learning; learning as self-organised adaptation. Complexity views student thinking and learning as an emergent process where ideas and concepts arise from specific contexts. The emergence of such ideas are inherently non-linear and unpredictable: ‘Although we may be able to predict that certain types of events or ideas may arise, we cannot predict the specific content or outcome’ (Bloom, 2001a, p.23).

From the perspective of complexity, participating agents play an active role in co-constructing knowledge through interaction over time (Jorg, 2000). Bloom (2001a) notes the important role of interaction with others and with one’s environment, highlighting the influence of variance, encountered through this interaction, as both source and product of cognition. According to Kauffman’s (1995) model, agents follow different rules of interaction and hence conflicting constraints emerge. There is also random mutation of the rules governing interaction, leading to further diversity amongst interacting agents. Such diversity imparts the capacity to move spontaneously to novel attractors. Random mutation plays a minor part, the major part lying in the interactions between entities. As Stacey, Griffin and Shaw (2000, p.x) emphasise, learning is a process of ‘co-evolution of jointly constructed reality’. Double loop learning which is foundational to action research, also finds a firm foundation in complex perspectives on learning (Stacey, 2001). Furthermore, if we go back to the definitions of experiential learning provided in section 4.6.1, complexity’s perspective is not greatly different to that proposed by Kolb.

8.4.1.1 Complex Constructivism

Constructivism’s perspective that knowledge is a function of both the interaction of individuals and the individual’s prior knowledge, parallels complexity’s notions of the active construction of internal models and schemas by agents through experienced-based adaptation to their environment. Davis and Sumara’s (1997a) discussion of complexity closely aligns to social constructivism (Kanuka & Anderson, 1999) and radical constructivism (Glasersfeld, 1996; Glasersfeld, 2000). Such positions hold that knowledge
under all circumstances is constructed by individuals as an adaptation to their subjective experience. Davis and Sumara (1997a, p.109) take this one step further: ‘As the learner learns, the context changes, simply because one of its components changes. Conversely, as the context changes, so does the identity of the learner’. Stacy (2001) argues that complexity moves away from social constructivist thinking which, he says, continues to argue on the basis of separate levels for the individual and the social, according primacy to the social and so largely losing focus on individual agency. Stacy’s exploration does not accord priority or primacy to either individual minds and actions or to social structure, but rather sees the two as mutually constituted. Such a constructivist position aligns with a theory of evolution as ‘natural drift’ where ideas and beliefs (like traits and species) emerge because they are personally viable in a given context, not because they are ideal (Sumara & Davis, 1997a). From this perspective the ‘creation of meaningful understandings of ever increasing complexity becomes a socially situated autopoetic (self-generating, self-making, self-sustaining) process’ (Bloom, 2000, p.5).

Doolittle (2000) proposes a ‘school’ of constructivist thought, which he refers to as ‘complex constructivism’: the perspective that learning involves adaptation, self-organisation, interaction, and history. Such a view embraces the non-linear nature of learning. Learning is seen as the ‘active construction and adaptation of one’s internal models of reality based on the interaction between oneself and one’s environment (including other persons), such that the functioning of one’s internal models exceeds the sum of the models’ components’ (Doolittle, 2000, p.7). Constructivist perspectives are also embraced by Bloom (2000) in his exploration of ‘patterns that connect’. Meaning, Bloom states, is not self-existing in the world but is created through our patterns of connection with our world. Stacey, Griffin and Shaw (2000) take these concepts further, exploring connections between complexity and the work of social psychologists such as Mead, Vygotsky and Bhaktin. From this exploration, Stacey, Griffin and Shaw emphasise that ‘mind’ and ‘self’ emerge in social relationships, from interaction between people and their ongoing choices and actions in relating to each other; and they arise in patterns that display both continuity and potential transformation. Such perspectives are consistent with constructivism, but add the dimension of transformative teleology, which can be argued as being absent from other constructivist perspectives.

8.4.1.2 The Enactivist Theory of Cognition

Davis and Sumara (1997a; 1996; 2000; 1997b) apply complexity thinking in their proposal of an ‘enactivist’ model of cognition and make recommendations from this for teacher education. Enactivism is defined as a form of collective cognition (Sumara & Davis, 1997a). As such, this approach challenges understandings of individuals as the locus of cognitive development. Rather, cognition is understood ‘as a process of organizing and reorganizing one’s own subjective world of experience, involving the simultaneous revision, reorganization and reinterpretation of past, present and projected actions and conceptions’ (1997a, p.107). This model also challenges cognitivist tenets that superior ideas supersede inferior ones and that we are on a linear path of progression toward better and more accurate understandings of the universe, either individually or collectively. These ideas are best presented through a direct quotation from these theorists:

...the tendency to regard learners as situated within particular contexts is rendered problematic. Rather, the cognising agent is recast as part of their context. As the
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learner learns the context changes, simply because one of its components changes. Conversely, as the context changes, so does the very identity of the learner... how we define ourselves and how we act is inevitably affected. And so, learning (and similarly teaching) cannot be understood monologically: there is no direct causal, linear, fixable relationship among the various components of any community of practice. Rather, all the contributing factors in any teaching/learning situation are intricately, ecologically and complexly related. Both the cognising agent and everything that it is connected to are in constant flux, each adapting to the other in the same way that the environment evolves simultaneously with the species that inhabit it (Sumara & Davis, 1997a, p.414).

The enactivist theory of cognition thus understands learning in terms of evolving complexity. Actions are not simply manifestations of (internal) understandings; they are themselves understandings. Cognition does not occur in minds or brains but in the possibilities for shared action. Teaching, from such a perspective, is understood to occur in the 'relations between the individual and the collective, between accepted truth and emerging sense, and between actualities and possibilities’ (Sumara & Davis, 1997a, p.417). These notions are explored in the following section, but what might be emphasised again is the congruence of these ideas with methodologies such as action research.

8.4.2 Complexity as Perspective on Teaching

Sawada and Caley (1985), somewhat humorously, illustrate how current conceptions of education and curriculum derive from the metaphor of school as a more or less well oiled machine that processes children. The education system, these authors state, comes complete with projection goals (desired end states), objectives, raw materials (children), a 13 stage assembly line, directions and managers for each stage, plant supervisors (principals), quality control mechanisms and so on. These authors emphasise that such a metaphor arises from a conception of schooling at equilibrium and imbues a particular notion of causality: that schooling, and more precisely teaching, ‘causes’ or ‘produces’ learning. ‘Anyone who has done any teaching knows that no formula, no rule, no theory ever works perfectly with every group of students’ (Iannone, 1995, e.p.). As Iannone continues, the scientific, determinist paradigm seems to be creating passive, unresponsive, non-thinking, dependent students and de-professionalised teachers. Current educational practices see teaching as a simplistic cause-effect system, yet nothing could be further from the truth. Both students and teachers bring to the learning environment a wide mix of variables, and the unpredictability of these variables is the rule rather than the exception. Foundational to complex thinking about education is the notion that teaching does not necessarily cause learning and learning cannot be pre-determined or ‘caused’ (in linear terms) by teaching:

...all of our understandings are situated in and co-emerge with complex webs of experience, and so we can never discern the direct causes of any particular action. Trying to establish a causal relationship between one event and another, or between a teaching action and a learning outcome confuses essential participation with monologic authority (Sumara & Davis, 1997a, p.412).

From this perspective, learning is occasioned, not caused. While we can present occasions that are rich with learning possibilities and in which we might participate with our students in the unfolding of understandings, we can not prescribe what will be learnt. ‘Teaching and learning must be understood as simultaneously shaped and being shaped by the circumstances in which they occur’ (Davis & Sumara, 1997a, p.116). Complexity’s
perspective on teaching and education thus represents an acceptance of uncertainty as part of the nature of education. Such perspectives on teaching seem to echo my own approaches, in particular the metacognitive model which did not attempt to ‘force’ change in student behaviour, but rather to provide rich stimulus for their own learning to evolve. I return to this discussion in section 8.5. Before doing so, I focus specifically on complexity’s perspective on curriculum and on teacher-student interaction.

8.4.2.1 Curriculum, Causality and Control

A number of writers have drawn on complexity to reach new understandings of curriculum (Davis & Sumara, 1997a; 1989a; Doll, 1989b; 2002; 1998; Fleener, in press-a; Gough, 1999; Iannone, 1995), emphasising in particular the implications of alternate understandings of causality and control and a more holistic perspective on the nature of education.

Complexity-based educationalists (for example, Doll, 1989a; 1989b; 1998; Iannone, 1995; Sawada & Caley, 1985) see the contemporary focus on objectives and learning outcomes as representative of an obsession with domination, control and reductionism. This parallels discussion within the organisational complexity literature which challenges the assumption that managers can choose strategic directions in organisations: ‘if managers are choosing what “emerges” then it is not emerging’ (Stacey, Griffin & Shaw, 2000, p.145). Rather, what emerges in organisations, and similarly in teaching contexts, arises from the conflicting constraints of agents, not the simple choice of any one individual. When teachers and educational systems attempt to pre-define and pre-structure curriculum they are working against the very notions of emergence. Rather, Doll (1989a) notes that we should structure and study curriculum in such a manner that internal, autocatalytic transformations are encouraged to occur. Pre-set outcomes must be ‘set aside in favor of more holistic, all-at-once co-emergent curricula that are as much defined by circumstances, serendipity, and happenstance as they are by predetermined learning objectives’ (Davis & Sumara, 1997a). Teachers need to accept students’ ability to organise, construct and structure learning, combining supportive and challenging behaviour; equilibrium with disequilibrium. ‘Curriculum becomes a process of development rather than a body of knowledge to be covered or learned, ends become beacons guiding this process, and the course itself transforms the indeterminate into the determinate’ (Doll, 1989a, p.250). Doll also adds that lessons should not focus on closure but rather on providing just enough disequilibrium to combine closure with openness. These arguments are returned to in the following section, specifically in relation to my own research.

8.4.2.2 Teaching as Interaction

As highlighted in previous sections, complexity emphasises the primacy of agent interaction. In educational systems, communication between individuals becomes the primary mode of self-reproducing and self-maintaining patterns and shared systems of beliefs, explanations and values. Communication becomes a movement from and toward an as yet unrecognised position that comes to be recognised (known) in the act of communication itself. Hence, all communication carries the possibility of change (Stacey, Griffin & Shaw, 2000). Iannone (1995) has highlighted that this might be as simple as a student asking a question which sends the teacher and the lesson in an entirely new direction. The importance of interaction has been a focus of research conducted by Bloom (n.d., p.12): ‘Where students (with or without teacher participation) are engaged in an
intense and impassioned argument... the resulting understandings constructed by the participants tend to be much more complex’. Differences between interacting individuals are themselves sources of spontaneous, potentially creative, change and are needed for evolution to occur. As Stacy Griffin and Shaw note, our education systems tend to downplay these differences, thus hampering possibilities for change. Diversity is seen as a key issue in maintaining flexibility. Once diversity reaches a certain level, complexity proliferates, as if in an autocatalytic reaction (Kauffman, 1992, cited in McAndrew, 1997).

8.5 My Research through the Lens of Complexity

The following sections of this chapter focus on how complexity thinking consolidated and reinforced my developing understandings of my own research undertaking. I open with a re-examination of the computer education context, arguing that computer learning and teaching is an open, non-linear system and that within such a context there can be no notion of ‘computer literacy’ as an end state. I then examine computer learning as self-organised adaptation and provide a fresh perspective on competency and capability. This section then explores notions of agent interaction in the context of the Unit, returning to the earlier mentioned concept of ‘learning organisations’. Following this, I re-evaluate and critique the Unit’s design through the lens of complexity, focusing specifically on the congruence of the metacognitive model with complexity’s perspective on education.

8.5.1 The Computer Learning Context as Open, Non-linear System

One of the scenarios which Marion (1999) draws upon, in discussing organisational change from a complexity perspective is the ‘rollout’ of computers into schools and the subsequent lack of change which has occurred in teaching pedagogy and practice. Simply pushing computers into classrooms, Marion emphasises, does not evoke change: ‘Change, particularly technological change... implicates complex interdependencies and multiple actors, yet change agents often approach change as if it were a simple linear process’ (p.214). Simple acts are not sufficient to create deep-level change. Rather, change represents a complex and dynamic interaction between multiple agents, the environment and history. The learning and teaching context depicted throughout this research is a rich illustration of this dynamic.

As highlighted in the introduction to this thesis, technology is evolving rapidly and is arguably fitting with complexity’s concept of emergence. Change in computer contexts is evolutionary. Technological development does not occur without end-users, and end-users are reliant on technological development. Technology well represents notions of transformative teleology (Stacey, Griffin & Shaw, 2000) in that there would seem to be no discernible end-state or purpose to change beyond the notion of change itself. Change does not necessarily represent ‘improvement’, and there is no ‘ideal’ or even ‘preferred’ state toward which movement is occurring. Computer learning and teaching is an open, non-linear system. Section 1.2.1 explored the notion of computer literacy. Expectations of computer literacy are changed by interactions of agents with their environment and the subsequent alterations of environment by those interactions. The indeterminability and unpredictability of technological development means that it is not possible to develop or sustain a valid definition of what ‘passes’ as computer literate, even within a defined professional field such as teacher education. If one were able to take into account all the contributing components of the computer context (such as hardware and software, pedagogical needs, skill requirements and so on) we would still not be able to develop a
workable definition of computer literacy. Even if we were to add here factors such as confidence, self efficacy, appropriate attribution and relevant learning style, one could still not identify an end state that we could confidently call ‘computer literate’. Knowing the present does not allow one to predict the future. For individuals to function successfully in such a constantly changing environment, they need to be able to cope with change and be open to evolutionary development. Such characteristics represent the benefits of capability.

Such an argument does not really extend earlier expressed conceptions of the computer learning environment, but re-frames the arguments within the metaphorical language of complexity. The underlying rationale for this research, as presented in chapters 1 and 2 thus might be seen as embodying an intrinsic recognition of complexity’s constructs even before I was aware of the literature itself. This can be interpreted as providing further justification for the relevance of complexity to this research. Having established this foundational relevance, other aspects of complexity can be demonstrated to be equally valid in enhancing our understandings of learning and teaching.

As already noted, complexity provides a perspective on learning as self-organised adaptation; and evolutionary metaphors prove particularly valuable in interpreting the computer learning context. Complexity’s perspective of adaptation is drawn from the Lamarckian view of evolution, founded on the concept of stochastic processes, whereby random variation gives rise to the possibility for innovation, creativity and ultimately survival. Complexity theorists argue that the ‘best’ place to be in order to respond appropriately to constant change is ‘at the edge of chaos’. The metaphors of complexity move from competition and survival to creative emergence and expression of appropriate novelty. ‘The point is not so much whether an individual acclimatizes or acculturates at the level of mere survival, but whether an individual can successfully participate in societies undergoing increasingly rapid changes’ (Bloom, 1998, p.6). From this perspective, learning strategies and behaviour that function close to the transition to chaos are seen as the ‘best’ place to be in an uncertain and unpredictable world. Ordered behaviour (and here we might think of competencies) often need to be dissolved and replaced by more adaptive behaviour as circumstances change. Ideas and learning strategies emerge because they are personally viable in a given context, not because they are ideal. Such an adaptational view on learning speaks strongly of the competency/capability debate, which has been critiqued throughout this thesis. In the following section, I will argue that the ‘edge of chaos’ is where capable computer users function.

8.5.2 Fresh Perspectives on Competency and Capability

In section 8.2 I noted that an approach to complexity founded upon transformative teleology diverges from notions of an ‘optimum state’, while section 8.3.2 introduced the argument that transformative teleology is at odds with emancipatory conceptions of action research. In my own research my actions had been intended to foster computer capability and in many respects I perceived this as an ‘optimum state’. However, complexity provided stimulus for further reflection on the notion of capability, challenging me to consider whether I was conceptualising my research as emancipatory and whether, in fact, such an approach was appropriate. In this section I elaborate on my resultant perspectives of computer learning, and competency and capability more particularly, through reference to the diagram presented in figure 8.
Figure 8  An interpretation of computer learning from a complexity perspective

This figure is presented as a two dimensional detailed figure, with an inset, which symbolizes a three dimensional view of the learning process. It illustrates potential paths of computer learning over time, acknowledging patterns of both competency and capability. The diagram indicates a common foundation in basic skills and knowledge but demonstrates how external input or stimulus can create bifurcation points. Bifurcations can either decrease computer confidence or increase computer confidence and skills, thus forming a transition from a continuum of ‘decreasing returns’ to one of ‘increasing returns’ (or vice versa). The figure indicates the limitations of competency and the potential of capability.

**LEGEND**

- Indicates individual’s background and ‘initial conditions’, including, for example attitudes, values, beliefs, motivation
- Indicates external input. External input on the capability continuum involves two-way stimulus indicated by
- Indicates potential pathways of learning
  - Indicates potential bifurcation points which *increase* self-efficacy
  - Indicates potential bifurcation points which *decrease* self-efficacy
- Reference is made to these particular positions A-J in the accompanying text
The first point to make about figure 8 is that computer learning occurs over time. Although the diagram shows learning as continually moving forward, it could stagnate or slow at any stage. Hence the horizontal axis of time is not quantitatively accurate or to scale, but rather a fluid notion of potential individual development over time. Figure 8 indicates that capability-based learning may take more time, however the outcomes are potentially ‘exponentially’ greater.

Secondly, both competency and capability are viewed as continuums, along the vertical axis, with competency representing a more defined and limited concept than capability. There is no notion of ‘being’ competent or ‘being’ capable, in a final sense. Rather, the concepts might be considered as matters of ‘becoming’ (Sawada & Caley, 1985): ‘The primary challenge in open systems is not to bring process to closure (to produce a “perfect” product) but to direct the transformations in such a manner that the becomingness of process is maintained’ (Soltis, 1989). Throughout this research I have identified ‘capable’ and ‘competent’ individuals (particularly in cycle 2 and 3). In retrospect, I have not meant to imply that these individuals are in a ‘final’ or stagnant state of development, but rather, that they are moving along the path of growth. There is no end-point to the two concepts or final, ideal state. In fact, I would argue that capability requires a recognition of this very notion in order that the individual embraces lifelong learning (see also table 16).

The third point to make in relation to figure 8 is that competency and capability share a common foundation in basic skills and knowledge. As was explored with the small groups in cycle 3a (section 7.3.3), there are some core skills and understandings which ground both competency and capability. Here, I’d like to pick up on a comment made by Hase (2002) that competence is an essential ingredient of being capable. As I have argued, competency and capability are both transformative continuums. Given that neither has an ‘end state’, per se, then neither can precede the other. An individual at position A (figure 8) on the capability continuum may have less skills and hence competence than an individual at position B, yet the individual at position A has greater capacity to respond and adapt to change, and therefore, in the ‘bigger picture’, may be better off.

Fourthly, figure 8 indicates that the path toward competency implies more narrowly defined outcomes and less capacity to adapt to an unpredictable context than the path toward capability. The diagram depicts the broadening and unpredictable base of skills, knowledge and abilities emerging from capability-based approaches. In a competency based approach the outcomes at any one stage (for example, positions C-G) can be defined and predicted. This is because there is stability and control in the learning/teaching dynamic. As mentioned earlier, the learning may, however, stagnate at any one of these points (for instance, when training finishes) as the system relies on external input. Individuals on the capability path, however, may have undefinable or unpredictable skills, knowledge or abilities and there is far less control over the learning process. Capability is not a closed system but an open one.

The fifth point to make is that external input or stimulus of some form is usually required in the initial stages of computer learning, as indicated at position H. However, competency-based teaching approaches represent what in economic terms is referred to as decreasing returns, or in complexity as negative feedback. As explained by Marion (1999) and
Waldrop (1992), negative feedback suggests that maturing systems eventually run out of steam, reaching a point in development at which further effort provides negligible returns and they settle into an equilibrium state (for example, position G). Homeostasis, according to systems theory, derives from the dampening of variation by negative feedback. The path toward competence, then, continues to require external stimulus as it progresses (as indicated by the purple arrows). Again, this stimulus might take many forms, most likely training or other direct instruction. Practice, of course, reinforces skill development and increases computer confidence; however, this alone does not lead to significant improvement or widening of ability. Bradley, in cycle 3a, might be cited as an example of this. Despite strong confidence and experience he had not explored and discovered easier means of double spacing his essays than using two carriage returns at the end of each line. Despite high confidence his learning seemed to have stagnated. External input (for instance, my feedback) was needed to evoke change. Capability-based teaching approaches, on the other hand, represent increasing returns, or in complexity terms, positive feedback: the deceptively simple idea epitomised by a rolling snowball, gathering speed and momentum. The capability pathway also involves input, but the difference here is that the stimulus is more likely to be two-way (as indicated by the green arrows). Capable individuals are more pro-active in their adaptation, actively seeking interaction with agents to address their learning needs, whether it be individual assistance, group instruction, interaction with resources, or implementation of self-directed strategies, including help-seeking strategies. This more intense embracing of agent interaction and pursuit of constant change and development might be considered as depicting individuals ‘at the edge of chaos’.

Sixthly, the diagram attempts to represent the influence of background and ‘initial conditions’ (as indicated by the blue arrows). These factors might include encouragement by others, use by others, perceived usefulness, support, attitudes, values, beliefs, motivation and attitude to learning in general. These ‘initial conditions’ influence the resultant dynamic in unpredictable ways. For instance, increased use by others does not cause higher computer self-efficacy or confidence, nor does increased support. Many students in the study felt that computers had high perceived usefulness but had not progressed far along the continuum of either competence or capability. These initial conditions produce a complex and unpredictable context for computer learning and teaching. Only the individuals themselves can begin to grasp the personal influence of these factors; hence the value of involving learners in metacognitive engagement.

In the seventh instance, the diagram conveys that the transition from ‘competence’ to ‘capability’ can occur anywhere along the developmental continuum. Drawing on the language of complexity this can occur at bifurcation points (for example, positions I or J). In this sense, bifurcations are events or reflective realisations that do not correspond with previously held concepts, theories or beliefs (Bloom, 2001b) and thus challenge and evoke significant change: what are sometimes referred to as ‘ah-ha’ experiences. The foundational idea of ‘big outcomes of small things’ might be emphasised here. This research would seem to support complexity’s premise that bifurcation points cannot be ‘caused’ or predicted. Rather, such changes occur through ‘systems instability’. In the
computer context instability is endemic, yet individuals can either ignore or embrace this instability. Recognising and embracing the context of continuing change can be one potential stimulus for bifurcation from competency to capability. Other potential stimuli are outlined in table 16, including examples drawn from the research data.

Table 16 Potential stimulus for bifurcation from competency-based to capability-based learning

<table>
<thead>
<tr>
<th>Potential stimulus for bifurcation</th>
<th>Examples from data</th>
</tr>
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<tbody>
<tr>
<td>Embracing the context of continuing change and/or recognising that learning must be lifelong</td>
<td>Student 24 (cycle 3a); Student 182 (cycle 3b)</td>
</tr>
<tr>
<td>Realising the importance or benefits of using technology, including perceiving usefulness for either professional and/or recreational purposes</td>
<td>Student 4 (cycle 2); Sally (cycle 3a)</td>
</tr>
<tr>
<td>Realisation that current skill levels are inadequate. This can lead either to increased competence (the individual learns a particular skill) or increased capability (the individual realises they need to set more continuous and ambitious goals)</td>
<td>Katy, Jill, Students 5 &amp; 93 (cycle 3a)</td>
</tr>
<tr>
<td>Realisation of learning stagnation</td>
<td>Student 93 (cycle 3a)</td>
</tr>
<tr>
<td>Increased opportunity to ‘play’; can involve purchasing a computer or actively pursuing increased access</td>
<td>Students 7 &amp; 108 (cycle 2); Peter (cycle 3a)</td>
</tr>
<tr>
<td>Realisation of ability to learn independently or use help. Often occurring through trialing and succeeding via independent or exploratory learning approaches</td>
<td>Jill &amp; Student 66 (cycle 3a)</td>
</tr>
<tr>
<td>Self-realisation and affirmation of current abilities</td>
<td>Students 28 &amp; 4 (cycle 2)</td>
</tr>
<tr>
<td>Recognition that some problems are beyond our control (appropriate attribution) or that problems are ‘normal’</td>
<td>Student 179 (cycle 2)</td>
</tr>
<tr>
<td>Realising the influence of affective dimensions (for instance anxiety) on learning</td>
<td>Student 144 (cycle 2)</td>
</tr>
<tr>
<td>Realising that you don’t need to know everything to be ‘capable’</td>
<td>Carol (cycle 3a)</td>
</tr>
<tr>
<td>Successfully working through a problem</td>
<td>Catherine (cycle 3a)</td>
</tr>
</tbody>
</table>

In discussing these ideas with colleagues I was challenged to consider whether or not bifurcation was always sudden. While this was not always the case, it was not uncommon for students to express a sudden ‘ah-ha’ experience in their journal, an example of which can be quoted from Student 182 (cycle 3b): ‘The notion of perceived usefulness hit me like a flash of light’. Figure 8 also illustrates that bifurcation does not always lead to an increase in either competency or capability and can prompt temporary, and perhaps even permanent, decreases in computer self-efficacy (as illustrated at position K or L). Student 68 (cycle 3a) reported having high computer self-efficacy 3½ years before coming to university as she had used computers widely in her workplace. Leaving that environment had decreased her confidence dramatically as she no longer pursued ambitious learning goals. While my research had supported claims that bifurcation cannot be ‘caused’, it is possible to see that an environment of instability could be promoted, and this, I would argue, is the primary role of the ‘teacher’. Capability, I suggest, represents a new level of ‘order’ and reassurance which lies with enhanced computer self-efficacy and the belief in one’s ability to meet new challenges.

In summary, then, figure 8 represents what this research has supported as being the differences between computer competence and computer capability, and the influences on learning within this framework. Notably this representation has not moved closer to a strict definition of computer capability, or a formulaic approach to its identification. To do so would be inconsistent with the espoused view of capability as a continuum and
complexity’s conceptions of emergence. Rather, this view is reflective of Cairns’ (1996a) statement that, while capability is an elusive and ‘tricky’ notion to explain, this, paradoxically, is a strength, in that it does not allow a narrow or prescriptive perspective to be taken.

What figure 8 does not adequately represent is complexity’s emphasis on agent interaction, and the influence of learning environment. These two aspects of the computer learning context are addressed in the following section.

8.5.3 Re-examining Agent Interaction and Learning Environment

I have already noted that complexity perceives agent interaction as central. Communication carries with it possibilities for change. Change itself is fed by changes in relationships of agents, and the cross-fertilisation of their internal schemas, including their beliefs, attitudes and values and I would specifically add here their styles, strategies and approaches to learning. Learning cannot be separated from the socially and historically constructed context in which it occurs. From a complexity perspective, individual, group, organisation and society are all the same kind of phenomena, at the same ontological level. ‘What is learned cannot be separated from how it is learned, suggesting that knowledge is not just within the individual, but part of the entire context’ (Kanuka & Anderson, 1999). Figure 8 presented a visual representation illustrating notions of competence and capability in computer learning, from a complexity-based perspective; however, this diagram did not adequately account for agent interaction and environment. Figure 9 extends this model but embraces these additional dimensions.

Figure 9 conceives of both the Unit resources (shaded blue) and the journal (shaded yellow) as mediating mediums for agent interaction. Neither is considered as outside or aside from the learner, nor as separate from other agents. Rather, each is shaped and formed by the learner themselves as they interact with other agents and their environment. In the context of this research, a number of divergent sources of interaction were harnessed to prompt learning and change. Students interact naturally with other students and tutors, but also with family, friends, practising teachers, help desk staff, and so on. All these interactions are explicitly embraced within the metacognitive and reflective approach to learning. A second important source of interaction lies with the theory itself: theory essentially representing the ideas of other agents. For the participants in this research, this was generally a filtered interaction via my own presentation of the theory, although a small number of students accessed primary resources themselves. The metacognitive process also prompted students to draw on historically positioned interactions, a point which both constructivism and complexity would see as inevitable. By reflecting on past experiences and resultant attitudes, values and beliefs, students could identify influences on their own learning. Sumara and Davis (1997a) draw parallels with the ‘hermeneutic circle of understanding’, where knowledge and learning are seen as an ever-evolving relationship among components of a system and are in a continual process of being re-interpreted. Sumara and Davis use the analogy of a conversation, where the topic cannot be predetermined and the outcomes can never be anticipated; rather, conversation emerges through interaction.
Figure 9 Complexity’s perspective on the Unit as computer learning environment

This figure illustrates the role of agent interaction and environment in the context of the Unit. It depicts the Unit resources and the journal (as reflective process) as mediating mediums between the individual and their environment. It also emphasises that the learning environment is not set, defined or controlled either by individual agents or by the Unit resources themselves.

Figure 9 emphasises that there is no one source of ‘control’ over the learning process. As a teacher, I am simply one of many possible influencing agents. The teacher role emerges from relationships, rather than being determined simply by global choices of some individuals, and hence my role emerged through my interactions with students. For some individuals this became an intense relationship; for others there was little contact, many of these students drawing support from agents elsewhere. As discussed in section 7.3.5, there were a wide range of unpredictable influences on students’ help-seeking. The Unit resources also mediate not only between me (as principal developer) and the student, but also between a wealth of other information and knowledge sources and the student. The
interaction is two-way in that feedback from students shaped the development of the Unit. Similarly, the journal mediates and reflects the student’s interactions with their environment. The research suggests that the outcomes of such agent interaction is highly unpredictable. As highlighted by the small group case studies, reactions to a common learning experience (the first year unit ED220) had evoked diverse outcomes. Katy’s comment that she didn’t have a purpose for her learning at the time can be starkly contrasted with Leon’s transformational experience as the timeliness of this unit coincided with his perceived need to engage in electronic communications with friends. Jill’s extremely negative reaction to this same learning context reinforces notions raised by other researchers such as Hemby (1998) that prior experience can be both a benefit and a problem for computer anxiety sufferers. While some students gain confidence through computer interaction, others show an increase in anxiety, and this was certainly the case with Jill, Sharon and Sally. Similar unpredictability of outcomes was highlighted in reaction to use and encouragement by others. Several of the students had grown up in contexts where family members (parents and siblings) were enthusiastic and frequent users of computers and provided seemingly strong support. Yet students such as Sally and Leon did not develop any interest in computers from this influence. In the case of Yvette, Sally and Sharon, this readily available support was acknowledged as a potential disincentive to learning. In this respect Group Two, through their reflection, were challenged to reconsider their initial beliefs and assumptions regarding the advantages presented for children with home access and technology-literate parents.

The learning environment is not seen as set or defined (as indicated by the outside dashed oval in figure 9) but as emerging through interaction of the learner with their environment. In very tangible terms this manifests in the Unit through the diversity, choice and flexibility offered to students. There was no need to ‘force’ students into learning groups; rather, I could acknowledge the wide range of naturally occurring learning contexts and interactions including friends, family, colleagues and children. As noted by Gare (2000, p.25) ‘a healthy society is one in which people spontaneously cooperate, not where they are regulated from above’. Again, I, as teacher, am just one of the agents. Students are empowered to go on changing their learning context or adapting to whatever computer context they encounter. They are given choice over the interactions that they engage in, but invariably this pattern of interaction emerges as they progress, rather than being chosen or ‘caused’. Variation in this interaction is important as learners see new ways of doing things, or new challenges, or new learning strategies. As this research indicates, it is not always preferable to be directed or shown particular skills or ways of performing computer tasks. Rather, learners often need to ‘discover’ their preferred approaches as perceived need and readiness emerge. The context created in the Unit was greater than the sum of its parts.

A final note might be made about agent interaction. In the early phases of the research (particularly section 2.4.3) I struggled with the ‘ideal’ of participation in the action research undertaking. From a complexity perspective, participation was inevitable.
8.5.4 Reflecting on the Unit’s Design and Metacognitive Foundation

This section draws on complexity thinking to re-examine the Unit’s design and metacognitive foundation, illustrating how the approach to computer education that developed from this research is consistent with learning and teaching approaches advocated by complexity theorists.

McAndrew (1997) has noted that we have attempted to create schools and, I would argue, learning contexts in general, that are orderly and predictable places which attempt to simplify learning. ‘Schooling rarely encourages processes that lead to the development of complex patterns of connections. Instead, teachers tend to follow narrow and linear approaches to instructions... result(ing) in fragmented knowledge with little or no relevance or meaning to the students’ (Bloom, 2000, p.7). Such comments echo those of Bjork (1994), as discussed in chapter 7. It will be remembered that Bjork warned of the risks of ‘contextualized training’ and discussed the importance of introducing variation and unpredictability into training contexts to increase retention of learning. Honebein, Duffy and Fishman (1993) have also argued that developing understanding in a simplified environment is quite different to the understanding developed in a full stimulus environment and that simplification of complex subject matter is a ‘conspiracy of convenience’. Drawing from constructivism, they argue that providing realistic levels of complexity in the learning environment can actually make learning easier: ‘tasks that are thought to be difficult when attempted in a decontextualized environment become intuitive when situated in a larger framework’ (Honebein, Duffy & Fishman, 1993, p.95). Rather than simplifying the environment, the goal of educators should be to aid the learner to function in rich learning environments. In a similar way, Iannone (1995) argues that education should be process-oriented and students must be actively engaged. Curriculum, he states, should be flexible, open, disruptive, uncertain and unpredictable and should accept tension, anxiety and problem creating as the norm. Such a call would seem to support not only a metacognitive learning and teaching approach but one which fosters exploratory learning.

Bloom (1998) is one of the few writers to comment explicitly on the place of metacognition within a complexity-based approach to education. According to Bloom, metacognition is learning about how to recognise and deal with contexts beyond the familiar and involves setting aside our habitual reliance on interpreting familiar contexts in certain ways. Again, these comments emphasise the importance of capability and resonate with the foundational issues underlying this research. Doll (1989b) also touches on these ideas in noting that reflection, reorganisation and interactive play need to be part of the curriculum. The metacognitive process does not cause learning or change but, rather, it opens up possibilities for change by prompting instabilities within and between participants. In considering this we might return to complexity’s notions of system instability and sensitivity to initial conditions. The input of a new idea or action into the system can lead to dramatically different and unpredictable outcomes (Eve, Horsfall & Lee, 1997b). Dramatic effects can happen, but mostly smaller and sometimes imperceptible changes occur. The system remains in a state of stability but it is only marginally stable. ‘A slight “poke” may not do anything at all. But, then again, something might happen’ (Doll, 2002, p.9). And herein lies an explanation for the varying levels of student engagement in metacognitive and reflective experience. Doll’s (2002) analogy of an earthquake is
valuable in illustrating this point. Tremors are going on all the time but are mostly imperceptible. It is the scale of the perturbations that is of importance. When the change is great enough it becomes noticed. Similarly, reflection is going on all the time, but it is the scale of the engagement that is of importance. Small ‘rumblings’ may be the beginning of larger, later eruptions.

As Doll (1986) perceives it, the role of the teacher is to intentionally cause enough chaos to motivate the student. While too much chaos will lead to disruption, too little will produce no reorganisation. What leads to instability for one individual will not be adequate to drive another to ‘the edge of chaos’. Throughout this research there have been numerous ways in which I have promoted learner instability, including: emphasising the importance of computer use in the teaching context; presenting a range of challenging activities; prompting students to set their own challenging goals at an individually relevant level; and moving away from directive to exploratory learning and teaching approaches. In relation to this latter point, the comments made by a number of complexity theorists with regard to play are relevant. Gare (2000), for instance, describes play as the ‘archetypal chaotic and unpredictable behaviour from which new order emerges’, ideas echoed by Reason and Goodwin (1999, e.p.): ‘Play is by nature spontaneous and purposeless; it is simply for its own sake; it is dangerous in not attending to the harsh realities of existence; yet it is helpful to living creatures because it contains the possibility of novelty’. The ‘iterative exploratory practice’ model described by Zhang and Fowler (1996), also touches on these issues. Complexity thus provided a fresh perspective from which to understand the centrality of play in computer learning.

Making explicit the complex context which is computer learning, and the need for lifelong computer learning approaches, might be viewed as a stimulus for instability in itself, as was the metacognitive and reflective framework. The Unit design, while maintaining notional structure, minimised linearity; for instance, the analogy of parenting introduced in cycle 3c (see section 7.4), represented an explicit acknowledgment of a complex and non-linear perspective on learning and teaching. By prompting students to self-examine their affects, motivations and strategies toward computer learning, the Unit prompted them to self-challenge existing learning patterns. Again, the metacognitive approach did not cause learner instability and this helps account for the various depths of reflective engagement explored in section 7.2.2. Some students were already on the capability continuum and did not need stimulus to ‘bifurcate’. Others were just not ready or willing. Part of the learning journey for me as an educator was to realise that I cannot predictably cause change. I can ‘train’ my students in computer skills and nudge them along the path toward increased competence, but I cannot ‘cause’ them to bifurcate to increased capability. In the organizational context, Stacey, Griffin and Shaw (2000) note that, while unpredictability emphasises the limitations of strategic planning it does not diminish the need for vision. Vision does not imply a future state or a destination, but clarity about purpose and direction. My role as ‘teacher’ was thus to convey a sense of ‘vision’: to be ‘a committed co-learner and occasional guide in the exciting journey of transformative learning’ (Mezirow, 1991a, p.360). I can create learning contexts rich in stimulus and opportunities for change and I can provide maximum support for that change; but I cannot predict the outcomes for individuals: the initial conditions of their learning are too complex and various. While this may sound like an abdication of teacher responsibility, I would argue that, rather, it represents a more accurate and realistic recognition of the realities of
‘teaching’. Furthermore, my research and teaching experience has taught me a lot about how I can increase the probability of bifurcation and hence capability. In accordance with Bjork’s (1994) ideas, I can foster a learning context complete with difficulties and challenges: what might be interpreted as instability in a complexity framework.

Reason (1999) notes that promoting learner instability may result in higher tolerance for ambiguity and lack of certainty. The relationship between anxiety and level of perceived control is frequently raised in the complexity literature. Anxiety, Streatfield (2001) states, is ever-present, and is therefore normal, healthy and essential for the emergence of novelty and change. Promoting learner instability within a supportive framework is thus important to enhance the likelihood of individuals bifurcating from competence to capability. In my own research, individuals who were most anxious often made the biggest changes (for example, Sharon, Jill and Katy), whereas the least anxious students made the least change (for example, Yvette and Bradley).

Complexity theory, while stemming from a very different paradigmatic basis, is not incongruent with the foundational postulates of social cognitive theory. Bandura’s notion of ‘triadic reciprocity’ between behaviour, cognition and environment resonates with complexity’s ideas of agent interaction, feedback and feedforward. Social cognitive thinking does acknowledge the broad range of factors influencing individual behaviour and provides a conceptual framework for understanding at least some of these. Notably, however, the causal and predictive underpinnings of much of the psychological research are challenged by complexity. Revisiting the literature outlined in chapter 4, I was struck again by its reductionism. Social cognitive theory, I believed, did not carry such implications and it was possible to re-read this theory without applying linear, causal thinking. My research had highlighted the inability to fully understand an individual’s approach to computer learning in terms of their self-efficacy and outcome expectations, although these were certainly contributing factors. Engagement with students had provided unique insights into the thought patterns, emotional reactions, affective state, motivation, and outcome expectations, but had brought me no closer to the development of a ‘teaching solution’. What it did emphasise was that students have been uniquely formed as an adaptation to their environment and experiences. Given the range of individual contexts, it is inevitable that the variables measured in the self-assessment survey would have unpredictable outcomes. For each student, and in each individual circumstance, the variables evoked a diverse array of responses.

It was also important to consider the role of learning objectives, outcomes and even goal-setting through the veil of complexity. In section 7.2.4 I noted that externally imposed objectives often had little real impact on students’ learning and ran the risk of defining minimum standards that impeded lifelong learning approaches. Rather, when capability is the goal, skills and achievements emerge because students are open and embracing of learning opportunities and the process is more fluid than is implied by pre-specified outcomes. Complexity provides a valuable framework through which to consider these issues and observations. From a complexity perspective, knowing, being and doing are not three different things, they are one: objectives cannot be ‘pre-specified prior to self-identified action-in-the-world’ (Davis, Sumara & Kieren, 1996, p.155). These ideas have also been expressed by Doll (1989b, p.171), who argues that ‘in a frame that recognizes self-organization and transformation, goals, plans and purposes arise not purely prior to but
also from within action’. As Stacey (2000) has described, the process of choosing aims, goals and visions in order to be ‘in control’ depends utterly on this foundation of predictability and implies rationalist teleology. ‘If a system’s specific long-term behavior is unpredictable, then setting specific goals for it is a questionable activity’ (p. 91). As Stacey (2001, p. 226) continues:

What the transformations will be cannot be predicted in advance. How the anxieties provoked by such transformations are to be lived with also cannot be known in advance. While participants do, of course, engage in the process with intention and foreknowledge, no one can predict how the experience will evolve or what will be learned, individually and collectively. It is, therefore, impossible to set learning outcomes in advance in any truly meaningful sense. The meaning will emerge in the session.

These ideas are consistent with those of Simons (1993) who notes that, from a foundation of constructivism, learning cannot and should not be goal-directed all the time. ‘Sometimes one should be satisfied with a global, general learning goal and let the learning environment guide the discoveries’ (p. 292). It is also worth citing Marion (1999, p. 174) who argues that organisations (and here I’ll substitute individuals) ‘don’t plan their environments, for environments are too complex; they simply learn to thrive within them’. These ideas provide a firm justification for the lifelong learning approaches advocated in this research.

Complexity also forms a valuable framework for reconsidering earlier discussions regarding the ‘tension’ between institutional and non-institutional learning. We might remember Brookfield’s (1984, p. 60) statement regarding ‘the false dichotomy in which institutionally sponsored learning is seen as purposeful and deliberate and learning occurring in non-institutional contexts is held to be serendipitous, ineffective and wholly experiential’. Learning outside classrooms is non-linear but institutional learning often represents a simplification of natural learning approaches, usually attempting to package learning into pre-designed, highly controlled and linear processes. To draw on the ideas of Doll (2002; 1998), linear and closed instructional design tends to trivialise the goals of education, focusing on very simple, concrete goals. These ideas are also expressed by Kliebard (cited in Iannone, 1995): ‘If anything is ingrained in curriculum thinking today, it is the notion that it is the job of curriculum planners to anticipate the exact skills, knowledge and – to use one of today’s most fashionable terms – competencies that will stand one in good stead at an imagined point in the future’ (p. 86). Here we can see a true resonance between the ideas of complexity theorists and my earlier critique of the competency/capability debate. Yet these challenges cut to the very heart of our educational systems and processes. Institutional learning is a reality. I was, after all, teaching an accredited university unit. The key task, however, is to create a learning context which minimises the distinctions between institutional and non-institutional learning, providing congruence in learning approaches and sustainability of strategies as students move out of the institutional learning setting; in other words, to promote lifelong learning. Institutionalisation fosters a concept of computer education that takes place in discrete and definable ‘units’. It will be recalled that two students in cycle 2 voiced their expectation that the Unit would tell them all there was to know about computers for their teaching career. We might also reflect here on the many students whose principal goal was to ‘pass’ the Unit. These are all symptoms of institutional perceptions of learning.
It is fitting here to return to a body of theory mentioned in chapter 2 as informing the direction of my research. The ‘learning organisation’ had been perceived as an appropriate metaphor for schools and, in particular, an informing vision for pre-service teacher education. Complexity and the ‘learning organisation’ share a foundation in systems thinking; and a number of educational complexity theorists (Fleener, in press-a; Sumara & Davis, 1997a) have described schools as learning organisations. However, both Fonseca (2002) and Stacey (2001) argue that, from a complexity perspective, it is meaningless to ask whether organisations learn or whether people in organisations learn. It is the same process. ‘If knowledge is not a thing but a process of meaning making where meaning is continually reproduced and potentially transformed in the action of communicative relating... then one cannot speak of sharing it, or of spreading it around an organization’ (Stacey, 2001, p.227). This discussion has most recently been taken up by Flood (2001).

Computer capability thus needed to be perceived as potentially emerging from a wider context of agents, schemas and events. It was not just individual students who needed to be capable; it was the whole learning context. I couldn’t view my position as standing outside this environment; rather, I was an active constituent of it. In thinking through where my professional practice might now lead, I returned to the notion of stimulating instability and realised that to foster capable computer users, individuals who were on the ‘edge of chaos’, I needed to foster greater instability in the wider learning environment. I return to these ideas in chapter 9.

8.6 Critiquing Complexity as Window on the Research Story

One criticism often leveled against complexity is its tendency to overstate its own importance. That said, the majority of complexity theorists are active in reflexive processes, self-critiquing the theoretical and methodological bases of their work. As Capra (1996) has stated, all theories are approximations to the ‘true’ nature of reality; and the generative metaphors (Gough, 1999) provided by complexity are no exception. In this section I critique my decision to discuss this research through the window of complexity theory.

Reflecting on my engagement with complexity, I realise that there might be a danger of adopting it as ‘dogma’. Complexity began colouring many facets of my life, from interpreting television documentaries and engaging with current affairs, to my critique of the organisational context in which I was employed and current trends in the management and governance of higher education. Complexity had undeniably prompted a transition in my frames of reference and my epistemic positioning. It was thus important that I remain critical of the application of complexity in education, while allowing it to open up new perspectives and opportunities for understanding and to provide access to both new worlds and new possibilities for action (Lissack, 2001). That said, I also acknowledge that my understanding of complexity and its application in learning and teaching will continue to develop and refine in the future. Acknowledging the dynamic state of my understanding is, in itself, the most valid position to take from a complexity perspective. Given the recency of complexity’s application, particularly in the context of education, there is much work still to be done in exploring the potential of this theory to support understanding of learning and teaching. The ideas presented in this chapter will, I trust, make a valuable contribution.
Much of the richness of this research has stemmed from my preparedness to read outside my foundational discipline of adult education and to explore unfamiliar terrain: to ‘break out of the shell that surrounds our understanding and locks in our behaviour’ (Passfield, 2001, p.39). My engagement with the literature surrounding mixed methods (chapter 5) resulted in my examination of the ‘paradigm wars’ and led me to a new-found preparedness to seek out theoretical positions from disparate disciplines. This, in turn, led to the holistic approach to computer education developed through this research. Consistent with systems thinking, which demonstrates healthy scepticism toward the division of disciplines (Checkland, 1981), complexity capitalises on cross-disciplinary understandings and cross-fertilisation of bodies of ‘knowledge’. In the words of Lincoln and Denzin (2000, p.1060), ‘the flowering of multiple paradigms and methods has been accompanied, to some extent, by a flowering of possibilities for the human spirit’.

My decision to present this thesis in a chronological manner, drawing on the metaphor of research as journey, is also supported by the theoretical foundation of complexity. Emergence, which is implicit in complexity, emphasises that the outcomes of research, or even any pre-specified objective, cannot be considered in isolation from the processes implicit in the conduct of the research. As Stacey (2001, p.140) describes:

> Human experience is story-like. In their relational communications people are constructing intricate narratives and abstract-systematic frameworks. When they reflect on what they have been doing, on what they are doing, and on what they hope to do, they select aspects of these dense narratives/abstract frameworks to tell stories or extend their abstract-systematic frameworks... in the process their very identities, individually and collectively, emerge.

These ideas emphasise that research, like other forms of learning, should be allowed to emerge. As Stacey (2000, p.170) continues, ‘People tinker, and as they do so they sense patterns. These patterns organize their perception and understanding, and as they tinker further those perceptions and understandings restructure, which in turn affects what people observe’. When justifying the narrative approach to this thesis (section 1.6.2), I emphasised that such a structure was appropriate in depicting the way the research was influenced by temporal considerations. The research was shaped not only by my interactions with participants and data, but also from the pragmatic ‘realities’ of the research context. Interaction with literature and theory also impacted significantly on the research ‘journey’, influencing my perceptions and understandings, which in turn influenced those of my students. My research would have been very different had I engaged with a different body of literature or even the same body of literature in a different order. This, in itself, speaks clearly of complexity; and similar points could be made about other aspects of the journey, such as my necessitated absence from the small group processes in cycle 3a. The outcomes from these groups might have been quite different had I continued to be present, just as the dynamic within the groups might have been quite different with alternative group membership. The narrative ‘story’ of the research undertaking embraces these understandings. As such, the research depicts complexity’s underpinning principle of emergence. An important aspect of my learning through this research has been to come to terms with this emergence, and to recognise the limitations in my ability to control or direct either my teaching or research context.
8.7 Stepping Back and Moving On

This chapter has represented something of a departure from the cycles of planning, acting and observing which have been traced through this thesis. As I have argued, complexity resonated both methodologically and theoretically with my research. Through reference to two figures, I have demonstrated that complexity provided a new and valuable metaphor through which to understand, not only the computer learning and teaching context, but the concepts of competency and capability themselves. The chapter has formed a ‘summative’ exploration of the overall research, presenting the resultant theoretical understandings for me as researcher and teacher. The following and final chapter presents my reflections on the research journey. In particular I return to my initial research question, the starting point of the journey, and consider the development of my teaching practice. I will also, reflexively, address issues of rigour and the relevance of the research and, in so doing, open up the research story as a continuing journey: the start of new adventures.
Chapter 9 - Journey Ending as Journey Beginning

We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time.

T.S. Eliot from ‘Little Gidding’

And so we draw to the final chapter and the point at which the reader may expect to find conclusions. Yet, as I will argue, the notion of ‘conclusion’ is, in itself, incongruous with the nature of action research. Unlike a traditional thesis, I do not revisit the data and findings from previous chapters. Rather, this final chapter will instead take stock of the research ‘journey’, summarising the learning that this voyage evoked for me as researcher and teacher. I return to the literature concerning rigour and quality in action research to provide a reflexive evaluation of the study. In so doing, I reconsider the narrative approach to the thesis presentation and its consistency with the research’s theoretical underpinnings. Heeding my original research question, I summarise the impact of the research on my teaching practice before considering the relevance of the research to others, and the challenges that have now been opened up. While this chapter represents an arrival ‘home’ it will be demonstrated that this return was made with new perceptions and understandings, both theoretical and practical, and that the journey instilled in me a renewed passion for ‘travel’. Where it is conventional to include recommendations for further research, this chapter points to the initiatives already emerging from this study. This chapter, then, represents the reflective memoirs of the journey thus far; but, more than that, it opens up plans for future and ongoing adventure.

9.1 Souvenirs of the Homecoming: A Reflexive Reappraisal of the Research

In the introduction to this thesis I cited the research focus as: ‘How can I improve my teaching practice to better facilitate the development of capable computer users?’ Before summarising the changes that have resulted to my teaching practice, I acknowledge that my focus has been drawn, throughout the study, to the students with whom I have worked. On reflection, this may be perceived as a divergence from attention to my own practice. Rather, I would argue that this represents a learner-centred focus and a realisation that it was not possible to improve my own teaching practice without improving my understanding of the students. Throughout this thesis I have explicated my theoretical orientations and personal attitudes, assumptions and beliefs; but, beyond this, I have continually confronted and readdressed these throughout the research cycles. I have also made every attempt to articulate and explain the research context and process through the perspective of participating students. Admittedly, this has inevitably been limited by issues of selective self-disclosure by participants. As far as possible, however, I have supplemented and triangulated the self-reported data of students through multiple data collection approaches and by providing multiple case studies to compare and contrast.
student experiences. In so doing, this thesis meets Zuber-Skerritt’s (2001) call for the action researcher to own their own perspective, demonstrate an interest in divergent perspectives rather than truth *per se*, and provide an honest account of how participants view themselves and their experiences.

For me, as teacher, the research has evoked significant growth. Aside from the tangible changes in teaching approach described throughout this thesis, and in particular the development of the metacognitive process presented in chapter 7, a number of more subtle changes have occurred. The research has necessitated my conscious ‘letting go’ of teacher control and centrality in the learning process. Despite my originally espoused support for learner independence I have, at times, felt uncomfortable when students sought assistance from others, acknowledging a hard-shed belief that teachers should be central to students’ learning. I later found comfort in reading of the similar struggles of Carson (1997, p.79) who noted a realisation of ‘how much the desire “to be seen as a teacher” permeates the teacher-education classroom on all sides’. This research has enabled me to step back and recognise the importance of explicitly acknowledging the breadth of authentic support structures which are important for lifelong and non-institutionally-based learning and fostering students’ help-seeking strategies. I have also had to determine how best to work with students who are not ready or willing to engage in self-directed, reflective or flexible learning, and again this has challenged my assumptions regarding notions of control and readiness. I have come to perceive my role as one of helping students to be comfortable existing ‘at the edge of chaos’; prompting them to move outside their zone of comfort and supporting them to develop new strategies to thrive in a rapidly changing technological environment.

The theoretical ‘complexity’ that became the cornerstone of my research and teaching journey depicts the holistic approach that I believe is critical in computer education. It is this holism which represents the biggest transition in my teaching practice and also which underpins the metacognitive process of computer education presented in figure 6. If there is one key learning that I have gained, and which I would hope to have depicted through this thesis, it is that it is insufficient, as a computer educator, to focus *only* on technical skills. This research represents a richness and breadth of understanding of the computer learning context. It argues that, to obtain a workable and effective understanding of computer learning, it is necessary to draw on understandings and practices from diverse contexts. There is a need to consider factors such as learner anxiety, motivation, self-efficacy, outcome expectations, learning strategies and help-seeking; but, more than that, it is important to keep in mind complexity’s postulate that the whole is ‘greater than the sum of its parts’. From such a perspective it is not enough to understand the computer learning context by understanding the influence of these individual ‘parts’ or factors. Rather, we need to work toward understanding computer learning and teaching by understanding the interaction of these ‘parts’. Only the learners themselves are positioned to reach such complex understandings and to support their own learning and, for this reason, it is important to conceptualise computer education in a metacognitive framework. In a context of rapid technological change, computer education must be about ‘learning to learn’.

These points may, in retrospect, seem self-evident. Having engaged with this research for some three years, I experience a tendency to perceive these understandings as ‘common sense’. However in stepping back and re-examining the wider context of computer
education, these values are certainly not embedded in contemporary practice. Competency-based initiatives such as the International Computer Driver’s License, which is being marketed and adopted widely, would seem to represent the antithesis of the approach advocated through this research.

A further learning from the research journey was that I could not consider my teaching of computer skills to pre-service teachers in isolation from the wider context of primary and secondary education. At the beginning of the research the Unit was generic in focus, with little emphasis on the application of technology in classrooms. In initially becoming involved with the Unit, I perceived my role as one of teaching computer skills to a group of adult learners. The research, however, clearly indicated the importance of perceived usefulness and outcome expectations as key to students’ learning. Teaching a generic computer unit to a target group such as pre-service teachers was not effective; and the Unit, and my teaching, required major modification to redress these issues. Again, such comments might seem to be self-evident. However, these findings have key implications in a higher education climate where economic rationalist imperatives prompt consolidation and rationalisation of unit offerings across courses. This research reinforces the unsuitability of teaching generalised computer units to a profession-oriented group such as school teachers. Furthermore, the diversity of skills and understandings which any student group brings to the computer learning context require innovative and flexible teaching strategies that challenge all learners, focusing not only on skills, knowledge and practical application, but also on confidence and learning strategies that enable lifelong learning. The model of flexibility and reflective learning developed in this research provides such an approach.

The introduction to this thesis referred to Long’s (1990) timeless statement that continuing to teach in traditional approaches is significantly easier than challenging an approach which has reinforced the power base of the teacher. My experiences emphasise that engaging students in metacognitive and reflective learning is not easy to do. Add the dimensions of flexibility and the idea of learner independence and the task becomes even more difficult. At a surface level the interests of students are served by teacher centred, non-flexible, directive teaching. Particularly in the computer learning context, this can be perceived as the only way of transferring defined sets of skills to the student. Yet this research has documented a wealth of data indicating the potentially detrimental impact of teacher-directed group learning contexts. The metacognitive approach developed in this research represents an alternative to conventional teaching. Again, this approach is not comfortable for all students and there have been instances where these teaching methods have met with resistance. The research has, however, documented many case studies demonstrating the potentially empowering outcomes of such an approach and the benefits to students of confronting their initial discomforts and their assumptions regarding computer learning and teaching.

9.2 Reviewing Rigour and Relevance
Toward the completion of this thesis, I became aware of the burgeoning area of self-research, and recognised its relevance to my own study, particularly in terms of its views on rigour and relevance. Elliott (1999) and Smith (2002) argue that validity of self-research is best measured by trustworthiness and authenticity, as judged by the reader, suggesting that the story must ‘ring true’ or resonate in terms of the reader’s experiences and
understandings. A story of value, Smith continues, should ‘will’ the reader to create useful and important meanings while also depicting the importance of meanings created by the researcher in living and retelling the story. Similar values are inherent in the work of complexity theorists. Stacey (2000, p.203), for instance, argues that ‘narrative knowledge is embedded in anecdotes and stories, as well as the evaluation of those stories. The point is not whether they can be empirically validated or not, but whether they resonate with the experience of others and assist them to make sense of that experience’.

Similar considerations underpin the quality of action research, namely relevance, application and practical utility: its capacity to evoke valuable and workable change, embraced by local stakeholders. Such pragmatic validation emphasises that credibility, validity and reliability can be judged by the willingness of local stakeholders to act on the results of the research (Greenwood & Levin, 2000). I return to these notions in following sections, demonstrating that the ideas and approaches embedded in this research have been embraced by students, teaching colleagues and now other key players. However, it must first be acknowledged that the learning and teaching approaches developed and investigated as part of this research were not embraced equally by all participants. In some respects this might be interpreted as undermining the validity of the research. However, the very notion of a ‘one-size-fits-all’ approach to teaching is itself a point of critique in this thesis. As discussed in section 8.5.3, teaching does not cause learning, nor can I, as teacher, cause bifurcation to capability. Yet, for the many students who reached ‘ah-ha’ experiences through the metacognitive approach, the resultant change in attitude, beliefs and particularly in confidence has been profound. In stating this, I am reminded of Gough’s (1999, p.59) comment that: ‘We do not solve problems in curriculum work in the hope that we eventually will have fewer such problems to solve, any more than crossword puzzle addicts hope that, by completing each crossword, they are reducing the number of puzzles remaining to be solved’. As a teacher, I cannot hope to solve all problems for all students, but I can create an environment rich with potential.

The reader of this thesis will thus not find any ‘answers’, ‘quick fixes’ or ‘guaranteed solutions’ with which to approach computer learning contexts. Nor will they discover any demonstrated cause and effect relationships between actions and outcomes. The metacognitive approach developed through this research will not have an equally effective outcome for every participant. As I have now established, such attempts are antithetical to the theoretical and epistemological foundations of my research. Rather, this research has illustrated that computer education should not be looking for single or ‘correct’ approaches but, rather, should embrace holistic considerations, approaches and strategies. ‘Truth, or correct knowledge, is what works in a situation – an idea that is founded on a ‘survival of the fit’ rather than a ‘survival of the fittest’ logic’ (Davis, Sumara & Kieren, 1996). Such a perspective is also consistent with a view of learning as lifelong. In non-institutional contexts we don’t expect ‘learning’ to be confined to a neat 13 week period. It is not possible to ensure all learners are ready for transition, nor that transition will occur in that time. However, creating a learning context rich with opportunity and diversity of experience can prompt learners to journey to the edge of comfort. Metacognition, then, can assist them to know they have the strategies to confront this inevitable unpredictability and ‘chaos’, now or in the future.
It is the comments of students themselves, however, that have led me to realise the broader implications of this research. The influence of the learning and teaching approaches developed throughout this research have not only changed my own practice, but have had an impact on the learning of many students. Such an impact will extend beyond the context of this Unit.

In conclusion 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 (Student 109, cycle 2).

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 (Student 15, cycle 2).

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 (Student 28, Cycle 2).

9.3 Reconceptualising Emancipation as Emergent Systems Change

At the outset of my journey I explicitly acknowledged that my intention was not an emancipatory one. My principal aim was to improve my own practice, rather than to challenge the broader educational system in which I worked. I have since argued that, from the perspective of complexity, change is emergent; and, while it cannot be ‘caused’ from outside, changes produced by agents within an environment will inevitably influence the wider system. In this way, the research has inevitably opened up initially unforeseen opportunities for emergent change within the broader educational context.

In chapter 7, I touched upon issues concerning adaptability to online, self-directed and flexible learning. Such limitations to learner engagement cannot be addressed without considering broader systemic issues in higher education and, for that matter, pre-tertiary education sectors. Decreased propensity for self-directed learning and low motivation to assume responsibility for learning have long been identified as resulting from learners being conditioned to authoritarian teaching (Harris et al., 1995). Resistance to self-directed learning emanates not only from learners, but from facilitators and from institutional policies, practices and attitudes (Brockett, 1994; Hiemstra & Brockett, 1994). As Brookfield (1990, p.87) emphasised some time ago, 'advocating self-directed learning is, in institutional terms, a highly political act. Granting control to learners is not something that can easily be done within institutional limits’. For students to assume greater autonomy, and in the context of this research, to develop towards computer capability, education systems need to evolve to support such models of learning. Despite the espoused focus in adult education on self-direction, learner centredness and flexibility, many contemporary educational trends and practices run counter to these professed ideals.
This argument is supported by Bjork (1994), who suggests that nonproductive training contexts remain the ‘norm’ because trainers are overexposed to the day-to-day performance and evaluative reactions of trainees. Trainers are vulnerable to ‘operant conditioning’, shifting their actions to increase ‘correct’ student responses, thus making their life as trainers easier. Institutional characteristics also reinforce such non-optimal learning contexts. Trainers are evaluated in terms of performance and satisfaction of trainees during training. Furthermore, trainers have little opportunity to observe long-term performance of the people they train. It is easier, as a teacher, to assume the comfortable approach to teaching: to provide the ‘answers’. Again, these ideas are not new. It is some time since Simons (1993) highlighted that, while many educators nominally support constructivist learning principles, if and when they implement constructivist teaching approaches they discover that ‘many students are not able or willing to reach an adequate level of independent learning on their own. Therefore they decide to take back control over the learning process by providing structure and informing students intensively’ (p.296). Hence, students do not learn how to take control and many come to believe that it is the teacher who should be organising learning.

Assuming an approach to teaching such as that developed in this research, inevitably creates tensions with institutional expectations. In moving beyond a compartmentalised view of teaching, I became increasingly critical of institutionally imposed time constraints and deadlines. Introducing these types of learning environments challenges institutional and individual attitudes, such as the meaning of making errors and mistakes (Bjork, 1994). I felt uncomfortable with compulsory attendance requirements, institutionally imposed due dates and assignment word limits, which implied that learning should commence by attending a class at a certain time and conclude once a due date arrived or a word limit was met. In my interactions with students I embraced much wider perceptions of flexibility, recognising that learning took different forms and posed different constraints for all individuals. These values were, however, often conceived of by other staff as undermining system expectations or, by some students, as resulting in unclear expectations. Despite the risk of non-acceptance by a small number of students, the Unit’s approaches represented a closer approximation of authentic computer learning environments that students are likely to encounter through life. As expressed by Student 20 (cycle 3a), computer learning is not always positive. It might entail bouncing between enthusiasm and disappointment, confidence and non-confidence, depending on rate of achievement, understanding and outright failure. Yet these experiences are realistic. The Unit did not set students up in an artificial environment of constant success. As my experience testifies, it requires considerable effort and reflective engagement on the part of educators to relinquish control of the learning process. Teachers need to embrace previously disparate levels of flexibility, and engage in metacognitive processes alongside their students. As Graham (2001, p.8) has stated, reflection is ‘integral to the continuing process of being a professional where learning to teach and teaching to learn are inextricably linked’. This research can only support Rieber’s (2001, p.3) claim that ‘guiding, shaping and managing the learning experience is far more demanding than that of dispensing information. It is far more satisfying as well’.

One of the most valuable outcomes of this research, for me as a teacher, is that I now feel I have the experience and confidence to effectively engage in the type of teaching suggested
by these educationalists. While completing the writing-up of this thesis in 2002, I have continued to engage with students in the Unit, particularly focusing on those most resistant to learning engagement. I can recognise that I now have better access to teaching techniques and motivational strategies than at any stage of my previous career. Most importantly, however, I now have the confidence, supported by the evidence of numerous case studies, to be more assertive regarding the benefits of the approach and its potential for student empowerment. I now feel I understand the diversity of students’ reactions to computer learning and the barriers which stand in the way of them becoming capable.

Armed with this experience and knowledge, I have felt far more confident to challenge both institutional and individual expectations and to nudge even the most resistant student toward learning independence.

We seem to be standing at a cross-roads – a point at which our education systems could ‘bifurcate’ to a system supportive of lifelong learning, or one which continues to institutionalise learning. Recently, Warner (2000) emphasised that our school and Vocational Education and Training sectors are still perpetuating dependency, rather than fostering self-direction. We continue to condition learners to be passive recipients of transmitted information, values that work against the need of modern workplaces for self-directed learners and capable computer users. Without the inclusion of units such as the one developed through this research, it seems unlikely that the situation in our education systems will change. If we are to assist our students to embrace lifelong learning, it is of critical importance that future teachers are exposed to a range of educational contexts, including those embracing non-linear and emergent understandings of learning. As Davis and Sumara (1997a) argue, reproducing teaching practices that are founded on limited conceptions of learning and cognition reproduce rather than transform school settings in which students and teachers feel disconnected from past, present and projected worlds of experience. This research has indicated that opening up such opportunities for teachers holds the potential for creating longer-term change.

9.4 Contributions to Knowledge

The major goal and purpose of any PhD thesis is to make an original contribution to knowledge (Perry, 1994). This research advances practice in, and understanding of, the computer learning context in a number of respects. The research has demonstrated that cognitive, metacognitive, motivational and affective variables play an important role in computer learning. As Harper and Radloff (1999) note, students need to possess both skill and will to be effective learners. The research has refined an approach to computer education which is flexible enough to accommodate learners’ wide range of background experience and degrees of confidence. In this respect it meets Laffey’s (1998, p.238) call for strategies that ‘accommodate diversity and inspire preservice teachers to new and creative ways to use technology, yet leave no one behind and untrained’. Furthermore, the research has progressed my teaching practice beyond simplistic directive techniques to an approach which holds potential for long-term impact on students. The research meets Ropp’s (1997) call for the consolidation of a teaching approach that is ‘useful for instructors and palatable for students’. Figure 6 graphically presented the metacognitive process of computer learning and teaching. This was further explained through a metaphorical simplification of the process in figure 7.
On a more theoretical level, chapter 8 presented a significant contribution to knowledge in the application of complexity thinking to the computer learning context. Figure 8 depicted a reconceptualisation of the nature of computer capability and computer competency through complexity and figure 9 extended this understanding to embrace the specific teaching and learning context discussed throughout this thesis.

To summarise, then, the contributions to knowledge made by this thesis encompass theoretical, disciplinary and methodological originality and can be succinctly summarised through reference to the publications arising to date from this research:

- Challenging of competency-based approaches to end-user computer education (Phelps, 2001; Phelps, Ellis & Hase, 2001);
- Challenging traditional teacher-directed approaches to computer education (Phelps & Ellis, 2002a);
- The integration of metacognitive learning and teaching approaches within a pre-service teacher-education computer context (Phelps, 2001; Phelps & Ellis, 2002b; Phelps, Ellis & Hase, 2001);
- The value of embracing specific metacognitive aspects of computer learning, such as self-efficacy, attribution and learning style (Phelps & Ellis, 2002b; Phelps & Ellis, 2002c);
- Exploring the theoretical connection between action research and complexity theory (Phelps & Hase, 2002);
- The application of complexity theory to the computer educational context (paper in progress);
- An understanding of competency and capability from a complexity-based perspective (paper in progress);
- A proposed alternate structure for the presentation of action research theses (paper in progress).

9.4.1 Implications for Fellow Travellers

A good theory arises out of practical experience, articulates qualities of practice to which we aspire, and challenges us, moment to moment in our professional and personal lives, to discover ways to realize these qualities in action (Reason, 2001, e.p.).

The issue of theory generation has received considerable attention from action researchers and complexity theorists alike. As Cartwright (2000) argues, ‘Unlike traditional notions of research, the action research process does not end with richer understandings of education for others to implement, rather it aids in changing education within and against particular contexts’. Consistent with complex constructivism, knowledge is not something that can be readily transferred but, rather, ‘is created by educational practitioners making sense of their practice and explaining their development as they improve the quality of their practice’ (Hughes, Denley & Whitehead, 1998). In emphasising this, I am arguing that the knowledge which has resulted from my journey cannot be directly transferred to others’ contexts. The souvenirs I present from my adventure should not discourage others from travel but, rather, should be conceived as informing their plans. ‘Through learning about the experiences of others, we get ideas, new ways of thinking, a sense of the uniqueness of our own context, and a window into ourselves’ (Brooks & Watkins, 1994, p.14). A journey,
once travelled, cannot be replicated. Consistent with complexity, the very act of
eengagement changes the context:

... all the contributing factors in any teaching/learning situation are intricately,
ecologically and complexly related. Both the cognizing agent and everything with
which it is associated are in constant flux, each adapting to the other in the same way
that the environment evolves simultaneously with the species that inhabit it... As the
learner learns, the context changes, simply because one of its components changes.
Conversely, as the context changes, so does the identity of the learner (Davis &
Sumara, 1997b, p.109).

The context of other computer educators will not be the same or even similar to my own,
and thus the implications of this research to others’ contexts can only best be determined
by them. That said, it is hoped that the learnings gained in and through this research will
inform learning and practice of others in a range of contexts.

A particular note might be made about the topicality and currency of this research in the
school education context at the time of thesis submission, particularly in terms of ongoing
teacher professional development. In June 2001 the Commonwealth Department of
Education, Science and Training published a report titled Making Better Connections:
Models of Teacher Professional Development for the Integration of Information and
Communication Technology into Classroom Practice (Downes et al., 2001). This report
does not appear to have been widely circulated until mid-2002. In this report the term
‘capability’ is widely and deliberately used, but nowhere defined or explored: an issue
which would be addressed through this research. Making Better Connections emphasises
that traditional forms of professional development are not really effective in improving
student learning and that there is a pressing need for collaboration and coordination
between pre-service teacher education, continuing professional development and systemic
and school reform. In exploring the state of teacher professional development in ICT this
report states that:

Patterns of system-level resource allocation tend to favour a training model over
alternative models that the literature argues or demonstrates are more effective in the long term. This is so despite ample evidence that traditional models are ineffective and wasteful... Alternative models are often messy, more difficult to account for, and longer in duration, but more effective in reform processes (Downes et al., 2001, p.18).

In examining a range of professional development processes and models, the report points
to the benefits of approaches such as professional learning communities and sustained
inquiry through teacher research projects, including reflection on practice. The
metacognitive approach developed through this research may have significant implications
for schools and school systems, addressing the limitations of traditional approaches spelt
out in this report. As will be described in section 9.5, the application of the metacognitive
approach in teacher professional development contexts is seen as an area for ongoing
research.

The research also has implications for those in contexts other than teacher ICT professional
development. At the time of completing this thesis, the integration of teaching and research
had become particularly topical. Increased pressure on academic staff to increase research
output (Cartwright & Noone, 2000) and emerging imperatives, such as quality auditing,
were adding to pressures of accountability and the need to document and provide evidence of quality teaching. The methodology employed in this research and techniques such as the self-assessment survey, make a significant contribution in this academic climate, providing ethical and collaborative approaches to research engagement with students. Perceiving the self-assessment survey, not only as a source of data, but as a source of learning for individuals and groups alike, resonates with the ideas most recently presented by Brennan and Noffke (1997). In May 2002, I presented a research seminar to the staff of Southern Cross University, focusing on my study as a model for the integration of teaching and research, and have been invited to discuss the methodology in more detail at a teaching and learning seminar later in 2002.

While it has not been an explicit focus of this research, this thesis also documents significant learning in relation to flexible delivery and online learning. These issues are highly topical in higher education, and are particularly so at Southern Cross University at the time of completing this research (Bird, 2001a; 2001b; Parry, 2002). My thesis may prove valuable as a case study of the development, delivery and refinement of a flexible-delivery approach and provides insights into learner acceptance, engagement and adaptation. Similarly, the experiences embedded in this research inform a higher education environment where online learning is being widely implemented. In 2001, a report into online learning (Brennan, McFadden & Law, 2001) challenged whether online delivery was suited to all learners, particularly those with low levels of technological and personal self-efficacy. My own challenge to such a statement is that, as educators, we have a responsibility to assist all learners to build computer self-efficacy, but it needs to be done in an informed and supportive way. It is not enough to ‘train’ students to use particular online learning environments. Rather, we need to focus on supporting them to develop the metacognitive capabilities to support their own learning in diverse contexts.

The research similarly holds relevance for a range of organisations seeking to support their employees or students in contexts of rapid technological development. Compeau and Higgins (1995a) highlight the importance of helping end-user support personnel to understand self-efficacy issues so that, rather than ‘fixing problems’, they can take the approach of helping users become confident in their own skills. This research reinforces the viability and significance of such approaches. Support is a double-edged sword. While essential, it is important that it takes the right form. As Compeau and Higgins explain, if the ‘expert’ fixes the problem quickly and efficiently, but without taking time to explain the situation and how it is resolved, the user is left feeling inadequate, especially if it was easy for the expert to fix the problem, thus lowering their self-efficacy. The learning gained in this research may prove highly relevant in informing new models of computer support and professional development.

9.5 New Visions, New Futures
I have already mentioned that key indicators of validity in an action research undertaking are relevance, application and practical utility; in other words, its capacity to evoke valuable and workable change that is embraced by local stakeholders. I have also indicated how complexity provides a perspective on practice which anticipates, even welcomes, future change (Gough, 1999). In this penultimate section I outline the ‘new visions’ and ‘new futures’ which have, and are, emerging from this research at the time of thesis completion. Firstly, I describe my collaborative engagement with staff in the School of
Education with the aim of fostering integration of computer technology and student self-regulation. Secondly, I allude to a research undertaking currently commencing to investigate the application of the metacognitive computer learning model with practising teachers.

**Working with Staff to Support Computer Capability and Student Self-regulation**

Throughout the three-year research period I engaged in a series of conversations with colleagues from the School of Education regarding their use of technology in their teaching. While staff were notionally supportive of the integration of technology in their teaching, few were doing so in creative ways. Thomas and Cooper (2000) make the point that university faculty members have generally never observed others teach effectively using IT, and are often satisfied with limited IT integration experiences such as word processing assignments and Internet searches for resources. Such claims certainly held true in my own context. The criticality of more lecturing staff modelling technology integration in their Key Learning Areas became increasingly evident throughout this research as the key impact of perceived usefulness became clear. These realisations might not, now, seem particularly original as the importance of integration has more recently become widely recognised in teacher education. The chronological presentation of my thesis is important here, as it was only later in my research that I began to encounter literature explicitly discussing integration.

Within my own context, I aimed to work more closely with my colleagues to support their use of technology, starting slowly with those staff most ready to be involved and working side-by-side in fostering creative visions for integration. In the light of learning from this research, I have started from the basis of perceived usefulness, attempting to feed other staff ideas for integration, to excite them to become involved and then support them during implementation. In some cases this has involved challenging their preconceptions that they must be fully confident and knowledgeable in all aspects of the initiative before providing direction to students. Instead, I encourage them to believe and trust in the computer abilities of their students: an important first step in fostering capability and the ability to learn ‘side-by-side’ with their students.

While the integration of technology was one of my goals, another, perhaps more important focus, was the fostering of a learning environment which facilitated student self-regulation, including metacognitive and reflective processes. In other words, teachers needed to support a culture of lifelong learning. Prompted by such considerations, I began to instigate dialogue within staff meetings regarding our collective expectations of students, particularly regarding the fostering of self-regulatory learning skills. As already discussed, challenging institutionally held ‘norms’, such as assessment and attendance expectations, proved most difficult with some staff.

In section 7.2.2, I mentioned my interactions with a colleague in the School of Education and our mutual concern to enhance the reflective capabilities of students in the BEd program. I indicated that this colleague had been involved in developing a first year unit within a reflective framework. As a result of our interactions and discussion of the issues emerging from this research, we consolidated a shared vision of the applicability of the metacognitive approach to the wider context of teacher education and began to work collaboratively in re-designing a first year unit. *Introduction to Teaching* was
conceptualised around the somewhat existential premise of prompting students to engage
with what it means to be a teacher, echoing Feldman’s (2002) calls that we need to help
teacher education students to understand what being a teacher means to them, including
reaching understandings of their own actions, intentions and beliefs. Committed to a vision
of teaching underpinned by reflection and metacognitive practices, and requiring a
commitment to lifelong learning, we shaped Introduction to Teaching around a visual
diagram provided in appendix 25. Embedded within this first year unit was a computer
laboratory component, which again was intended to locate computer technology as integral
to being a contemporary teacher and lifelong learner. My colleague and I conceived the
computer tutorials, not as isolated from the content of the unit, but rather as an integral
component; an opportunity for metacognition and reflection. Teaching these computer
tutorials in semester 1, 2002 represented an opportunity to consolidate the findings of this
research, and to implement and transfer my understandings to a different learning context.
Beyond this, however, Introduction to Teaching represented an important opportunity to
work with other staff within the School who were involved in the unit, modelling not only
computer integration but also reflective and metacognitive teaching approaches. The model
was also presented at a staff meeting, opening up dialogue about the issues. Again, these
developments represent the progression of the research to a more institutional and systemic
level. The opportunity to embed such approaches in the first year of the program was
particularly significant in terms of fostering change in students’ conceptualisation of
learning, meeting Milter’s (1999, e.p.) call that ‘adults who have experienced this
(experiential) approach to learning from the start might not be bogged down trying to
unlearn the process methods of passive learning before joining in as active participant in
the learning process’.

Trialling the Metacognitive Approach with Practising Teachers
In consolidating the metacognitive approach to computer learning and teaching, an evident
question arose as to the applicability of the approach for practising teachers. As outlined in
the introduction to this thesis, teacher professional development in computer technology
has become a major priority at the state and national levels (Esson, Johnson & Vinson,
2002; Ramsey, 2000). The full implementation of state-wide computer skills assessments
for all NSW Year 10 students in 2004 (and later, Year 6 students) will require all teachers
to assume responsibility for the integration of ICT skills across key learning areas. Of
significance was the assertion in the Inquiry into the Provision of Public Education
(Esson, Johnson & Vinson, 2002) that, for too long, there has been a focus on ‘training and
development’ rather than ‘professional development’. This report highlighted the potential
value of reflective approaches.

The research reported in this thesis focused on my teaching involvement with pre-service
teachers. However, in 2001, I had adapted the undergraduate unit discussed in this research
into a postgraduate unit to be offered at Masters level. While sharing a foundation with the
undergraduate unit, this postgraduate unit placed a greater emphasis on engaging
participants with the theory of metacognition as well as active implementation in the
classroom. In 2002, a local non-state education provider approached the School of
Education regarding the potential for involving a cohort of their teachers in this
postgraduate Unit. Through these discussions, we decided to embark on a new research
endeavour: an investigation of the effect of a metacognitive and reflective approach to the
professional development of practising teachers in information and communication
technology. Funding for a collaborative research grant was sought and gained. At the time of completing this thesis, this research is in its early stages and will involve two components: the involvement of a cohort of 40 practicing secondary teachers in a metacognitive computer learning approach, based on that developed in this research; and a broader survey of the professional development needs and current learning approaches employed by a wider sample of teachers. The latter component has been included with a view to investigating the potential applicability of the metacognitive approach to other areas of teacher professional development. While the study will employ similar data collection strategies to those used throughout this research, these will be supplemented by interviews with participants 6 months following the intervention to determine the longer-term outcomes of the professional development intervention and the rate of adoption and integration of technology in their teaching practice. Through this research, it is hoped to document the effectiveness of the model for teacher professional development and to refine the approach to best meet the needs of practising teachers.

9.6 Parting Words

Undertaking a PhD is a profound and all-consuming experience. No candidate can, or should, expect to emerge as they commenced. The metaphor of the journey has gained greater strength and meaning for me as I have progressed. The diversity of cultures which I have encountered through engagement with some 650 students has had a profound influence on my understanding, not only of them, but of myself. I have learnt a lot about computer learning and teaching, but also about the nature and process of change itself. In chapter 1, I described action research as more than a methodological choice but an underlying philosophy. In drawing this thesis to a close, I can only re-emphasise this point. My engagement with complexity and the synergies which this theoretical understanding has brought to my understanding not only of action research, learning and change, but of the nature of knowledge itself, has had a profound influence on me as a teacher, researcher and individual. My practice as an adult educator has changed considerably, and I now better comprehend the diversity of student reactions to computer learning and appropriate means of supporting their development toward computer capability. Beyond this, I believe that the research has made a ‘real difference’ in the learning lives of many students, opening up not only new approaches to computer learning, but also non-traditional approaches to teaching. If even a small portion of these future teachers carry these values and approaches to learning into their own classrooms then the change process will be ongoing and the research worthwhile. It is this capacity for ongoing change which is the ideal of action research. In parting, I leave Reason (2001, e.p.) with the final word:

Knowing will be more valid – richer, deeper, more true to life and more useful... if our knowing is grounded in our experiences, expressed through our stories and images, understood through theories which make sense to us, and expressed in worthwhile action in our lives.
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Appendix 1 - Editorial and Stylistic Considerations

A. **Spelling and Punctuation:** As a general guide, all editorial conventions (including punctuation, spelling and italicisation) are in accordance with the *Australian Style Manual* (Australian Government Publishing Service, 2000). Spellings contained within quotation marks conform with the original document quoted. Some spelling inconsistencies in the thesis may result as a consequence.

B. **Page numbers from electronic publications:** Where direct quotes are drawn from electronic sources such as Web sites, page numbers are cited according to the page of the printed document (A4) from which the quote was drawn. Where such quotes are drawn from electronic versions of publications printed elsewhere, and where original page numbers are not known, the abbreviation ‘e.p.’ is used instead of a guestimate of the original page source.

C. **Pseudonyms and Student Identification:** Given the large number of students participating in the research in each year, the decision was made to allocate a number to each student for the purpose of identifying student quotes. This numbering commences at 1 in each student intake (i.e. cycle 1, cycle 2, cycle 3a and cycle 3b). Students are thus identified, for example, as ‘Student 34, Cycle 3a’. Chapters drawing on data from a single student cohort omit the cycle number, on the assumption that this is implied by the context. An exception to this numerical identification of students occurs in cycle 3a where the intense personal involvement with a smaller group of students warranted a more personal and individual identification. Here, pseudonyms are adopted. These pseudonyms maintain gender identification.

D. **Definitions:** A wide range of terms has come to be associated with the area of computers in education. Information Technology (IT) is a broad term used in a range of contexts from end-user computing to programming; however, it lacks a focus on end-user computing, particularly as it applies in learning and teaching contexts. Information and Communication Technologies (ICT) has been widely adopted for educational contexts in the UK and New Zealand (Brown, 1999) and more recently in Australia (Toomey, 2001). While this term does place a focus on the communicative applications of information technologies, others have argued that the convergence of communications and computer technology means that there is little sense now in distinguishing them (Australian Council for Computers in Education, 1999). Brown (1999) has attempted to focus definitions further through the use of terms such as ‘learning technologies’ or ‘educational technologies’. While these terms successfully place the focus on end-user computing and specifically its role in learning and teaching, what is missing is a distinction between computer technologies and other ‘technologies’, such as television, video, overhead projection or even the humble biro. For these reasons my preferred term became ‘educational information technology’,
and the name of the thesis being discussed in this Unit changed to reflect this preference in 2000. Throughout the thesis, consistency is attempted in my own writing through this use of the term ‘computing’ or ‘computers’ rather than ‘IT’ or ‘educational IT’. Quotations conform with the original document and hence some inconsistencies in terminology may result.

C. Abbreviations

ACCE: Australian Council for Computers in Education.

ANTRA: Australian National Training Reform Agenda.

BEd: Bachelor of Education (Primary); a four year undergraduate degree.

CBT: Competency Based Training.

DET: New South Wales Department of Education and Training.

Dip.Ed.: Diploma of Education (Secondary): a one year degree undertaken by students who already have an undergraduate degree.

ICT: Information and Communication Technology (see IT).

IT: Information Technology:

Macro and Micro research: The differentiation between the macro and micro research was discussed in section 1.5.2.

NSW: New South Wales

TAFE: Technical and Further Education

Unit: See also section 1.5.1. The Unit exists as a Web site with password protected access for Southern Cross University students. As is detailed in the thesis, from 2000 onwards a version of the Web site was burnt to CD and made available in this optional format. Where mention is made of the Unit CD-ROM this should be understood to be identical to the Unit Web Site.

VET: Vocational Education and Training
Appendix 2 - Invitation to Participate

I am currently engaged in an action research PhD. I am using my experiences as a lecturer in the area of educational information technology to help me better understand the effect of various learner-focused teaching and learning methods in developing individual capability in the context of information technology.

Action research is a form of collective self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own social or educational practices, as well as their understanding of these practices and the situations in which these practices are carried out…. The approach is only action learning when it is collaborative, though it is important to realise that the action research of the group is achieved through the critically examined action of individual group members. (Kemmis, 1988)

Action research is not research ‘on’ people but research ‘with’ people. Under this ideological stance I invite both my undergraduate and postgraduate students to participate in this research with me.

You may well ask, well, what's in it for me? I believe that it is both consistent with the objectives of this unit, as well as in your interest, to also engage in self-reflective enquiry about effective teaching and learning processes in the context of information technology. The learnings which I gain as I work with students at undergraduate and postgraduate level are continually shaping the units which I teach and the way that I teach them. As I change the units to incorporate the understandings I have developed with students I hope that the units become better able to develop capable information technology users and teachers. I pass these understandings along to my students as they pass their developing understandings of their own practice along to me. This means that we all benefit from each other.

The learning which you gain through this process will hopefully assist you to be a more capable user of IT in the school environment and, most importantly, to help your students become capable IT users. It is a process of learning together.

What would it involve if I participate?

In answer to this, little more than you would otherwise be involved in throughout this Unit. The Unit is structured such that, even if you don’t choose to participate in the overall research project, then you will be involved in reflection and documentation of your learning.

If you do choose to participate, all that is required is your consent for me to utilise some of the information which you provide in your reflective journal as data to help me develop in my own understandings. The additional cover sheet for Assignment 1 asks you to indicate your willingness, or otherwise, to participate.

In addition you are asked to complete the self-assessment survey (provided to you) before you begin study on this Unit. You will also be requested to complete the survey again after completing the unit. Again, your permission for the use of this information is optional.
Appendix 3  - Reflective Journal Cover Sheet

Please complete the form below and return with your submission of Assignment 2 (Reflective Journal).

Assignment 2 is a Reflective Journal. In this journal you are required to provide reflections on your engagement with the unit material and your experiences with technology throughout the Unit. Only the tutors and/or markers for the Unit will read this journal. However as outlined previously you are invited to participate in a larger action research study which is investigating the effect of various learner focused teaching and learning methods in developing individual capability in the context of information technology.

It is envisaged that some of the information in your journal may be highly valuable in informing this research study, assisting us to refine our approaches to teaching about technology in teaching and learning through research as well as to further development this unit.

We thus seek your permission to keep a record of excerpts from your Journal. With your permission some excerpts of your journal may be photocopied and you will be notified of those sections which I have copied. These excerpts will be kept but would not be able to be directly connected to you personally. If at any point these excerpts are quoted, they would remain anonymous (i.e. your name will not be included).

If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time before the end of your participation in the unit. However, we would appreciate you letting us know of your decision.

If you decide not to provide permission for this to occur, your choice will not count against you in any way.

Renata Phelps
PhD Candidate and Lecturer, EDU10003

☐ Yes. I am happy for excerpts from my journal to be copied and used anonymously.

☐ No, I would prefer excerpts from my journal were not used in this way.

Your Name:

Signature: Date:
Appendix 4 - Teaching Evaluation Form

This questionnaire can be completed within 10 minutes. For most questions, please circle a number on the scale that reflects your opinion about each statement. The final questions require your written comments. To preserve your anonymity, please print your comments and do not write your name on the questionnaire.

Course Enrolled In:  
- BEd (Primary)  
- Dip Ed (Secondary)  
- Other

Staff Member:  
- Renata Phelps  
- Tutor  
- Independent/external Learning

1. How often in your experience is the following true?

   a. The staff member makes it clear what I need to do to be successful in this unit.  
   b. The staff member is well prepared for classes.  
   c. Feedback on my submitted work from the staff member is helpful to my learning.  
   d. The staff member shows a genuine concern for the quality of my learning.  
   e. The staff member presents the subject matter clearly.  
   f. Overall, how would you rate the staff member's teaching in this unit?


<table>
<thead>
<tr>
<th>Very Poor</th>
<th>Poor</th>
<th>Less Than Satisfactory</th>
<th>Satisfactory</th>
<th>Good</th>
<th>Very Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. How often do you think the following is true?

   a. The staff member teaches at a level that I can understand.  
   b. In my opinion, the staff member makes good use of examples and illustrations in teaching.  
   c. The staff member presents the material at a satisfactory pace for me.  
   d. The staff member communicates enthusiasm for the subject to me.  
   e. The staff member gives me clear guidance when I have a problem.  
   f. The staff member corrects errors/difficulties without causing me embarrassment.  
   g. In my opinion, there is a good balance in the study materials between theory and its application.  
   h. The staff member encourages me to be responsible for my own learning.

Would you also please answer the questions on the reverse side of this sheet.
3. What, in your view, are the best aspects of the course?

4. In your view, what aspects of the course need improvement?

Course Specific Feedback

1. How would you describe:

Least High
Your computer skill levels at the beginning of this course
Your computer confidence at the beginning of this course
Your computer skill levels at the end of this course
Your computer confidence at the end of this course

2. Did you attend the face-to-face tutorials 3 times or more (i.e. more than the compulsory sessions) Yes No

3. Please rank the value of each of the Modules to you personally

Thinking
Using
Applying
Creating

4. How would you rate each of the following in helping your learning during this course

Face to Face tutorials
EDU10003 Online Resources
One-on-one assistance from tutor
Assistance from Peers
Books or other resources

Thank you for completing this questionnaire.
Appendix 5 - Student Evaluation Data, 1999 – 2001

This appendix summarises the student evaluation data from 1999-2001. All questions, with the exception of question 1f are measured on a five-point Likert scale with 1 indicating ‘Some of the time’ and 5 indicating ‘all of the time’. Question 1f was measured on a seven point with 1 indicating ‘Very poor’ and 7 indicating ‘Excellent’.

### Table 17  Responses to teaching evaluation, 1999-2001

<table>
<thead>
<tr>
<th></th>
<th>CYCLE 1</th>
<th>CYCLE 2</th>
<th>CYCLE 3A</th>
<th>MY TEACHING</th>
<th>TEAM TEACHING/INDEPENDENT LEARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Av.</td>
<td>S.D.</td>
<td>Av.</td>
<td>S.D.</td>
<td>Av.</td>
</tr>
<tr>
<td>1a The staff member makes it clear what I need to do to be successful in the unit</td>
<td>4.4</td>
<td>0.6</td>
<td>4.5</td>
<td>0.6</td>
<td>3.0</td>
</tr>
<tr>
<td>1b The staff member is well prepared for classes</td>
<td>4.6</td>
<td>0.6</td>
<td>4.8</td>
<td>0.4</td>
<td>2.8</td>
</tr>
<tr>
<td>1c Feedback on my submitted work from the staff member is helpful to my learning</td>
<td>4.4</td>
<td>0.8</td>
<td>4.8</td>
<td>0.6</td>
<td>3.7</td>
</tr>
<tr>
<td>1d The staff member shows a genuine concern for the quality of my learning</td>
<td>4.7</td>
<td>0.5</td>
<td>4.8</td>
<td>0.4</td>
<td>3.2</td>
</tr>
<tr>
<td>1e The staff member presents the subject matter clearly</td>
<td>4.5</td>
<td>0.7</td>
<td>4.5</td>
<td>0.7</td>
<td>3.2</td>
</tr>
<tr>
<td>1f Overall, how would you rate the staff member’s teaching in this unit</td>
<td>6.2</td>
<td>0.7</td>
<td>6.3</td>
<td>0.8</td>
<td>4.0</td>
</tr>
<tr>
<td>2a The staff member teaches at a level that I can understand</td>
<td>4.3</td>
<td>0.8</td>
<td>4.2</td>
<td>0.8</td>
<td>3.8</td>
</tr>
<tr>
<td>2b In my opinion, the staff member makes good use of examples and illustrations in teaching</td>
<td>4.3</td>
<td>0.8</td>
<td>4.3</td>
<td>0.9</td>
<td>3.0</td>
</tr>
<tr>
<td>2c The staff member presents the material at a satisfactory pace for me</td>
<td>3.9</td>
<td>1.1</td>
<td>3.9</td>
<td>1.1</td>
<td>3.2</td>
</tr>
<tr>
<td>2d The staff member communicated enthusiasm for the subject to me</td>
<td>4.7</td>
<td>0.7</td>
<td>4.6</td>
<td>0.6</td>
<td>4.0</td>
</tr>
<tr>
<td>2e The staff member gives me clear guidance when I have a problem</td>
<td>4.7</td>
<td>0.7</td>
<td>4.8</td>
<td>0.4</td>
<td>4.2</td>
</tr>
<tr>
<td>2f The staff member corrects errors/difficulties without causing me embarrassment</td>
<td>4.7</td>
<td>0.7</td>
<td>4.8</td>
<td>0.4</td>
<td>3.4</td>
</tr>
<tr>
<td>2g In my opinion, there is a good balance in the study materials between theory and its application</td>
<td>3.9</td>
<td>1.0</td>
<td>4.3</td>
<td>0.8</td>
<td>3.0</td>
</tr>
<tr>
<td>2h The staff member encourages me to be responsible for my own learning</td>
<td>4.8</td>
<td>0.4</td>
<td>4.7</td>
<td>0.5</td>
<td>4.6</td>
</tr>
</tbody>
</table>

**Number of Respondents**

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>29</td>
<td>38</td>
<td>6</td>
<td>20</td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

* SD = Standard Deviation
** Please note that in Semester 1, 2001 I had to take unforeseen medical leave for 6 weeks and so results are skewed by changes in the staffing of the Unit and my non-availability during that period. Response rates are also low for this same reason.
### Table 18  Average skill and confidence levels at the beginning and end of the Unit

<table>
<thead>
<tr>
<th></th>
<th>CYCLE 1</th>
<th>CYCLE 2</th>
<th>CYCLE 3A</th>
<th>CYCLE 3B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Mean self-perceived skill level</td>
<td>2.5</td>
<td>4.1</td>
<td>2.9</td>
<td>4.2</td>
</tr>
<tr>
<td>Mean self-perceived confidence level</td>
<td>2.6</td>
<td>4.1</td>
<td>2.9</td>
<td>4.2</td>
</tr>
<tr>
<td>Average increase in skill</td>
<td>1.5</td>
<td>1.5</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Average increase in confidence</td>
<td>1.5</td>
<td>1.4</td>
<td>1.4</td>
<td>1.2</td>
</tr>
</tbody>
</table>

### Table 19  Perceived value of various learning resources

<table>
<thead>
<tr>
<th>Learning Resources</th>
<th>MEAN PERCEIVED VALUE 1999</th>
<th>MEAN PERCEIVED VALUE</th>
<th>MEAN PERCEIVED VALUE</th>
<th>MEAN PERCEIVED VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face to face tutorials</td>
<td>4.2</td>
<td>4.4</td>
<td>4.4</td>
<td>4.3</td>
</tr>
<tr>
<td>Online resources</td>
<td>3.8</td>
<td>3.9</td>
<td>3.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Assistance from tutor</td>
<td>4.7</td>
<td>4.6</td>
<td>4.3</td>
<td>4.6</td>
</tr>
<tr>
<td>Assistance from peers</td>
<td>3.8</td>
<td>3.9</td>
<td>3.8</td>
<td>3.7</td>
</tr>
<tr>
<td>Books or other resources</td>
<td>2.7</td>
<td>2.3</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Module One (Using the Internet)</td>
<td>3.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module Two (Learning and Teaching with the Internet)</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module Three (Publishing on the Internet)</td>
<td>4.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinking</td>
<td>3.2</td>
<td>3.4</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>Using</td>
<td>3.6</td>
<td>3.9</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>Applying</td>
<td>4.3</td>
<td>4.1</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>Creating</td>
<td>4.8</td>
<td>4.4</td>
<td>4.6</td>
<td></td>
</tr>
</tbody>
</table>
This table presents a collation of the qualitative responses to the open-ended questions on the teaching evaluation surveys. In summarising the data some collapsing of categories derived from each semester’s data has occurred to provide scope for comparison across cycles.

<table>
<thead>
<tr>
<th>BEST ASPECTS OF THE UNIT</th>
<th>CYCLE 1</th>
<th>CYCLE 2</th>
<th>CYCLE 3A</th>
<th>CYCLE 3B</th>
<th>ASPECTS OF THE UNIT NEEDING IMPROVEMENT</th>
<th>CYCLE 1</th>
<th>CYCLE 2</th>
<th>CYCLE 3A</th>
<th>CYCLE 3B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill development; Specific technical skills (e.g. digital camera); Using different platforms</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td></td>
<td>More skills (scanning, burning, FTP, compression)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Designing a Website</td>
<td>8</td>
<td>13</td>
<td>9</td>
<td>7</td>
<td>Designing a Website</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variety of tasks</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Too much content</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinking module</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Smaller Thinking section</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theory</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>More theory</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevance to teaching and schools</td>
<td>7</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>Addressing value of IT in education</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catered for a variety of learning styles</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Challenging level/catered for all abilities; ‘forces aspects of personal initiative’</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>Pace of learning; either Slow down learning; too hard OR Speed up learning; too easy; More extension work; cater for more advanced</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>UNIT DESIGN/PEDAGOGICAL APPROACH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online resources /CD-ROM</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>Online resources preferred in book form/or CD-ROM (in cycle 1)</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Self-paced learning Flexibility</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>More structure</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical, hands-on Unit; ‘Students are forced to be hands-on’; ‘made me spend more time on the computer’: total immersion in learning computer skills’</td>
<td>1</td>
<td>13</td>
<td>10</td>
<td>8</td>
<td>Technical issues; computers crashing; accessing computers</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tutorials</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td>More structure in tutorials</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-compulsory tutorials; Not having lectures</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td>Make tutorials compulsory; More directed teaching; more guidance</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion board</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Discussion board</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher assistance, individual help, enthusiasm, encouragement and patience</td>
<td>7</td>
<td>2</td>
<td>4</td>
<td>11</td>
<td>More one-on-one help; more tutors; more tutorials; ‘some people dominated tutorials’; support for externals; smaller tutorials</td>
<td>12</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Relevance of assessment</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>Clarity of assignments</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Use of Reflective Journal</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Reflective journal; ‘Too much work however was beneficial to my learning’; ‘too much emphasis at expense of skills’; ‘huge task’; less emphasis but a good idea.</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Space out assignment due dates</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth in confidence and skills</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Year-long Unit; more time</td>
<td>1</td>
<td></td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 20 Analysis of responses to open-ended questions on teaching evaluation, 1999-2001.
Appendix 6  -  Self-Assessment Survey

Computers and You: A Self-Assessment Survey

The attached survey is designed to assist you to better understand your current attitudes and beliefs about computers. It is also designed to help inform us about the success or otherwise of this unit in helping you to gain the skills, attitudes and confidence to use computers in your future work as teachers.

Your responses to the questions will help you to reflect on the factors which affect teaching and learning with computers and will inform your own learning throughout the course. You will be prompted to reflect on this survey as you work through the “Thinking” section of the Unit and you are asked to include the survey in your Reflective Learning Journal, together with this permission sheet. You will also be asked to complete the survey at the end of your involvement in the unit.

This form provides you with the option of allowing us to use the information that you provide on this survey as part of a research project. Should you agree to this, then the information which you provide will at all times be treated as confidential and your anonymity will be preserved (i.e. the information will not be linked to you personally for the purpose of data analysis or reporting). Your responses to this survey will not in any way affect your results in this unit, nor will they be utilised in any way in connection to your grading. If at any stage you change your mind and do not wish to participate in the study then your consent can be withdrawn simply by contacting your tutor in writing.

Should you decide not to allow your responses to the survey to be used in this way then your decision will not affect your results in the unit.

Renata Phelps
PhD Candidate and Lecturer, School of Education

Approval for Use of Data:

Yes ☐ I give permission for my responses to this self-assessment survey to be recorded and analysed for the purposes of course improvement and research into students attitudes and beliefs about computers. I understand that the information will not be identified to me personally in any way during analysis and reporting. My name will only be utilised to match information which I provide at the beginning and end of semester. I understand that my responses to the questions will not in any way affect my grades in this unit.

No ☐ I do not give permission for my responses to be utilised in this way.

Name: _______________ Student Number: _______________
Signature: _______________ Date: _______________

Please keep one copy of this letter for your own future reference and submit the signed copy with your survey.
## Computers and You: A Self-Assessment Survey

### A. Demographic Information

<table>
<thead>
<tr>
<th>Name:</th>
<th>Student ID Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Male
- Female

<table>
<thead>
<tr>
<th>Age:</th>
<th>17-20</th>
<th>21-25</th>
<th>26-30</th>
<th>31-35</th>
<th>36-40</th>
<th>41-45</th>
<th>46-50</th>
<th>51+</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

- Primary
- Secondary

If Secondary, which KLA area _________________________

Please respond openly and truthfully to the questions, giving each question reasonable thought. The information which you gain from it will be most valuable to you (and to us as researchers) if it is an accurate representation of your perceptions.

Please indicate if this as a Pre-semester survey or a Post Semester survey

### B. Frequency and Duration of Computer Use

Please circle the option below that is most appropriate to your current circumstances

<table>
<thead>
<tr>
<th>1. On average, how long would you spend on a computer each day (in hours)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. As a general rule, how frequently would you use a computer</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tr>
</tbody>
</table>

### D. Frequency of use by others

Please respond to the following five questions using the following scale, where 1= strongly disagree and 7= strongly agree.

<table>
<thead>
<tr>
<th>1. Member(s) of my family use computers …</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. My friends (or a close friend) use computers …</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>3. My lecturers/tutors use computers …</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</thead>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. My work colleagues use computers …</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Other students use computers …</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tr>
</tbody>
</table>

### C. Encouragement by others

Please respond to the following five questions using the following scale, where 1= strongly disagree and 7= strongly agree.

<table>
<thead>
<tr>
<th>1. I have been encouraged to use computers by member(s) of my family</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</thead>
<tbody>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>2. I have been encouraged to use computers by my school teachers</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>3. I have been encouraged to use computers by my friends</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>4. I have been encouraged to use computers by my lecturers/ tutors</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>5. I have been encouraged to use computers by my employers or work colleagues</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</table>

<table>
<thead>
<tr>
<th>6. Overall I feel encouraged by others to use computers</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tbody>
</table>

### E. Support

Please respond to the following five questions using the following scale, where 1= strongly disagree and 7= strongly agree.

<table>
<thead>
<tr>
<th>1. If I need assistance in using computer hardware this assistance is easy to get</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. If I need assistance in using computer software this assistance is easy to get</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<table>
<thead>
<tr>
<th>3. If I need assistance in selecting or purchasing computer equipment this assistance is easy to get</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. My fellow students, friends or peers are a good source of support and advice regarding computers</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Overall, I feel that the university is supportive of my use of computers</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. I feel generally supported in my use of computers</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix F: Perceived Usefulness

Please respond to the following five questions using the following scale, where 1 = strongly disagree and 7 = strongly agree.

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Using computers enables me to be more efficient in my study</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>2. Using computers will help me in my future teaching</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>3. Using computers gives me a good sense of accomplishment</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>4. Using computers enhances my standing with my peers</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>5. Using computers will help me get a job</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>6. With the use of computers I can create instructional materials to enhance my teaching</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>7. Using computers I can access information sources for my teaching</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>8. Using computers will help me feel more confident teaching my students</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>9. Using computers provides me with better results as a student</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>10. Overall I consider computers to be useful to me</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

### Appendix H: Feelings

Please respond to the following five questions using the following scale, where 1 = strongly disagree and 7 = strongly agree.

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am confident about my ability to do well in a course that requires me to use computer technology</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>2. I feel at ease learning about computer technology</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>3. I am the type to do well with computer technology</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>4. The thought of using computers is not frightening</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>5. I do not feel threatened by the impact of computer technology</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>6. I am not worried about “breaking” computers</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>7. I feel comfortable about my ability to work with computer technology</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>8. Overall I don’t ever feel anxious about using computers</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

### Appendix I: Learning Confidence

Imagine you were given a new software package. It doesn't matter specifically what this software package does, only that it is intended to make your job easier and that you have never used it before. The following questions ask you to indicate whether you could use this unfamiliar software under a variety of conditions. Respond to each question according to the following scale:

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. …if there was no one around to tell me what to do as I go</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>2. …if I had only the software manuals for reference</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>3. …if I had seen someone else using it before trying it myself</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>4. …if I could call someone for help if I got stuck</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>5. …if someone else had helped me get started</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>6. …if I had a lot of time to complete the job for which the software was provided</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>7. …if I only had the built-in help facility for assistance</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>8. …if someone showed me how to do it first</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>9. …if there was someone giving me step by step instructions</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>
J. Attribution

This section of the survey is designed to help you understand the reasons you attach to particular outcomes when using computers.

Six imaginary scenarios are presented below. For each you are asked to indicate the most likely reason why the particular outcome has occurred. You will then be asked to further describe this reason which you have listed as either:
- something to do with yourself or something outside your control;
- something likely to occur in the future, or not; and
- something that affects you generally or only in this situation.

For instance, say I was to imagine a situation where I bought a piece of furniture (say a computer desk) - one of those ones which comes in a box. I spend hours trying to put it together, but it just won't work. I am asked to write down one possible reason why this might happen. I might respond that I think it is because the instructions are really difficult to understand. In this case I might respond that I see this as mostly due to others (2) and that it might occur reasonably frequently in the future (6). I probably will feel that this "reason" does not affect other areas of my life (1).

Please respond to the following 6 scenarios (and one general questions) below:

1. Imagine that you are asked to produce an assignment using a computer. When you are marked on your assignment you receive a low mark for presentation and layout. Write down one possible reason why this might happen.

   a) To what extent is this reason due to something about you or something about other people or circumstances?
   - Totally due to others
   - Totally due to me

   b) In the future will this cause be present?
   - Never present
   - Always present

   c) Is this cause something that affects just this type of situation or does it influence other areas of your life?
   - Just this situation
   - All situations

2. Imagine that you are asked to locate some information on the World Wide Web and find exactly what you are looking for first go. Write down one possible reason (or cause) why this might happen.

   a) To what extent is this reason due to something about you or something about other people or circumstances?
   - Totally due to others
   - Totally due to me

   b) In the future will this cause be present?
   - Never present
   - Always present

   c) Is this cause something that affects just this type of situation or does it influence other areas of your life?
   - Just this situation
   - All situations

3. Imagine that you purchase a new computer program to use with your students in the classroom. You cannot get the software to work. Write down one possible reason why this might happen.

   a) To what extent is this reason due to something about you or something about other people or circumstances?
   - Totally due to others
   - Totally due to me

   b) In the future will this cause be present?
   - Never present
   - Always present

   c) Is this cause something that affects just this type of situation or does it influence other areas of your life?
   - Just this situation
   - All situations
4. Imagine that you send an e-mail to a friend however they cannot read the e-mail. Write down one possible reason why this might happen

<table>
<thead>
<tr>
<th>a) To what extent is this reason due to something about you or something about other people or circumstances?</th>
<th>Totally due to others</th>
<th>1 2 3 4 5 6 7</th>
<th>Totally due to me</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) In the future will this cause be present?</td>
<td>Never present</td>
<td>1 2 3 4 5 6 7</td>
<td>Always Present?</td>
</tr>
<tr>
<td>c) Is this cause something that affects just this type of situation or does it influence other areas of your life?</td>
<td>Just this situation</td>
<td>1 2 3 4 5 6 7</td>
<td>All situations</td>
</tr>
</tbody>
</table>

5. You teach a lesson to your students while on Practicum which incorporates computers. The lesson is a fabulous success and your supervising teacher is most impressed. Write down one possible reason why this might happen

<table>
<thead>
<tr>
<th>a) To what extent is this reason due to something about you or something about other people or circumstances?</th>
<th>Totally due to others</th>
<th>1 2 3 4 5 6 7</th>
<th>Totally due to me</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) In the future will this cause be present?</td>
<td>Never present</td>
<td>1 2 3 4 5 6 7</td>
<td>Always Present?</td>
</tr>
<tr>
<td>c) Is this cause something that affects just this type of situation or does it influence other areas of your life?</td>
<td>Just this situation</td>
<td>1 2 3 4 5 6 7</td>
<td>All situations</td>
</tr>
</tbody>
</table>

6. Imagine that your friend is having trouble doing something on their computer and asks you for assistance. You are able to solve their problem with very little difficulty. Write down one possible reason why this might happen

<table>
<thead>
<tr>
<th>a) To what extent is this reason due to something about you or something about other people or circumstances?</th>
<th>Totally due to others</th>
<th>1 2 3 4 5 6 7</th>
<th>Totally due to me</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) In the future will this cause be present?</td>
<td>Never present</td>
<td>1 2 3 4 5 6 7</td>
<td>Always Present?</td>
</tr>
<tr>
<td>c) Is this cause something that affects just this type of situation or does it influence other areas of your life?</td>
<td>Just this situation</td>
<td>1 2 3 4 5 6 7</td>
<td>All situations</td>
</tr>
</tbody>
</table>

7. When things in your life generally go well for you it is because…

<table>
<thead>
<tr>
<th>a) To what extent is this reason due to something about you or something about other people or circumstances?</th>
<th>Totally due to others</th>
<th>1 2 3 4 5 6 7</th>
<th>Totally due to me</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) In the future will this cause be present?</td>
<td>Never present</td>
<td>1 2 3 4 5 6 7</td>
<td>Always Present?</td>
</tr>
</tbody>
</table>

8. When things in your life generally go badly for you it is because…

<table>
<thead>
<tr>
<th>a) To what extent is this reason due to something about you or something about other people or circumstances?</th>
<th>Totally due to others</th>
<th>1 2 3 4 5 6 7</th>
<th>Totally due to me</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) In the future will this cause be present?</td>
<td>Never present</td>
<td>1 2 3 4 5 6 7</td>
<td>Always Present?</td>
</tr>
</tbody>
</table>
Appendix 7 - Self-Scoring Form

Recording your scores

Complete the following scoring sheet after completing the questions as attached.

This self-assessing scoring sheet is designed to assist students to gain an immediate and general overview of their computer self-efficacy, and their attribution and learning style. It is not intended to provide any interpretation of your results.

This sheet is to be retained by you and used for your own purposes.

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>RESPONSE/TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency and Duration of Computer Use</td>
<td>B1 x B2 = SUM OF EACH AV. SCORE</td>
</tr>
<tr>
<td>Encouragement by others</td>
<td>Total Question C</td>
</tr>
<tr>
<td>Frequency of use by others</td>
<td>Total Question D</td>
</tr>
<tr>
<td>Support</td>
<td>Total Question E</td>
</tr>
<tr>
<td>Perceived Usefulness</td>
<td>Total Question F</td>
</tr>
<tr>
<td>Attitude</td>
<td>Total Question G</td>
</tr>
<tr>
<td>Feelings</td>
<td>Total Question H</td>
</tr>
<tr>
<td>Confidence</td>
<td>Total Question I</td>
</tr>
</tbody>
</table>

J. Attribution

Record your scores to the attribution questions in the following table:

<table>
<thead>
<tr>
<th>Q 1</th>
<th>Q 2</th>
<th>Q 3</th>
<th>Q 4</th>
<th>Q 5</th>
<th>Q 6</th>
<th>Aver-age</th>
<th>This is your computer specific score for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part a</td>
<td>internal/external attribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part b</td>
<td>Stability of attribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part c</td>
<td>Generalisability of attribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question 7</th>
<th>Question 8</th>
<th>Aver-age</th>
<th>This is your general score for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part a</td>
<td>internal/external attribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part b</td>
<td>Stability of attribution</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Visually compare your general attribution score to your computer specific scores using the box below.
## Appendix 8 - Teaching Strategy Evaluation Form

<table>
<thead>
<tr>
<th>Student Name: _____________________</th>
<th>Date: _________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Method: ____________________</td>
<td></td>
</tr>
</tbody>
</table>

**Did you find this method of learning Easy or Difficult?**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No improvement</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significant improvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**To what extent did this method of learning improve your specific computer skills?**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No improvement</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significant improvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**To what extent did this method of learning improve your general computer skills?**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No improvement</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significant improvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**To what extent did this method of learning increase your general computer confidence?**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No improvement</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significant improvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Would this method work for your ongoing computer skill development?**

- Yes [ ] or No [ ]

**Why?**

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

**Would you consider using this approach when teaching your own students?**

- Yes [ ] or No [ ]

**Why?**

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

**Any other comments:**

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Appendix 9  -  Tutor Letter of Consent

An investigation of the effect of various learner-focused teaching and learning methods in developing individual capability in the context of information technology.

In your role as tutor in EDU10003 – Educational Information Technology, you are invited to participate in an action research project to investigate the influence of various teaching and learning approaches on computer skill development. If you choose to participate in this study you are asked to work closely with the researcher, in implementing a range of teaching approaches during your tutorials. You are also requested to keep in communication with your co-tutor, to participate in regular ‘de-briefings’ and/or a final interview at the conclusion of the semester.

It is not expected that you will be required to undertake additional work or face any additional time demands above those normally required of tutors. However your commitment to the aims of the project and to the philosophical underpinnings of its methodology (i.e. action research) would be highly beneficial to the project. By way of elaboration the following quote is provided:

Action research is a form of collective self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own social or educational practices, as well as their understanding of these practices and the situations in which these practices are carried out.... The approach is only action learning when it is collaborative, though it is important to realise that the action research of the group is achieved through the critically examined action of individual group members (Kemmis, 1988).

It is anticipated that the co-tutor and principal researcher for the project, Renata Phelps, will maintain records based on discussions with you (i.e. through debriefing sessions) and survey the reactions of students to these approaches. These observations and reflections will be made available to you and you will be free to make any omissions, alterations or additions to these. Unless you choose to do so, you will not be required to make such notes yourself.

The aim of the research is not intended to evaluate your teaching ability. The ethos of the study is to engage in collaborative enquiry towards improved practise by all participants (students and tutors). Therefore information gathered from the project will not be used in any personally relevant context. Issues regarding your anonymity (versus acknowledgment) in any documentation of the research will be up to you and you will be consulted before any mention is made of you personally in connection with the study.

Should you wish to be involved in publishing from the research then opportunities will exist for collaborative publication. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time.

Renata Phelps, PhD Student and Lecturer, EDU10003.

I have read the information above and agree to participate in this study.

Name of Participant: .......... Signature of Participant: Date: ..........

I certify that the terms of the form have been verbally explained to the tutor, that the tutor appears to understand the terms prior to signing the form, and that proper arrangements have been made for an interpreter where English is not the subject's first language. I asked the subject if she/he needed to discuss the project with an independent person before signing and she/he declined (or has done so).

Signature of the researcher: Date: ..........
Appendix 10 - Graphic Interface to the Unit
Appendices

Appendix 11 - Cycle 2 Participation Rates and Demographic Data

Table 21  Student Participation by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>PRIMARY</th>
<th>SECONDARY</th>
<th>TOTAL</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>48</td>
<td>39</td>
<td>87</td>
<td>73.1</td>
</tr>
<tr>
<td>Male</td>
<td>7</td>
<td>25</td>
<td>32</td>
<td>26.9</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>64</td>
<td>119</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 22  Age by Sector

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>PRIMARY</th>
<th>SECONDARY</th>
<th>TOTAL</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-20</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2.5%</td>
</tr>
<tr>
<td>21-25</td>
<td>37</td>
<td>29</td>
<td>66</td>
<td>55.5%</td>
</tr>
<tr>
<td>26-30</td>
<td>7</td>
<td>9</td>
<td>16</td>
<td>13.4%</td>
</tr>
<tr>
<td>31-35</td>
<td>3</td>
<td>7</td>
<td>10</td>
<td>8.4%</td>
</tr>
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<td>TOTAL</td>
<td>55</td>
<td>64</td>
<td>119</td>
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Table 23  Student Participation by Sector

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<th>VALID PERCENT</th>
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<td>Secondary – Science</td>
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<td>Secondary – English and other Languages</td>
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<td>Primary</td>
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<td>46.2%</td>
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<tr>
<td>TOTAL</td>
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Appendix 12 - Pre-Semester Self-Efficacy Data, Cycle 2

Table 24  Pre-Semester Self-efficacy Data, Cycle 2

Note: Data were rounded off to the nearest percentage and in each case calculations were performed on valid survey responses.

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<td>16%</td>
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<td>Enable me to be more efficient</td>
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<td>Will help me in future teaching</td>
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<td>7</td>
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<td>0</td>
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<td>6</td>
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</tr>
<tr>
<td>Gives me a sense of accomplishment</td>
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<td>4</td>
<td>17</td>
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<td>Enhances standing with peers</td>
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<td>17</td>
<td>13%</td>
<td>9</td>
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<td>28</td>
<td>21</td>
<td>13</td>
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<tr>
<td>Provides better results as a student</td>
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<td>2</td>
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<td>2</td>
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<tr>
<td>Will help me get a job</td>
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<td>Can create instructional material to enhance teaching</td>
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<td>4</td>
<td>49</td>
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</tr>
</tbody>
</table>

* The lower response was probably due, as noted by several students, to their non-participation in the work force.
| Can access information for my teaching | 118 | 7 | 7 | 0 | 3 | 2 | 8 | 8 | 34 | 63 |
| Helps me feel more confident teaching my students | 118 | 6 | 6 | 4 | 4 | 17 | 2 | 19 | 31 | 26 |
| Provides better results as a student | 118 | 6 | 6 | 2 | 2 | 7 | 12 | 28 | 39 | 28 |

### ATTITUDE

| I like working with computers | 118 | 5 | 6 | 5 | 3 | 5 | 20 | 29 | 40 | 16 |
| Once on the computer I find it hard to stop | 118 | 4 | 4 | 8 | 7 | 16 | 13 | 35 | 27 | 10 |
| I would choose to use a computer in my spare time | 118 | 4 | 5 | 15 | 13 | 14 | 19 | 22 | 25 | 17 |
| I prefer to use a computer to write assignments | 118 | 7 | 7 | 2 | 2 | 3 | 2 | 6 | 9 | 32 |
| I would choose to use computers in my teaching | 118 | 6 | 6 | 2 | 2 | 0 | 6 | 11 | 21 | 52 |

### ANXIETY (FEELINGS)

| I am confident in the ability to do a course requiring computers | 118 | 5 | 5 | 9 | 8 | 6 | 12 | 22 | 33 | 18 |
| I feel at ease learning about computer technology | 118 | 5 | 5 | 7 | 6 | 8 | 7 | 11 | 19 | 19 |
| I feel comfortable about my ability to use computers | 118 | 5 | 5 | 5 | 4 | 8 | 4 | 9 | 20 | 20 |

### LEARNING DEPENDENCY

| If there was no one around | 118 | 4 | 4 | 9 | 8 | 12 | 15 | 29 | 25 | 18 |
| If I only had manuals | 118 | 5 | 4 | 4 | 10 | 8 | 3 | 25 | 30 | 28 |
| If I had built in help only | 118 | 5 | 5 | 3 | 3 | 6 | 5 | 10 | 20 | 36 |
| If there was some one giving step-by-step instruction | 118 | 7 | 7 | 0 | 1 | 1 | 10 | 14 | 22 | 64 |

| Table 25 Cross-tabulation of frequency and duration of computer use |

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<td>Never</td>
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<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Duration of computer use (in hours)</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
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</tr>
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<td>5</td>
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<td>6</td>
</tr>
<tr>
<td>Total</td>
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Appendix 13 - Analysis of Individual Outlying Responses Indicating Low Self-Efficacy

Table 26 Analysis of Individual Outlying Responses Indicating Low Self-Efficacy

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<th>ENCOURT BY OTHERS</th>
<th>FREQ. USE BY OTHERS</th>
<th>SUPPORT</th>
<th>PERC'D USE.</th>
<th>ATTITUDE</th>
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### Appendix 14 - Analysis of Correlation, Pre-Semester Survey, Cycle 2

Table 27  Analysis of correlation, pre -semester; Cycle 2

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>SPEARMAN'S RHO</th>
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<tbody>
<tr>
<td>I am the type to do well with computers</td>
<td>.001</td>
</tr>
<tr>
<td>Ability to use software independently</td>
<td>-.127</td>
</tr>
<tr>
<td>Would use computers in spare time</td>
<td>.144</td>
</tr>
<tr>
<td>Sense accomplishment</td>
<td>.155</td>
</tr>
<tr>
<td>Would use computers in teaching</td>
<td>.364*</td>
</tr>
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</table>

**ENCOURAGEMENT BY OTHERS**

| | |
| Encouragement by family | .366* | .303* |
| Encouragement by school teachers | .208** | .158 |
| Encouragement by friends | .332* | .271* |
| Encouragement by lecturers | .156 | .131 |
| Encouragement by work colleagues | .042 | .084 |

**USE BY OTHERS**

| | |
| Family's use | .128 | .054 |
| Friends' use | .290* | .326* |
| Lecturers' use | -.089 | -.115 |
| Work colleagues' use | .098 | .174 |
| Other students' use | .133 | .178 |

**SUPPORT**

| | |
| Assistance using hardware easy to get | .455* | .350* |
| Assistance using software easy to get | .529* | .406* |
| Assistance purchasing equipment easy to get | .499* | .332* |
| Fellow students, friends are source support | .334* | .289* |
| University is supportive of use of computers | .407* | .377* |

**PERCEIVED USEFULNESS**

| | |
| Enable me to be more efficient | .350* | .282* |
| Will help me in future teaching | .286* | .197** |
| Gives me a sense of accomplishment | .224** | .174 |
| Enhances standing with peers | .257* | .116 |
| Provides better results as a student | .324* | .292* |
| Will help me get a job | .289* | .172 |
| Can create material to enhance teaching | .344* | .273* |
| Can access information for my teaching | .350* | .215** |
| Helps me feel more confident teaching | .069 | -.062 |
| Provides better results as a student | .277* | .177 |

**ATTITUDE**

| | |
| I like working with computers | .586* | .474* |
| Once on the computer I find it hard to stop | .407* | .434* |
| Would choose to use computer in spare time | .481* | .467* |
| Prefer to use computer to write assignments | .376* | .238* |
| Would choose to use computers in teaching | .453* | .341* |

**FEELINGS**

| | |
| Confidence in ability to do well in course | .853** | .687* |
| I feel at ease learning about IT | .841** | .718* |
| I am the type to do well with IT | .696* | .481* |
| The thought of using IT is not frightening | .740** | .593* |
| I do not feel threatened by the impact of IT | .790** | .609* |
| I am not worried about "breaking" computers | .608** | .586* |
| Comfortable about ability to work with IT | .811** | .693* |

**LEARNING INDEPENDENCE**

| | |
| If there was no-one around | .696* | .467* | .174 | .341* |
### Appendix 15 - Analysis of Post-Semester Self-Efficacy Data, Cycle 2

**Table 28** Post-semester self-efficacy data, cycle 2

<table>
<thead>
<tr>
<th>Table 28</th>
<th>Post-semester self-efficacy data, cycle 2</th>
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<tbody>
<tr>
<td></td>
<td>N</td>
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<tr>
<td>Duration of Computer Use</td>
<td>57</td>
</tr>
<tr>
<td>Frequency of Computer Use</td>
<td>56</td>
</tr>
</tbody>
</table>

#### ENcouragement by OTHERS

| Encouragement by family | 57 | 4 | 5 | 10 | 17.5% | 2 | 3.5% | 10 | 17.5% | 8 | 14.0% | 16 | 28.1% | 6 | 10.5% |
| Encouragement by school teachers | 57 | 5 | 6 | 7 | 12.3% | 4 | 7.0% | 1 | 1.8% | 9 | 15.8% | 11 | 19.3% | 15 | 26.3% |
| Encouragement by friends | 57 | 5 | 5 | 7.0% | 0 | 12.3% | 19.3% | 9 | 19.3% |
| Encouragement from lecturers | 57 | 7 | 7 | 0 | 0 | 0 | 3 | 5 | 17 | 32 |
| Encouragement by work colleagues | 54 | 5 | 5 | 8 | 14.8% | 3 | 2 | 2 | 7 | 13 |

#### FREQUENCY OF USE by OTHERS

| Family’s use | 57 | 5 | 5 | 3 | 4 | 5.3% | 7.0% | 5.3% | 14.0% | 28.1% | 16 | 22.8% | 13 | 17.5% |
| Friends’ use | 57 | 6 | 7 | 0 | 2 | 4 | 3.5% | 7.0% | 8.8% | 15.8% | 9 | 26.3% | 22 |
| Lecturers’ use | 57 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 15 | 42 |
| Work colleagues’ use | 50 | 6 | 6 | 0 | 2 | 4 | 4.0% | 2.0% | 10.0% | 18.0% | 17 | 23.6% |
| Other students’ use | 57 | 6 | 7 | 0 | 0 | 1 | 1.8% | 3.5% | 7.0% | 21.1% | 14.0% | 19.3% |

#### SUPPORT

| Assistance using hardware easy to get | 57 | 5 | 4 | 4 | 1 | 1.8% | 7.0% | 24.6% | 3.6% | 3.6% | 61.8% |
| Assistance using software easy to get | 57 | 5 | 4 | 1 | 3 | 1.8% | 5.3% | 10.5% | 22.8% | 24.6% | 17.5% |
| Assistance purchasing equipment easy to get | 57 | 5 | 4 | 4 | 6 | 3.5% | 7.0% | 10.5% | 28.1% | 19.3% | 21.1% |
| Fellow students and friends are good support | 57 | 5 | 7 | 1 | 8 | 1.8% | 1.8% | 14.0% | 14.0% | 21.1% | 15.8% |
| University is supportive of use of computers | 57 | 6 | 6 | 0 | 0 | 1 | 1.8% | 10.5% | 10.5% | 40.4% | 47.4% |

#### PERCEIVED USEFULNESS

| Enable me to be more efficient | 55 | 7 | 7 | 0 | 0 | 1 | 1.8% | 1.8% | 6 | 10.9% | 13 | 23.6% | 34 |
| Will help me in future teaching | 55 | 7 | 7 | 0 | 0 | 0 | 2 | 2 | 3.6% | 3.6% |
| Gives me a sense of accomplishment | 54 | 7 | 7 | 0 | 1 | 1.9% | 9.3% | 22.2% | 13.0% | 53.7% |
| Enhances standing with peers | 55 | 5 | 5 | 2 | 4 | 3.6% | 7.3% | 5.5% | 21.8% | 23.6% | 16.4% |
| Provides better results as a student | 55 | 5 | 7 | 0 | 1 | 0 | 1.8% | 3.6% | 14.5% | 21.8% | 58.2% |
| Will help me get a job | 55 | 7 | 7 | 0 | 1 | 1.8% | 3.6% | 16.4% | 23.6% | 40.5% |
| Can create instructional material to enhance teaching | 55 | 7 | 7 | 0 | 0 | 0 | 1 | 1.8% | 9.1% | 16.4% |
| Can cases information for my teaching | 55 | 7 | 7 | 0 | 0 | 0 | 1 | 1.8% | 9.1% | 21.8% |
| Helps me feel more confident teaching my students | 55 | 7 | 7 | 0 | 2 | 1 | 3.6% | 1.8% | 7.3% | 9.1% | 18.2% | 60.0% |
| Provides better results as a student | 52 | 7 | 7 | 1 | 0 | 0 | 1 | 1.9% | 17.3% | 15.4% | 63.5% |
### Attitude

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<tbody>
<tr>
<td>I like working with computers</td>
<td>14.2%</td>
<td>5.6%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1</td>
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<td>12</td>
</tr>
<tr>
<td>Once on the computer I find it hard to stop</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
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<tr>
<td>I would choose to use a computer in my spare time</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
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<tr>
<td>I prefer to use a computer to write assignments</td>
<td>14.2%</td>
<td>3.7%</td>
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<td>1.9%</td>
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<tr>
<td>I would choose to use computers in my teaching</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
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### Anxiety (Feelings)

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<tr>
<td>I am confident in the ability to do a course requiring computers</td>
<td>14.2%</td>
<td>3.7%</td>
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<td>1.9%</td>
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<tr>
<td>I feel at ease learning about computer technology</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
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</tr>
<tr>
<td>I am the type to do well with computer technology</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>1</td>
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<tr>
<td>The thought of using computers is not frightening</td>
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<tr>
<td>I do not feel threatened by the impact of computer technology</td>
<td>14.2%</td>
<td>3.7%</td>
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<td>1.9%</td>
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<tr>
<td>I am the type to do well with “breaking” computers</td>
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<td>3.7%</td>
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<td>7</td>
<td>12</td>
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<tr>
<td>I feel comfortable about my ability to use computers</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>1</td>
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### Learning Dependency

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<th>11</th>
<th>12</th>
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</thead>
<tbody>
<tr>
<td>If there was no one around</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>1</td>
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<td>If I only had manuals</td>
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<td>1.9%</td>
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<tr>
<td>If I had observed someone beforehand</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
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<td>12</td>
</tr>
<tr>
<td>If I could call someone if I got stuck</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>If some one helped me get started</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>If I had lots of time</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>If I had built in help only</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>If some one showed me how to do it</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>If there was some one giving step-by-step instruction</td>
<td>14.2%</td>
<td>3.7%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>12</td>
</tr>
</tbody>
</table>
### Appendix 16 - Attributional Analysis, Pre-Semester Data, Cycle 2

#### Attributions for Lack of Success

#### Table 29  
**Frequency analysis of attributions for lack of success on assignment presentation**

<table>
<thead>
<tr>
<th>Locus</th>
<th>Stability</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext.</td>
<td>Int.</td>
<td>Unstable</td>
<td>Stable</td>
</tr>
<tr>
<td>Lack of knowledge/skill</td>
<td>35</td>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>Lack of effort/time commitment</td>
<td>18</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Communication fault of others (incorrect information/instructions)</td>
<td>14</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Differing expectations</td>
<td>8</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Technical problems</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Didn't follow direction</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Communication fault of self</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Poor judgement</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Lack confidence</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>100</td>
<td>11</td>
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</tbody>
</table>

#### Table 30  
**Frequency analysis of attributions for inability to get new software to work**

<table>
<thead>
<tr>
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<th>Stability</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext.</td>
<td>Int.</td>
<td>Unstable</td>
<td>Stable</td>
</tr>
<tr>
<td>Lack knowledge/Skills</td>
<td>32</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>Technical problems</td>
<td>26</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>Incorrect information/instructions</td>
<td>17</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>Lack of effort/time commitment</td>
<td>15</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Lack experience</td>
<td>13</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Need assistance</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Frustration</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>107</td>
<td>100</td>
<td>19</td>
</tr>
</tbody>
</table>

#### Table 31  
**Frequency analysis of attributions for friend being unable to read an e-mail you send**

<table>
<thead>
<tr>
<th>Locus</th>
<th>Stability</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext.</td>
<td>Int.</td>
<td>Unstable</td>
<td>Stable</td>
</tr>
<tr>
<td>Technical problems</td>
<td>44</td>
<td>43</td>
<td>21</td>
</tr>
<tr>
<td>Lack knowledge/Skills</td>
<td>14</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Other person's inability</td>
<td>13</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Incorrect information/instructions</td>
<td>12</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Mistake</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Lack of effort/time commitment</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>103</td>
<td>100</td>
<td>36</td>
</tr>
</tbody>
</table>
Table 32  Attributions for things going generally badly

<table>
<thead>
<tr>
<th>LOCUS</th>
<th>STABILITY</th>
<th>FREQUENCIES</th>
<th>%</th>
<th>EXT.</th>
<th>INT.</th>
<th>UNSTABLE</th>
<th>STABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luck</td>
<td></td>
<td>15</td>
<td>16</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Lack of effort</td>
<td></td>
<td>14</td>
<td>15</td>
<td>1</td>
<td>12</td>
<td>4</td>
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<tr>
<td>Self</td>
<td></td>
<td>14</td>
<td>15</td>
<td>12</td>
<td>1</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Attitude</td>
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<td>9</td>
<td>9</td>
<td>1</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td></td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Lack of control</td>
<td></td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lack confidence</td>
<td></td>
<td>4</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<td>3</td>
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<td></td>
<td></td>
</tr>
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<td>Understanding</td>
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<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other people</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>21</td>
<td>22</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
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<td>100</td>
<td>11</td>
<td>56</td>
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Table 33  Summary of causal explanations relating to commonly cited attributional explanations for lack of success

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<tr>
<th>QUESTION NO.</th>
<th>FREQUENCIES</th>
<th>%</th>
<th>LOcus</th>
<th>STABILITY</th>
<th>BREAKDOWN AS A PERCENTAGE OF THE NO. OF RESPONDENTS PROVIDING THAT ATTRIBUTIONAL EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>UNSTABLE</td>
<td>STABLE</td>
<td>GENERALISABILITY</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EXT.</td>
<td>INT.</td>
<td>NON-GENER.</td>
</tr>
<tr>
<td>Lack of knowledge/skill</td>
<td>Q1</td>
<td>35</td>
<td>35</td>
<td>86</td>
<td>29</td>
</tr>
<tr>
<td>Q3</td>
<td>32</td>
<td>30</td>
<td>75</td>
<td>6</td>
<td>47</td>
</tr>
<tr>
<td>Q4</td>
<td>14</td>
<td>14</td>
<td>64</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>26%</td>
<td></td>
<td>5</td>
<td>75</td>
<td>24</td>
</tr>
<tr>
<td>Technical problems</td>
<td>Q1</td>
<td>4</td>
<td>4</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Q3</td>
<td>26</td>
<td>24</td>
<td>27</td>
<td>38</td>
<td>31</td>
</tr>
<tr>
<td>Q4</td>
<td>44</td>
<td>43</td>
<td>48</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>24%</td>
<td></td>
<td>30</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>Incorrect information/instructions</td>
<td>Q1</td>
<td>14</td>
<td>14</td>
<td>21</td>
<td>36</td>
</tr>
<tr>
<td>Q3</td>
<td>17</td>
<td>16</td>
<td>65</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Q4</td>
<td>12</td>
<td>12</td>
<td>8</td>
<td>50</td>
<td>42</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>14%</td>
<td></td>
<td>31</td>
<td>35</td>
<td>34</td>
</tr>
<tr>
<td>Lack of effort/time commitment</td>
<td>Q1</td>
<td>18</td>
<td>18</td>
<td>89</td>
<td>39</td>
</tr>
<tr>
<td>Q3</td>
<td>15</td>
<td>14</td>
<td>87</td>
<td>27</td>
<td>40</td>
</tr>
<tr>
<td>Q4</td>
<td>1</td>
<td>1</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>11%</td>
<td></td>
<td>92</td>
<td>22%</td>
<td>60%</td>
</tr>
</tbody>
</table>

* Note that percentages do not amount to 100% as responses of ‘4’ (i.e. neither internal nor external, stable or unstable, general or non-generalisable) are not shown but are taken into account.
## Appendices

### Attributions for Success

#### Table 34  Frequency analysis of attributions for success on World Wide Web search

<table>
<thead>
<tr>
<th>LOCUS</th>
<th>STABILITY</th>
<th>GENERALISATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Knowledge/Skill/Experience</td>
<td>45</td>
<td>42</td>
</tr>
<tr>
<td>Luck</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Had precise information/instructions</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>Technical factors</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Effort/time</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Education</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Confidence</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ease of task</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wouldn't happen</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>11</td>
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<tr>
<td>Total</td>
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<td>100</td>
</tr>
</tbody>
</table>

#### Table 35  Frequency analysis of attributions for success on teaching a lesson incorporating computers

<table>
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<tr>
<th>LOCUS</th>
<th>STABILITY</th>
<th>GENERALISATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Preparation (Effort/time)</td>
<td>47</td>
<td>44</td>
</tr>
<tr>
<td>Knowledge/Skills/Experience of self</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>Knowledge/Skills of others</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Confidence</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Bluff</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Lack</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Technical factors</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ease of task</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>107</td>
<td>100.0</td>
</tr>
</tbody>
</table>

#### Table 36  Frequency analysis of attributions for success in solving a friend's computer problem

<table>
<thead>
<tr>
<th>LOCUS</th>
<th>STABILITY</th>
<th>GENERALISATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Knowledge/Skills/Experience of self</td>
<td>82</td>
<td>78</td>
</tr>
<tr>
<td>Luck</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Lack of knowledge/Skills of others</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Education</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ease of task</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Confidence</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Other</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 37  Frequency analysis of attributions for things going generally well

<table>
<thead>
<tr>
<th></th>
<th>FREQ.</th>
<th>%</th>
<th>LOCUS</th>
<th>STABILITY</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>EXT.</td>
<td>INT.</td>
<td>UNSTABILE</td>
<td>STABLE</td>
</tr>
<tr>
<td>Hard work/effort</td>
<td>17</td>
<td>18</td>
<td>14</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luck</td>
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<td>12</td>
<td>8</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
<tr>
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<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
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<td>Control</td>
<td>8</td>
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<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>14</td>
<td>14</td>
<td>11</td>
<td>1</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Attitude</td>
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<td>18</td>
<td>17</td>
<td>15</td>
<td></td>
<td></td>
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<td>Confidence</td>
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<td>4</td>
<td>3</td>
<td>2</td>
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<td></td>
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<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Focused</td>
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<td>1</td>
<td></td>
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<tr>
<td>Other</td>
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<td>Total</td>
<td>97</td>
<td>100</td>
<td>76</td>
<td>2</td>
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</tr>
</tbody>
</table>

Table 38  Summary of causal explanations relating to commonly cited attributional explanations for success

<table>
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<tr>
<th></th>
<th>QUEST NO.</th>
<th>FREQ.</th>
<th>%</th>
<th>LOCUS</th>
<th>STABILITY</th>
<th>GENERALISABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EXT.</td>
<td>INT.</td>
<td>UNSTABLE</td>
</tr>
<tr>
<td>Knowledge/skills/experience</td>
<td>Q2 45</td>
<td>42</td>
<td>2</td>
<td>73</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Q5 17</td>
<td>16</td>
<td>88</td>
<td></td>
<td>76</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Q6 82</td>
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<td>62</td>
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<tr>
<td></td>
<td>AVERAGE</td>
<td>45%</td>
<td>1</td>
<td>80</td>
<td>11</td>
<td>70</td>
</tr>
<tr>
<td>Effort/Time</td>
<td>Q2 3</td>
<td>3</td>
<td>66</td>
<td>33</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q5 47</td>
<td>44</td>
<td>2</td>
<td>94</td>
<td>2</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Q6</td>
<td></td>
<td>AVERAGE</td>
<td>45%</td>
<td>23</td>
<td>42</td>
</tr>
<tr>
<td>Luck</td>
<td>Q2 20</td>
<td>19</td>
<td>33</td>
<td>35</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Q5 2</td>
<td>2</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q6 7</td>
<td>7</td>
<td>29</td>
<td>57</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>AVERAGE</td>
<td>9%</td>
<td>54</td>
<td>31</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Confidence</td>
<td>Q2 1</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Q5 10</td>
<td>9</td>
<td>80</td>
<td>80</td>
<td>10</td>
<td>70</td>
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<tr>
<td></td>
<td>Q6 1</td>
<td>1</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<tr>
<td></td>
<td>AVERAGE</td>
<td>4%</td>
<td>80</td>
<td>80</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>Education</td>
<td>Q2 2</td>
<td>2</td>
<td>100</td>
<td></td>
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<td></td>
<td>Q5 0</td>
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</tr>
<tr>
<td></td>
<td>Q6 3</td>
<td>3</td>
<td>33</td>
<td>33</td>
<td>66</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>AVERAGE</td>
<td>2%</td>
<td>44</td>
<td>11</td>
<td>55</td>
<td>44</td>
</tr>
<tr>
<td>Ease of task</td>
<td>Q2 1</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td>Q5 1</td>
<td>1</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Q6 2</td>
<td>2</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>AVERAGE</td>
<td>2%</td>
<td>33</td>
<td>66</td>
<td>66</td>
<td>33</td>
</tr>
</tbody>
</table>

* Note that percentages do not amount to 100% as responses of ‘4’ (i.e. neither internal nor external, stable or unstable, general or non-generalisable) are not shown but are taken into account.
Appendix 17 - The Characteristics of ‘Capable’ Computer Users

It is important to note that the responses students provided were open ended. The omission of a point by a student did not mean that they did not see this as important, merely that it was not what came to their mind at the time.

<table>
<thead>
<tr>
<th>Group</th>
<th>Characteristics of a Capable computer user</th>
<th>Student Cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Confidence in own skills and abilities: ‘not afraid or intimidated’ (Student 7); ‘I regularly back everything up and know that all errors can be fixed. This gives me the confidence to get in and give a new program a go’ (Student 89); ‘Confident enough to make mistakes - and proficient enough to correct them!’ (Student 123); ‘Confident that… he could use proven strategies to find out…’</td>
<td>5, 7, 17, 28, 32, 35, 36, 39, 46, 53, 74, 79, 87, 89, 109, 111, 113, 126, 131, 133, 138, 148, 154, 156, 165, 169, 180</td>
</tr>
<tr>
<td></td>
<td>Patient and persistent Determined, stays calm; ‘will often sit down and work things out which may take them hours’ (Student 16)</td>
<td>16, 28, 61, 72, 74, 88, 95, 109, 110, 112, 123, 133, 135, 142, 144, 153, 161, 169, 176, 177</td>
</tr>
<tr>
<td></td>
<td>Risk takers, courage to experiment, try new things: Not afraid to try or make mistakes; ‘not afraid to play around with the computer and so is not held back when strange things happen’ (Student 56); ‘Like all kids he had very little concept of the price or ‘delicate nature’ of the machine and so as game to try anything’ (Student 33); Learn from their mistakes</td>
<td>5, 8, 16, 33, 39, 46, 56, 65, 75, 87, 88, 89, 105, 111, 113, 123, 126, 138, 142, 144, 154, 176</td>
</tr>
<tr>
<td></td>
<td>Methodical/logical thinking: ‘clarity and speed of thinking’ (Student 36); ‘Fluidity of thought which allows him to see things in a new light and skip from one point in a mental process to another without interruption to his logic (i.e. he doesn't rely purely on a routine or set pattern of thinking)’ (Student 37).</td>
<td>5, 17, 36, 37, 39, 60, 72, 89, 133, 142, 168</td>
</tr>
<tr>
<td></td>
<td>Enthusiasm and motivation: Enjoy using computers; Positive attitude, personal interest; Spends leisure time using computers; ‘Time spent at the computer is a pleasure and there is virtually no limit to the time he wants to spend trying and fiddling’ (Student 33); ‘Don't connect the hours spent on practising as work’ (Student 47)</td>
<td>4, 5, 28, 33, 47, 79, 90, 105, 109, 110, 111, 154, 161, 165, 167</td>
</tr>
<tr>
<td></td>
<td>Technical knowledge: Good knowledge of available programs; Knowledge of software and hardware; Knowledge of terminology: Fluency and language use in relation to IT ‘he seems to use a lot of accurate and specific terms… his accurate learning facility also mean that he is able to express and clarify his thoughts well and participate in productive intellectual exchanges with other similarly capable technology users (Student 37).</td>
<td>12, 27, 31, 32, 36, 37, 41, 42, 53, 55, 76, 78, 79, 87, 90, 109, 110, 119, 135, 140, 155, 158, 165, 169, 170, 177</td>
</tr>
<tr>
<td></td>
<td>Love of Learning: ‘Not intimidated by learning new processes’ (Student 17); ‘A thirst to learn’ (Student 5); ‘Like a challenge’ (Student 16); See things as a ‘challenge to be mastered rather than a fear of the unknown’ (Student 7); enthusiasm to learn and his ability to learn quickly’ (Student 15); A constant learner (Student 81); ‘Enjoy a challenge’ (Student 88); Curious about new developments; Know that there is always more to learn and understand; Learns by engaging fully with every learning situation and keeping g himself open to any information, ideas and facts presented (Student 37). Inquisitive.</td>
<td>4, 5, 7, 15, 16, 17, 28, 37, 46, 47, 58, 6181, 88, 89, 110, 112, 137, 153, 154, 159, 161, 170, 171</td>
</tr>
<tr>
<td></td>
<td>Constant Use, deep immersion: ‘Experience, and lots of it’ (Student 9); Spends a great deal of time at computer; Has time to play (Student 74) Use it regularly; Owns their own computer (Student 164, 167).</td>
<td>4, 9, 28, 36, 37, 58, 74, 79, 89, 91, 105, 114, 127, 161, 164, 167, 176</td>
</tr>
<tr>
<td></td>
<td>Problem-solving abilities, deduction: ‘someone who can get themselves out of trouble, fix mistakes’ (Student 19); Understanding of problems that could exist (Student 67); Ability to ‘Trouble Shoot’; Excellent at defining problems (Student 72); ‘I always look on the positive side of things and know there is a solution to every problem’ (Student 89); They know there is an answer to the problem and are determined to solve it.</td>
<td>42, 19, 39, 67, 72, 74, 81, 89, 109, 135, 140, 142, 154, 155</td>
</tr>
</tbody>
</table>
### B

**Ability to share skills:** Ability to impart knowledge to others (Student 81); Ability to know what someone less capable is talking about (Student 85); his willingness to share and discuss his knowledge enriches his development. As well as inspiring others with his ideas he receives the same in return. (Student 112)

**Transferability/flexibility:** Ability to build on existing knowledge; ‘to adapt old knowledge to new concepts. They apply principles rather than needing to learn exact, specific processes each time.’ (Student 5)

**Knows when and where to seek help:** Knowledge or how to obtain resources to address problems; Not afraid to ask; Qualifying comment: Avoids assistance until she has explored all avenues (Student 113)

**Metacognitive Awareness:** reflective learner; Ability to critically analyse and reflect and to use these abilities to analyse problems that arise and to learn from experiences (Student 32)

**Readily accept change:** not daunted or flustered.

**Organisation:** ‘Ability to sort, categorise and prioritise the constant influx of data’ (Student 37)

**Creative, inventive:** Lateral thinkers; ‘fortitude to pursue new alleys or paths yet unseen’ (Student 5); ‘doesn’t rely purely on a routine or set pattern of thinking’ (Student 37); This point is contradicted by Student 17: ‘They are very rarely the creative type of person. The way these people learn is through a set of processes, that is they build an understanding over time, and once this is done they can piece it all together into one big picture’ (Student 17)

**Efficient:**

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<tr>
<td>6, 76, 79, 87, 140</td>
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**Easy going nature, calm:**

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<td>142, 156, 101, 105</td>
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**Lack people skills:** prefer to work in isolation

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<tr>
<td>6, 43, 110, 169, 178</td>
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</table>

### C

**Youth:** Being so young and fearless they are able to pick things up so quickly…. They grew up with computers

[Interestingly this factor was not mentioned frequently and from the descriptions provided by students of the capable computer users they were thinking of there was a huge range in ages…including many parents.]

<p>| | |</p>
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<tbody>
<tr>
<td>111</td>
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**Memory:**

<p>| | |</p>
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<tbody>
<tr>
<td>168</td>
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</table>

**Identified need to be a competent computer user**

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<table>
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<tr>
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<tr>
<td>4, 131</td>
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**Realistic**

<p>| | |</p>
<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>Do not expect the computer or software to be infallible</td>
<td>89</td>
</tr>
</tbody>
</table>

**Inquisitive**

<p>| | |</p>
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<tr>
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<tr>
<td>109</td>
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</table>

**Can type**

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<tbody>
<tr>
<td>53, 177</td>
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</table>

**Speed of reading (to read manuals)**

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<tbody>
<tr>
<td>56</td>
<td></td>
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</table>

**Innate intuition concerning computers**

<p>| | |</p>
<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>60</td>
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**Clear about what they want to achieve**

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<th></th>
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<tbody>
<tr>
<td>154</td>
<td></td>
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</table>

**Explorative**

<p>| | |</p>
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<tbody>
<tr>
<td>74</td>
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</table>

**Ability to concentrate, remain focused**

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<tbody>
<tr>
<td>46, 74</td>
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</table>

**Visualise processes and procedures**

<p>| | |</p>
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<tbody>
<tr>
<td>46</td>
<td></td>
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</tbody>
</table>

**Recognise that they don't know everything.**

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<tr>
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</thead>
<tbody>
<tr>
<td>72, 171</td>
<td></td>
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</tbody>
</table>

**Intelligent:** ‘I think this particular characteristic comes to mind because for me computers appear to be quite technical… I often find the manuals are sometimes difficult to understand. I personally think it takes a reasonably intelligent person to be able to understand these things’; ‘is generally intelligent especially when it comes to the terminology in manuals’ (Student 88)

This is strongly contradicted by Student 46: ‘I am positive a successful IT user does not necessarily have to be someone who is intellectually gifted…’ the student refers to a 15 year old boy who did very poorly at school yet was outstanding with computers.

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<tbody>
<tr>
<td>16, 37, 88</td>
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</tbody>
</table>

(46) (61 also qualified her initial response - see below)
<table>
<thead>
<tr>
<th>How a Capable computer user learns</th>
<th>Student Cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimentation, trial and error, exploring, playing around</td>
<td></td>
</tr>
<tr>
<td>Learns incidentally through structured 'playing' (Student 79)</td>
<td></td>
</tr>
<tr>
<td>Reading Manuals, Books and Magazines</td>
<td>6, 42, 56, 72, 74, 78, 79, 85, 88, 144, 153</td>
</tr>
<tr>
<td>Consults with others, Peer Group</td>
<td>4, 8, 12, 26, 33, 53, 72, 74, 81, 111, 112, 123, 154, 171</td>
</tr>
<tr>
<td>Having a ‘mentor’</td>
<td></td>
</tr>
<tr>
<td>Observation and reflection (Student 4)</td>
<td></td>
</tr>
<tr>
<td>Using help files</td>
<td>26, 72</td>
</tr>
<tr>
<td>Training (TAFE, University)</td>
<td>53, 110, 112, 114, 158</td>
</tr>
<tr>
<td>Individual instruction</td>
<td>76, 168, 170</td>
</tr>
<tr>
<td>‘learn firstly listening to others’ (Student 76)</td>
<td></td>
</tr>
<tr>
<td>Spending time</td>
<td>9</td>
</tr>
<tr>
<td>‘Immerse himself in the task and discover for himself what the computer, and himself, were capable of.</td>
<td>15</td>
</tr>
<tr>
<td>Prefer to work in isolation rather than in cooperative group session.</td>
<td>43</td>
</tr>
<tr>
<td>Don’t need to write things down</td>
<td>85</td>
</tr>
<tr>
<td>Able to learn in a variety of learning situations</td>
<td>61</td>
</tr>
</tbody>
</table>
### Appendix 18 - Case Study Self-Efficacy Data, Cycle 2

<table>
<thead>
<tr>
<th>CASE STUDY</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<tr>
<td>MEDIAN MODERATE</td>
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<td>1</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
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<tr>
<td>Duration of Computer Use</td>
<td>6</td>
<td>7</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>7</td>
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<tr>
<td>Frequency of Computer Use</td>
<td></td>
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</tbody>
</table>

### ENCOURAGEMENT BY OTHERS

| Encouragement by family | 4 | 5 | 1 | 4 | 2 | 6 | 5 | 5 | 1 |
| Encouragement by school teachers | 4 | 4 | 3 | 3 | 6 | 4 | 5 | 5 | 4 |
| Encouragement by friends | 4 | 4 | 3 | 1 | 2 | 4 | 5 | 7 | 4 |
| Encouragement from lecturers | 6 | 6 | 5 | 5 | 6 | 6 | 7 | 7 | 6 |
| Encouragement by work colleagues | 4 | 4 | 4 | 1 | 2 | 6 | - | 5 | 7 |

### FREQUENCY OF USE BY OTHERS

| Family’s use | 6 | 7 | 7 | 5 | 1 | 6 | 7 | 7 | 3 |
| Friends’ use | 6 | 6 | 5 | 5 | 5 | 6 | 6 | 7 | 6 |
| Lecturers’ use | 7 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 7 |
| Work colleagues’ use | 6 | 6 | 5 | 1 | 2 | - | - | 6 | 6 |
| Other students’ use | 6 | 6 | 5 | 6 | 5 | 6 | 7 | 7 | 7 |

### SUPPORT

| Assistance using hardware easy to get | 4 | 4 | 4 | 5 | 1 | 2 | 3 | 3 | 4 |
| Assistance using software easy to get | 4 | 4 | 4 | 5 | 1 | 2 | 3 | 4 | 7 |
| Assistance purchasing equipment easy to get | 4 | 4 | 4 | 3 | 2 | 2 | 4 | 4 | 4 |
| Fellow students and friends are good support | 5 | 5 | 5 | 3 | 6 | 4 | 4 | 7 | 5 |
| University is supportive of use of computers | 5 | 5 | 3 | 4 | 2 | 4 | 6 | 6 | 5 |

### PERCEIVED USEFULNESS

| Enable me to be more efficient | 6 | 6 | 4 | 6 | 4 | 3 | 7 | 6 | 6 |
| Will help me in future teaching | 6 | 7 | 7 | 7 | 7 | 5 | 7 | 7 | 6 |
| Gives me a sense of accomplishment | 6 | 5 | 5 | 2 | 6 | 7 | 6 | 6 | 7 |
| Enhances standing with peers | 4 | 4 | 7 | 2 | 1 | 3 | 4 | 2 | 3 |
| Provides better results as a student | 6 | 6 | 7 | 3 | 4 | 3 | 7 | 6 | 6 |
| Will help me get a job | 6 | 7 | 7 | 7 | 4 | 4 | 7 | 7 | 7 |
| Can create instructional material to enhance teaching | 6 | 7 | 7 | 6 | 4 | 4 | 7 | 7 | 6 |
| Can access information for my teaching | 7 | 7 | 3 | 4 | 2 | 4 | 7 | 7 | 7 |
| Helps me feel more confident teaching my students | 6 | 6 | 3 | 2 | 7 | 6 | 5 | 7 | 6 |
| Provides better results as a student | 6 | 6 | 5 | 3 | 4 | 3 | 7 | 6 | 6 |

### ATTITUDE

<p>| I like working with computers | 5 | 6 | 1 | 1 | 4 | 6 | 3 | 6 | 6 |
| Once on the computer I find it hard to stop | 4 | 4 | 1 | 1 | 4 | 4 | 5 | 4 | 2 |
| I would choose to use a computer in my spare time | 4 | 5 | 1 | 1 | 4 | 1 | 2 | 6 | 5 |
| I prefer to use a computer to write assignments | 7 | 7 | 1 | 7 | 6 | 4 | 7 | 7 | 7 |
| I would choose to use computers in my teaching | 6 | 6 | 1 | 3 | 7 | 4 | 7 | 7 | 6 |</p>
<table>
<thead>
<tr>
<th></th>
<th>MEDIAN</th>
<th>MODE</th>
<th>STUDENT 9</th>
<th>STUDENT 1</th>
<th>STUDENT 5</th>
<th>STUDENT 6</th>
<th>STUDENT 7</th>
<th>STUDENT 8</th>
<th>STUDENT 15</th>
<th>STUDENT 35</th>
<th>STUDENT 45</th>
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</thead>
<tbody>
<tr>
<td><strong>ANXIETY (FEELINGS)</strong></td>
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<tr>
<td>I am confident in the ability to do a course requiring computers</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>I feel at ease learning about computer technology</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>I am the type to do well with computer technology</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>The thought of using computers is not frightening</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>1</td>
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<tr>
<td>I do not feel threatened by the impact of computer technology</td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>1</td>
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<td>2</td>
<td>4</td>
<td>3</td>
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<tr>
<td>I am not worried about ‘breaking’ computers</td>
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Appendices

Appendix 19 - Small Group Letter of Consent

Thank you for your interest in participating in the reflection and support action learning group associated with the unit EDU10003 – Educational Information Technology.

This group is intended primarily to help inform the larger action research study which is investigating the effect of various learner focused teaching and learning methods in developing individual capability in the context of information technology. You have been invited to participate in this group so that you might play an active role in informing this research. However the group is also intended to be beneficial to you in terms of providing collegiality and support for your learning throughout the semester.

It is proposed that your participation in the reflection and support group will provide a discussion-based alternative to the written reflective learning journal. You will still be required to cover all the same unit content as is required of all students in the unit. Participation in the group is not a substitute for hands-on practise or reading associated with the unit. However, rather than being required to keep a written learning journal your reflections will emerge from the group discussion.

Each group (currently 2) will involve approximately 6 participants and myself in an informal but semi-structured group discussion. Groups will be held for 2 hours on weeks 2-10 (excluding the study week). You would be expected to attend each week. If you miss a week then it may be necessary for you to provide a written submission on that week’s work.

Group discussions will be tape recorded. It is envisaged that some of the information from the group discussions may be highly valuable in informing this research study, assisting us to refine our approaches to teaching about technology in teaching and learning through research as well as to further development this unit. In volunteering to participate in this group it is assumed that you are willing to participate in the action research project, and that you are happy for the discussions to be tape recorded. These excerpts would not be able to be directly connected to you personally. If at any point these excerpts are quoted, they would remain anonymous (i.e. your name will not be included). The tape recordings will only be listened to by the principal researcher (myself).

Trust is an important aspect of any group process such as this. It is important that all members of the group feel that they can confide in the other group members and that their thoughts, reflections and feelings are respected. Agreement to participate in the group represents an agreement to respect other group members and to value their contributions to the group process.

If at any point you decide to withdraw from the group then you would be required to complete the remaining requirements for the journal in a written format.

Each week may involve some preparation work in terms of being encouraged to cover certain components of the unit by designated weeks. However it is acknowledged that there will need to be some flexibility in this.

Assessment will be made in terms of your overall contributions to the discussion as well as your evidence of engagement with the unit resources. Both frequency and quality of contribution will be taken into account. Marking will be conducted on par with written submissions. However, it is not intended that the group discussion would be competitive in nature. It is envisaged that were students contribute equally then a shared mark will be awarded to all students. If a student has not contributed equally then a lower mark will be awarded. Should a student wish to pursue a higher mark then they might choose to submit additional written work however this is by no means required or expected.

You are asked to think seriously about your commitment to the group at this stage as it is preferable that you stay with the group over the nine weeks should you choose to be involved. If you decide not to participate, your choice will not count against you in any way.

Renata Phelps, PhD Candidate and Lecturer, EDU10003

☐ Yes. I am happy to participate in the Reflection and Support Action Learning Group, for our discussions to be tape recorded and for excerpts from these discussions to be used anonymously for the purpose of the research. I am aware that trust is important to the group situation and I am prepared to uphold that trust.

Your Name:

Signature: Date:
Appendix 20 - Small Group Participants’ Profiles, Cycle 3a

Group 1 Participants

**Katy** initially saw herself as lacking confidence with computers. In the early sessions she spoke of negative past experiences and concern about breaking computer equipment. Katy had been exposed to computers in primary school, but not significantly in secondary school. Although Katy had a computer at home she only used it to type assignments and it was not connected to the Internet. She did occasionally use the University computers. Katy had been involved in the first-year computer Unit but reflected that she didn’t have a purpose for learning at the time. In this early Unit she had been shown how to send e-mails but had not done so since. Katy described herself as a risk taker and an independent problem solver in other areas but not with computers, and saw this as a reflection of her lack of motivation and confidence: ‘it has to be something you really want to do’. When reflecting on her confidence to learn to use software independently, Katy stated that: ‘You wouldn’t even get me on the computer’. She was not into exploration and would only be comfortable learning if someone was there with her. In the first session Katy expressed her personal goal for the Unit ‘to not rely on other people for every step’. She also saw it as important that she could assist her own students: ‘I want my students to use computers because I know how hard it is for me at the moment.’ Under this resolve Katy changed significantly in her approach to learning during the semester. Acknowledging that she was not very playful she resolved to try to be more so. In week 6 she mentioned realising that she learnt best by doing rather than watching others and by week 9 she reflected that she ‘used to observe and then have someone help her out step-by-step but now she was more confident to go in’. She reflected that previously she would write down the steps but now she was experimenting, doing it ‘again and again as practise’. By week 10 Katy was changing settings on her computer and ‘things like that I would never have done before’.

**Yvette** described herself as having ‘a fair bit of experience’ with computers and was fairly confident in her ability to ‘figure things out’, although it depended on ‘what it is and whether I have to’. As for Katy, a ‘purpose’ was important in motivating Yvette’s learning. Like many students quoted in Cycle Two, Yvette stated that she didn’t respond positively to group learning contexts such as the first year computer unit, and tended to learn more through ‘play’. Like others in Cycle Two she was also uncomfortable with one-on-one support. Yvette’s father and brother were described as adept at computers, a point which Yvette reflected ‘does help’; however, she also acknowledged that they often did things for her. While Yvette continued, throughout the semester, to reflect on the lack of value of the tutorials and the fact that she ‘should be teaching myself’ she insisted on attending each week, multi-tasking and ‘playing around’ and tuning in if there is something she couldn’t do. In week six, however, she made a decision not to attend but to spend some time working independently at home. When asked to reflect on the experience she wasn’t sure if it was more beneficial or not and she continued to attend tutorials. Yvette seemed to strike difficulties in the Challenge Assessment and produced a problematic Web site for the third assignment.
Gary had used computers for quite some time primarily through his past employment in an insurance company. In this position he had used programs specific to that industry and learnt in a very directive context, memorising the steps and reinforcing through repetition; as he described it you ‘didn’t have to learn to think for yourself’. Gary had a computer at home set up by someone else to access the Internet. Like Yvonne and Katy, Gary had been involved in the first-year computer unit, something which he said ‘went in one ear and out the other.’ Gary described computers as very abstract and intangible. While Gary’s computer experience had been rather limited in scope he acknowledged that using them at his place of work every day, and observing others solving problems, did decrease the fear of breaking them. Gary, as with the other members of the group, had been involved in the first year computing unit and although he had received a good mark he reflected that he ‘didn’t know any of it... I didn’t learn anything because it was not fun’. Gary stated that he preferred learning contexts with someone to support him, although he noted that he just didn’t have someone he could call on to do that. Although Gary didn’t seem to become intensely involved with the Unit resources he did recount skill development, gained mainly through friends. While maintaining the importance of one-on-one assistance, Gary did seem to increasingly embrace self-directed learning approaches. In reflecting on the exploratory learning approaches he commented on higher learning retention: ‘When we were just playing around, doing it yourself, you have to make a connection in your brain’. At a later point in the semester he described how a friend had shown him how to save images from the Internet and he noted that he initially didn’t ‘take it in’ or write down any steps but he did try it again himself at home. ‘I kept pressing and it kind of happened for me eventually... I didn’t write it down step-by-step because I don’t think it helps you... you kind of have to get it in a part of your memory where you format it with other things’. He had also, independently, figured out how to use Word art.

Peter was a mature aged student who had started doing this Unit the previous year and didn’t complete it. Peter had struggled with the online resources, finding the links difficult to maneuver and the information difficult to locate and navigate around. In a solution to this he had, in the previous year, printed out the Unit, converting it to a linear format. Despite this he had not submitted any assignments, had neglected to withdraw and had failed the Unit simply through non-participation. Peter had had a computer at home for some time and, although experimenting with it a little, he stated he really only did basic things at home and was ‘not game to try things in case I break it’. That said, he did spend a fair bit of time accessing the Internet from University and found Web pages fun and motivating. Like Katy he had been shown how to use e-mail in first year but had not used it since: ‘I feel confident doing what I’m doing. But if it was stuff I wasn’t familiar with then I wouldn’t feel comfortable’. Peter did not see himself as a ‘playful’ person but wanted ‘to know exactly how to achieve it. I don’t want to fool around’. Half way through the semester Peter purchased a new computer and started to ‘play’ with it a little more, experimenting, for instance, with sound recording. Peter continued to struggle with the online Unit resources and said that it ‘felt like chance if he discovered things’. Peter found the site map helped him to navigate through the Unit and several times recommended it as a strategy for others. The Unit remained a problem for Peter and by weeks nine and ten
Peter continued to say that he ‘didn’t know where to start’. Despite this Peter completed the Unit successfully. Interestingly, when I liaised with students at the end of the following semester, I was told that Peter had ‘disappeared’ from the BEd course mid-way through semester two, apparently returning to a panel-beating job which he had previously been employed in.

**Group 2 Participants**

**Leon** was a fourth year student who had a computer at home which he used daily. Leon’s history with computer interaction was particularly interesting. Leon had had the opportunity to access computers at school; however, he had hated using them. Leon reflected back on his school friends arguing about who would get the turn to play Carmen Sandiego while he would dread his half hour free time on the computer. For Leon, computer use was boring and did not motivate him and he reflected that he was ‘probably scared... a bit worried about pushing buttons’. Leon had also had access to a computer at home as a teenager but didn’t use it. It was not until Leon finished school and his friends moved away that he discovered a need to use the computer. Given what Leon termed ‘a need’ he was soon using e-mail every day. Leon had done the introductory first year unit in computing and had enjoyed it. Interestingly here though, the course would have been timely for Leon as he had freshly discovered a benefit in using e-mail. Leon often noted his confidence to figure out new tasks or solve problems himself through play; however, he acknowledged that he rarely had the patience or persistence to do so.

**Jill** was a fourth year student who now also had a computer of her own at home and accessed one regularly at work. Jill did not have the same level of confidence and experience as Leon and had a background of high computer anxiety. Jill had no computer experience from school. She had initially enrolled in the introductory computer unit in her first year but had been extremely upset by the experience and found herself frequently in tears. She reflected that she had been unable to keep up in tutorials and ‘had no idea what I was doing’. She had really struggled for her first three years at University, paying people to type assignments for her despite having a computer at home. Through her work situation she had more recently gained much more exposure to computers, which in her own words had been ‘good’ for her. Her work environment afforded what seemed to be quite an unpressured self-driven computer context where she could experiment and try things out for herself, although, as she mentioned, she still often felt scared she would stuff something up. The children of her employer were regular computer users themselves and she was evidently quite comfortable seeking assistance and support from them when having difficulties. Jill became quite an interesting story in her own right as the semester progressed, becoming a strong advocate of self-directed and independent learning.

Jill had felt incompetent in her use of computers on her last practicum and began the semester determined to learn and to gain confidence: ‘I want to get on top of it – I’m sick of stuffing around and feeling un-confident. I’ve just got to take it on because its important’. Jill responded to the flexible learning context immediately, choosing not to attend tutorials. She expressed her enjoyment of being able to work in her own time and at her own pace, contrasting this with the negative experiences of an earlier group computer learning context. ‘It has been good for me to work through things on my own and to think for myself’. Jill repeatedly shared her learning strategies with the group, explaining that she
would work through the CD-ROM, write down any steps she was unsure of and then open up the program and work through it: ‘It is common sense and not getting frustrated... just slowly going through the motions’. She expressed how ‘really stoked’ she was when she realised that she could learn independently, only seeking assistance occasionally, and how this enhanced her confidence. Jill increasingly assumed an encouraging and modelling role with the other less confident students, emphasising her own successful experience working independently and the positive effect it was having on her self-efficacy. Jill voiced genuine and honest enthusiasm, all the while, however, emphasising that her learning was not without problems: ‘to me that is all part of the challenge of learning it. I want to put myself under that pressure so that I know I can do it’.

**Matt** was a third year mature aged student who had started at University in a different degree program some 10 years earlier. Matt freely admitted to steering clear of computers. He reflected on being at University for several years and going to the computer labs only once or twice. Throughout his degree he had paid people to type his assignments or to perform required computer tasks. Matt had purchased a computer when he started the Education degree but had really only used it to type assignments. He rarely used the Internet and had never used e-mail. Even when one of his units had required him to send an e-mail the previous semester he had arranged for someone else to send it for him. Matt had a modem at home but had been struggling for quite some time to get it to work, and had basically given up. He noted that there was no-one he could ask for advice as the help desk had done all they could. He wasn’t sure whether it was him or the modem and pointed out the expense of having a shop look at it. Matt had children of his own, aged 8 and 9 and they were beginning to exert pressure to access things such as the Internet. Matt spoke of reinforcing his learning after the tutorials and identified the limitations if he left it too long before practising.

**Catherine** had purchased a computer in 1996 (a Macintosh) and used it mainly for word processing. She estimated that during University time she would spend around 4 hours a day on the computer for word processing and now used the Internet quite confidently. Catherine commented that she would like to do more with the computer; however, she found it time consuming. Catherine reflected on how much she had learnt from the experience of purchasing her computer and putting it together. She had encountered major problems.... ‘all the time I thought it was me, so I spent hours and hours on the phone to the support people and then finally after several months, maybe longer, I realised that there was something wrong with the motherboard’. Catherine reflected that she just ‘had to throw herself in’ as there was no-one to help. Catherine also had a young son and she had reflected on his ability to pick up computer skills and remember how he had done things. Catherine spoke quite regularly of the difficulties in making the transition between her Macintosh to a PC.

**Sharon** had been at University for a shorter period than most of the other students and had recently transferred to the education degree from a different course. In her previous course she had been required to use the University computer labs, which had been a very new experience at the time – ‘I was out of my field’. When transferring to Education she had felt the need to purchase a home computer. Sharon felt that being mature aged meant that it took a long time to learn things if there was no-one there to help. Sharon was quite reliant on her husband’s computer skills, referring frequently to his assistance or advice. Her
husband did have a computer background but had not used them for some time before they purchased one for home: ‘it was like starting again’. He used the computer regularly to contact family and friends overseas; ‘he now knows more than me because he likes it’. Sharon had undertaken a TaFE basic computer course the previous year, but had not completed it. As Group Two got to know each other better there was a realisation of Sharon’s reliance on her husband’s assistance, both by Sharon herself and the group as a whole. Several interesting interchanges ensued as group members encouraged Sharon to gain independence. Sandra reinforced to Sharon that self-realisation of her reliance on her husband was a positive first step in itself: ‘It is a really good to realise that you can’t take him to school with you’. Sandra suggested that Sharon should try a strategy of putting the computer on when her husband wasn’t there and try using ‘help’ if she encountered difficulties. Sharon indicated on several occasions that she was starting to adopt such strategies. Interestingly, Sharon’s preference for, and reliance on, directive assistance was also evident in her having chosen to undertake a TaFE basic computer course the previous year. Sharon reflected that ‘what you covered in one day we didn’t even cover in three months’. Yet despite highly directive, step-by-step instructions and intensive assistance, Sharon freely admitted on many occasions to not being able to do some of the basic skills covered in this course. She had not, however, questioned whether the approach taken at TaFE had been appropriate or effective, internalising her decision not to complete. Initially Sharon held tightly to her need for one-on-one, intensive assistance to learn new skills. Later, however, Sharon reflected that it did have a lot to do with how you are taught: that if you were taught in a highly directive step by step way then this would be what you were used to and you wouldn’t be able to think of other ways. This was a very interesting comment for Sharon to make given her involvement in the highly directive TaFE learning context and was quite significant in terms of reinforcing the potential benefit of the approaches employed in my teaching/research. Sharon seemed to struggle a fair bit during the Unit and held tightly to her need for one-on-one, intensive assistance to learn new skills. Despite this she insisted on creating a complicated Web site incorporating sound files, despite recommendations to keep it simple. My lasting impression was that Sharon was a highly dependent learner but in referring back to transcripts I realised that she was, in fact, one of the most vocal proponents of independent learning, encouraging others and supporting the teaching approaches which encouraged independence and exploration: ‘You have to get them to try to think’.

Carol was a fourth year student who claimed to be ‘quite fearful of computers’. In reflecting on her school opportunities Carol indicated that she had ‘stayed away because (she) thought they were really complicated’. More recently she used computers for word processing and had used the Internet which, she stated, motivated her because she knew there was interesting stuff on there. She also mentioned being motivated by her realisation of the need to use computers in her future teaching. However, computer use was evidently still quite stressful for Carol – at one point she remarked that she felt exhausted after using them for any period and that they gave her headaches, something she freely admitted was probably a stress response. She referred to gaining experience using the Internet on the University computers. Although she had been quite scared about it she was less fearful of breaking it because it was not hers. She also mentioned not understanding what double spacing was until third year. Carol had tried teaching a computer-based lesson on a previous practicum and had had a ‘nightmare’ experience. However she reflected that she had learnt a lot and had realised that the problems were happening for others as well, not
just herself. Carol’s desire to use computers effectively in her teaching was a strong motivator for her and she expressed her determination that she would learn ‘this stuff’ for her teaching. Carol reflected on the potential advantage of being a teacher who didn’t have highly developed computer skills and knowledge, enabling kids to see that their teacher was ‘having a go’ and learning together. These reflections gave Carol confidence that she didn’t need to ‘master’ everything and she began to see herself as a ‘capable’ computer user. Like Matt, Carol stated that she would practise the skills covered in tutorials each week. Carol mentioned finding online learning impersonal and that she even found text-based learning more interactional. Carol proved to be an excellent facilitator of the group in my absence, demonstrating some profound insights into the metacognitive and metamotovalational learning process.

Sally was a vivacious fourth year student who provided yet another rich manifestation of computer anxiety. She was certainly not a non-user, having been taught to use the Internet in a one-on-one context by her flatmate who had a computer. As she admitted, Sally was ‘quite comfortable’ on the Internet providing the computer was already on; she also referred to it occasionally as ‘fun’. Sally reflected that she hadn’t used computers much at school, with computer use limited only to the playing of Carmen Sandiego. Her family were evidently enthusiastic computer users, particularly her father and brother. Sally’s father had purchased her a computer for Christmas and, although she got it out of the box, she hadn’t plugged it in by the beginning of semester: ‘I don’t care to do it, I never use it’. This was evidently an exaggeration given her comments about Internet use; however, this lack of initiative or interest in setting up her own new computer evidenced a significant anxiety. Sally did seem to be ‘one of those individuals’ who experienced more than her fair share of problems with computers. For instance, in one of the tutorials, she volunteered to demonstrate software installation and in the process my laptop crashed; although I didn’t ever let on to her that this had happened. In one humorous session she reiterated an incident in the library when the server had ‘gone down’ and she felt it was her fault (although, as she had described it, it was merely a coincidence). Sally described it as ‘another disheartening computer moment’. Sally didn’t set up her computer until around week five of semester, an event rewarded with cheers of elation and congratulations from the rest of the group. By week nine she was playing primary school games on the computer and doing assignments, although she wasn’t sure if it had a built-in modem and hadn’t looked for one. Sally spoke of plans to purchase a music program so she could write her own music: ‘It is still not something that if I had free time I’d say I’m going to play on the computer, but I do allocate time to it and use it – not once a day, but every 2nd or 3rd day’. By the end of the Unit Sally stated, ‘I wouldn’t have chosen a computer elective of my own accord because I would have been too scared to but I wish now there was one I could do.’

Bradley, in contrast to several of the other students, had not grown up with a computer in his house, so whenever he got a chance to use a computer he ‘didn’t take it for granted... I would get on and play around’. There was always a computer in the classroom and time allocated to using it, together with free time. Using a computer was seen as fun, and partly a reward and he used them as often as possible at school or friends’ houses, accessing programs such as Maths Blaster and other games. Bradley spoke of using the Internet for personal and recreational purposes including making travel arrangements. Bradley saw the tutorials as ‘a waste of time... too basic’ but did little work on the Unit from the course materials. Despite emphasising at one point that you couldn’t put off computer learning as
you ‘get further behind’ Bradley showed repeated evidence of procrastination. Interestingly, on submitting a piece of assessment work electronically I observed that he was manually double spacing his writing with carriage returns, without utilising the built in double spacing facility.

Sandra was a mature aged student and a single mother. Like several of the other students she had a computer at home but she didn’t like using it: ‘I hate sitting in that room and my time is really valuable and I’d rather do other things’. Like Matt, she indicated that unless she really had to she wouldn’t use it. Sandra perceived her aversion to computers as being due to her social concerns regarding the influence of computers on children and society: ‘because I hate them and hate what they are doing’. Sandra thus responded positively to some section of the ‘Applying’ section which talked about ‘how you can make computer learning co-operative and stimulate interaction and discussion’. Sandra freely admitted that her biggest motivation was to ‘pass the Unit’ but also added that she acknowledged that there was ‘a huge emphasis on technology in the classroom’. Carol’s mention of using computers on her practicum stimulated some genuine self-reflection for Sandra as she noted that ‘now I’m starting to think I should introduce it and use it somehow’. Sandra was very conscious of the strategies she was employing in her learning and the factors impacting on her success. She also evidenced great determination to implement new strategies. An example of this was her reference to the ’10 Tips’ section: ‘one of the tips was to try things instead of writing it down and this really worked for me because the last course I did I was so busy trying to write things down that I’d get left behind’. Sandra indicated that her confidence had gone from 2 to 6 during the semester and when quizzed as to what was going to make her get to 10 Sandra acknowledged that she needed to spend more time on the computer to improve. Sandra moved toward a genuine realisation that using computers wasn’t as difficult as she originally thought. Sandra wrote a reflective summary of her experiences in the Unit which she provided to me at the end of the group process. She spoke of her experiences learning to use computers as ‘empowering’ and ‘liberating’ in terms of realising her independent ability and she noted that she felt ‘more complete, in control and relaxed’ in classroom contexts. She described how for the first time in five years she had typed an assignment without any assistance: ‘this was an extraordinary achievement for me because to date, I had had a deep hate, passionate fear and strong aversion to computers’. Reflecting on what had changed her ‘negative mindset’ she noted the ‘warm, friendly, relaxed and tolerant demeanours’ of the tutors and their encouragement of her to try and work things out herself firstly; successfully completing the Challenge Assessment and its non competitive structure; the small group sessions which she described as ‘motivating and stimulating’; the readings in the Thinking and Applying modules; having the material at home where she didn’t have to leave her children; her motivation to improve, succeed and graduate and the General Tips for Learning.
Appendix 21 - Small Group Self-Efficacy Data, Cycle 3a
Note that data was not available from Peter Jill, or Leon

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<td>7</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENCOURAGEMENT BY OTHERS</th>
<th>MEDIAN</th>
<th>MODERATE</th>
<th>KATY</th>
<th>YVETTE</th>
<th>GARY</th>
<th>MATT</th>
<th>CATHERINE</th>
<th>SHARON</th>
<th>CAROL</th>
<th>SALLY</th>
<th>BRADLEY</th>
<th>SANDRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encouragement by family</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Encouragement by school teachers</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Encouragement by friends</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Encouragement from lecturers</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Encouragement by work colleagues</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>-</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Overall Encouragement by others</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FREQUENCY OF USE BY OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family’s use</td>
</tr>
<tr>
<td>Friends’ use</td>
</tr>
<tr>
<td>Lecturers’ use</td>
</tr>
<tr>
<td>Work colleagues’ use</td>
</tr>
<tr>
<td>Other students’ use</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistance using hardware easy to get</td>
</tr>
<tr>
<td>Assistance using software easy to get</td>
</tr>
<tr>
<td>Assistance purchasing equipment easy to get</td>
</tr>
<tr>
<td>Fellow students and friends are good support</td>
</tr>
<tr>
<td>University is supportive of use of computers</td>
</tr>
<tr>
<td>I feel generally supported in use of computers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PERCEIVED USEFULNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable me to be more efficient</td>
</tr>
<tr>
<td>Will help me in future teaching</td>
</tr>
<tr>
<td>Gives me a sense of accomplishment</td>
</tr>
<tr>
<td>Enhances standing with peers</td>
</tr>
<tr>
<td>Will help me get a job</td>
</tr>
<tr>
<td>Can create instructional material to enhance teaching</td>
</tr>
<tr>
<td>Can access information for my teaching</td>
</tr>
<tr>
<td>Helps me feel more confident teaching my students</td>
</tr>
<tr>
<td>Provides better results as a student</td>
</tr>
<tr>
<td>Overall I consider computers to be useful to me</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ATTITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like working with computers</td>
</tr>
<tr>
<td>Once on the computer I find it hard to stop</td>
</tr>
<tr>
<td>I would choose to use a computer in my spare time</td>
</tr>
<tr>
<td>I prefer to use a computer to write assignments</td>
</tr>
<tr>
<td>I would choose to use computers in my teaching</td>
</tr>
<tr>
<td>Overall I like using computers</td>
</tr>
</tbody>
</table>
## ANXIETY (FEELINGS)

<table>
<thead>
<tr>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am confident in the ability to do a course requiring computers</td>
<td>5.0</td>
</tr>
<tr>
<td>I feel at ease learning about computer technology</td>
<td>5.0</td>
</tr>
<tr>
<td>I am the type to do well with computer technology</td>
<td>4.0</td>
</tr>
<tr>
<td>The thought of using computers is not frightening</td>
<td>5.0</td>
</tr>
<tr>
<td>I do not feel threatened by the impact of computer technology</td>
<td>5.0</td>
</tr>
<tr>
<td>I am not worried about ‘breaking’ computers</td>
<td>6.0</td>
</tr>
<tr>
<td>I feel comfortable about my ability to use computers</td>
<td>5.0</td>
</tr>
<tr>
<td>Overall I don’t feel anxious about using computers</td>
<td>5.0</td>
</tr>
</tbody>
</table>

## LEARNING DEPENDENCY

<table>
<thead>
<tr>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>If there was no one around</td>
<td>4.0</td>
</tr>
<tr>
<td>If I only had manuals</td>
<td>5.0</td>
</tr>
<tr>
<td>If I had observed someone beforehand</td>
<td>5.0</td>
</tr>
<tr>
<td>If I could call some one if I got stuck</td>
<td>6.0</td>
</tr>
<tr>
<td>If some one helped me get started</td>
<td>6.0</td>
</tr>
<tr>
<td>If I had lots of time</td>
<td>5.0</td>
</tr>
<tr>
<td>If I had built in help only</td>
<td>4.0</td>
</tr>
<tr>
<td>If some one showed me how to do it</td>
<td>6.0</td>
</tr>
<tr>
<td>If there was some one giving step-by—step instruction</td>
<td>7.0</td>
</tr>
</tbody>
</table>
## Appendix 22 - Computer Specific Learning Style Survey

Rank the following sentences with 4 = most like you
3 = second most like you
2 = third most like you
1 = least like you

For example…..

<table>
<thead>
<tr>
<th>1. When I learn:</th>
<th>3</th>
<th>I am happy</th>
<th>2</th>
<th>I am fast</th>
<th>1</th>
<th>I am logical</th>
<th>4</th>
<th>I am careful</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>1. When I learn a new computer skill:</th>
<th>I like to discuss my feelings about the learning situation</th>
<th>I like to watch and listen to others first</th>
<th>I like to think about the ideas presented</th>
<th>I like to jump straight in and have a go</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>2. I am most likely to successfully use a new computer program when:</th>
<th>I trust my hunches and feelings</th>
<th>I listen and watch carefully</th>
<th>I rely on logical thinking</th>
<th>I work hard</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>3. When I am encountered by a new and unfamiliar computer technology:</th>
<th>I have strong feelings and reactions</th>
<th>I am quiet and reserved</th>
<th>I try to reason things out</th>
<th>I am keen to try it out</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>4. I learn computer skills best by:</th>
<th>Feeling</th>
<th>Watching</th>
<th>Thinking</th>
<th>Doing</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>5. When a friend suggests I try out a new piece of software:</th>
<th>I am open to the new experience</th>
<th>I like to see how they use it first</th>
<th>I like to analyse how the software would be useful</th>
<th>I like to try things out first</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>6. When I am learning a new computer program:</th>
<th>I am an intuitive person</th>
<th>I am an observing person</th>
<th>I am a logical person</th>
<th>I am an active person</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>7. I learn computer skills best from:</th>
<th>Being reassured and helped by my friends and family</th>
<th>Observing others</th>
<th>Thinking through what needs to happen</th>
<th>Trying it out and practicing it</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>8. When I attend a tutorial/training session on computers:</th>
<th>I like to feel personally involved in things</th>
<th>I like to take my time watching others before acting</th>
<th>I like be exposed to ideas and theories</th>
<th>I like to see results from my work</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>9. I am most successful in my computer skills learning when:</th>
<th>I rely on my feelings</th>
<th>I rely on my observations</th>
<th>I rely on my ideas</th>
<th>I can try things out for myself</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>10. People teaching me to use computers would perceive me to be:</th>
<th>An accepting person</th>
<th>A reserved person</th>
<th>A rational person</th>
<th>A responsible person</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>11. When I learn a new program:</th>
<th>I get involved</th>
<th>I like to observe</th>
<th>I evaluate things</th>
<th>I like to be active</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>12. I learn computer skills best when:</th>
<th>I am receptive and open-minded</th>
<th>I am careful</th>
<th>I analyse ideas</th>
<th>I am practical</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>TOTAL the scores in each column</th>
<th>TOTAL</th>
<th>TOTAL</th>
<th>TOTAL</th>
<th>TOTAL</th>
</tr>
</thead>
</table>

The four columns that you have just totalled relate to the four learning styles….
Appendices

Appendix 23 - Responses on General and Computer Specific Learning Style Survey

Complete data were obtained from nine of the thirteen students; the remaining four students missed one, or both surveys, or chose not to submit them to me.

<table>
<thead>
<tr>
<th>NAME</th>
<th>General</th>
<th>Computer Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CONCRETE EXPER.</td>
<td>REFLECTIVE OBSERV'N</td>
</tr>
<tr>
<td>Katy</td>
<td>20</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>(-2)</td>
<td>(+13)</td>
</tr>
<tr>
<td>Peter</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>(-2)</td>
<td>(+15)</td>
</tr>
<tr>
<td>Gary</td>
<td>43</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>(-12)</td>
<td>(+9)</td>
</tr>
<tr>
<td>Catherine</td>
<td>31</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>(-9)</td>
<td>(+6)</td>
</tr>
<tr>
<td>Bradley</td>
<td>33</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>(-2)</td>
<td>(+2)</td>
</tr>
<tr>
<td>Sally</td>
<td>30</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>(+1)</td>
<td>(+13)</td>
</tr>
<tr>
<td>Matt</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>(-5)</td>
<td>(+1)</td>
</tr>
<tr>
<td>Sharon</td>
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<td>41</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>(-4)</td>
<td>(-2)</td>
</tr>
<tr>
<td>Sandra</td>
<td>26</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(+6)</td>
</tr>
<tr>
<td>Mean Change</td>
<td>-3.9</td>
<td>+7</td>
</tr>
</tbody>
</table>
Appendix 24 - Unit CD-ROMS
Appendix 25 - Introduction to Teaching Model