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Edited by Bill Cope and Mary Kalantzis

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ABSTRACT
As Information Technology (IT) gains greater integration into the teaching and learning processes within all levels of education the capability of both teachers and students to embrace this ever-changing technology becomes essential. Traditional "training" approaches in relation to IT have tended to emphasise competency in specific computer skills. It is argued that a capability-based, rather than competency-based, approach to computer education may provide more significant and empowering learning outcomes for students. An action research project is reported which is investigating the effect of a metacognitive approach to learning and teaching on the self-efficacy and learning capability of students. Several cohorts of teacher-education students were prompted to reflect on a range of teaching and learning contexts and reflect on the benefits and disadvantages of these approaches for themselves as learners. In this paper a focus is placed on the various teaching approaches which have been employed and it is illustrated that this reflective, metacognitive approach can assist learners to become more capable, independent, lifelong computer learners.

BIONOTE
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Capability versus Competency in Information Technology Education: Challenging the Learning Context for Lifelong Technological Literacy

Renata Phelps, Southern Cross University

Introduction

All of us, I am sure, can think of someone whom we consider to be an excellent computer user. Perhaps it is a friend, fellow student or family member... perhaps you are someone who considers yourself to be a good computer user, someone whom other people are also likely to view this way. Even so, you probably can think of someone similar to yourself or of an even higher skill level. It is interesting to reflect upon the personal characteristics and learning approaches adopted by such individuals.

Another interesting source of reflection is to compare the patterns of computer learning adopted by children and adults. Anyone who has watched young children use computers will have at some stage remarked on the ease with which children adapt to information technology. Many adults however, struggle and their confidence continues to plummet as they watch others around them becoming more and more competent.

I have found it interesting throughout my career to observe and reflect upon different patterns of learning adopted by individuals in computer contexts. As an educator (or more accurately, learning facilitator) I believe that reflective practice is essential for both teachers *and* learners. This paper will describe a research project which is investigating the benefits of using reflection, and in particular metacognition, in developing more capable computer users.

The paper will open with a brief exploration of the notion of ‘computer literacy’, challenging competency-based approaches to computer education as dis-empowering individuals for life-long learning. The paper then goes on to describe current research which is utilising reflective and metacognitive learning and teaching approaches to develop capable computer users. In this paper a focus is placed on one particular aspect of this research project – the use of a variety of learning and teaching approaches to promote independent, life-long learning.

Computer Literacy: New Definitions and New Approaches for Changing Times

An examination of the literature surrounding ‘computer literacy’ reveals an ever-evolving and fluid conceptualisation of the nature of the term. Early literature emphasised the need for understanding hardware and programming (Higdon, 1995). At present the emphasis is application oriented, stressing skill development and competency in using particular programs (Oliver & Towers, 2000). This evolution has been brought about, to a large extent, by advances in end-user computer applications, decreasing hardware costs and increased infiltration of computer technology throughout society. As technologies become more transparent and ‘user friendly’ there has been less need to emphasise technical aspects in training and a greater need to emphasise effective and efficient utilisation in a range of contexts. The increasing adoption of the term ‘literacy’ in end-user computing contexts is interesting in itself and reflects the essential nature of computer skills in contemporary society (Oliver & Towers, 2000).

Education and ‘training’ for computer literacy have now become a significant component of education provision at compulsory and post-compulsory level. Competency-based training (CBT) approaches to computer education have been widely implemented throughout the Australian Vocational Education and Training (VET) sector, and now increasingly in tertiary and school sectors. Such CBT

approaches emphasise pre-specified objectives and the achievement of clearly specified and measurable skill levels (Corben & Dunn, 1999).

The notion of competency can be contrasted with that of capability, “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” (Cairns, 2000). Capability implies an individual’s confidence in their ability to function in both familiar and unfamiliar, changing settings (Australian Capability Network, 1996; Bawden, 2000; Cairns, 1996a, 1996b, 1997; Hase, Cairns & Malloch, 1998; Limerick & Cunningham, 1993; Price, 1996; Royal Society for the Encouragement of Arts Manufactures and Commerce, 1996; Stephenson, 1996). Capability-based approaches to learning and teaching thus gain greatest value in contexts of rapid change (Australian Capability Network, 1996; Stephenson, 1993), a feature, of course, of technology contexts. Adaptability to change and an emphasis on life-long learning are aspects seen as deficient in competency-based initiatives (Wildman, 1996).

Engagement with the capability-competency debate challenges notions of computer literacy. While competency-based teaching approaches emphasise attainment of specified computer skills, capability-based approaches emphasise adaptability and ‘learning how to learn’. While computer competency might be viewed as the ability to ‘use’ a particular program or to carry out particular computer-based tasks, computer capability might be seen as the ability to adapt to any computer context, to learn new computer programs relatively independently, to change from one computer platform to another or one program to another, and to apply one’s skills to meet the demands of new and unfamiliar contexts.

While competency-based approaches to ‘training’ certainly have their place in computer education contexts, it is argued that such approaches have limited long-term viability in meeting the needs of workplaces, organisations and society

in general (Phelps, Ellis & Hase, 2001). Computer capability is much more to do with an approach to learning and working than simply a set of technological skills (Loveless, 1995).

How then do we develop capable computer users? In this paper I present my own reflections and those of my students in relation to this very question. I begin with presenting some experiences and reflections which brought me to a formal action-research based investigation of this very issue.

Reflection as Impetus for Changing Teaching Practice

Over the past several years I have been involved in teaching undergraduate students computer skills. Many of the students I was in contact with had never used a computer before - some were highly motivated and excited, others highly reticent and anxious. I began by teaching students using the methods I had seen used by other ‘teachers’ and ‘trainers’ and the methods which students seemed to ‘expect’. I utilised highly directive step-by-step approaches in a competency-based framework.

After each week's tutorials my mind was continually drawn to the difficulties I had seen my students, and particularly the most beginner students, encounter. Some students struggled to write down each step as I talked them through the processes, despite the fact that they were provided with fairly comprehensive print-based resources. Others struggled to keep up with the pace of the group, panicking when they fell behind a step. 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. And despite significant emphasis on its importance, many students did not engage in any follow-up practice.

The teaching approaches I was using, and the learning approaches which many of my students were adopting, bore little resemblance to the learning approaches which I observed ‘capable’ computer users employing. As alluded to in the introduction to this paper, capable computer users tend to learn independently through self-directed learning, experimentation, trial and error, exploring and ‘playing around’. They have the confidence to try new things and are not afraid to make mistakes. They are enthusiastic and motivated and enjoy using computers regularly (Phelps, Ellis and Hase, 2001). Many of these learning approaches (which were identified and documented formally through the subsequent research) were far from the teaching and learning approaches being employed by myself and other computer ‘trainers’.

I became increasingly self-critical of my teaching practice and realised that the approach I was assuming was antithetical to my beliefs about adult education. I was strongly committed to self-directed, learner-managed and life-long learning philosophies (Brookfield, 1984; Brookfield, 1986; Candy, 1990; Graves, 1993; Knowles, 1970; Knowles, 1990; Smith, 1982); however, the teaching approach I was employing was, I believed, reinforcing learner dependency. Although I did not believe my teaching approaches were appropriate they did seem to be what many of the students expected, wanted and appreciated. Many of the students just wanted to be told what to do and expected me as a teacher to be able to deliver "all there was to know". This challenged me to reflect on how I could transform my teaching approaches to better foster ‘capable’ computer users.

Metacognition and the ‘Expert Learner’

A connection can be drawn between the notion of ‘capability’ and that of the ‘expert learner’ as discussed by Ertmer and Newby (1996). By way of definition they 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" (Ertmer & Newby, 1996, p.1). By way of further explanation they continue that:

> 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).

Expert learners are those who are aware of the knowledge and skills they do or do not possess and use appropriate strategies to actively implement or acquire them. They are thus self-directed and goal-oriented (Ertmer & Newby, 1996). Central to the notion of the 'expert learner' is metacognition. The term 'metacognition' appears to have emerged from the early work of Flavell who referred to it as knowledge concerning one's own cognitive processes and products or anything related to them (Flavell, 1976; Flavell, Miller & Miller, 1993). Biggs also discusses the role of metacognition in learning, utilising the term 'metalearning' to define the application of metacognition to student learning (Biggs, 1985). More particularly, Biggs defines metalearning as students' awareness of their learning and control over their strategy selection and deployment (Biggs, 1985, p.192). The metalearner is one who is aware of his/her motives, task demands and personal cognitive resources and exerts control over strategies used (Biggs, 1988, p.127).

In contexts of rapid change, such as in computer contexts, expert or 'capable' learners' metacognitive strategies provide distinct advantages, and may in fact be more important than skills themselves. Thus, teaching approaches which can assist students to become 'expert learners' are more likely to empower them for life-long learning in turbulent and rapidly changing contexts, such as those involving computer technology. I thus resolved to investigate whether the use of

metacognitive approaches to computer learning and teaching could help develop more ‘capable’ computer users.

The Research Context

In 1999 I became involved with teaching a Unit designed to provide pre-service teacher education students with information technology skills. This Unit is a core in both the Bachelor of Education (Primary) and Diploma of Education (Secondary) degrees. The student base included a wide range of people, many without strong IT backgrounds or any significant interest in computing. Some students had rarely used a computer at all, while others were quite experienced.

As future teachers themselves it was critical that these students developed the ability to engage with new and emerging software and hardware in creative and imaginative ways. While there were certainly some core skills that might be considered essential for this group, these future teachers needed to be prepared for a changing and unknown future technological context. This Unit and its student group thus provided an excellent opportunity to investigate ways of assisting individuals to develop sustainable and life-long learning approaches toward computers – in other words an opportunity for investigating methods of developing ‘capable’ computer users.

Action research was seen as an appropriate methodology given its focus on change processes, participation and reflection. This paper focuses specifically on the second research cycle of the authors’ research conducted in Semester 2, 2000 with a group of 179 students from the Bachelor of Education (Primary) and Diploma of Education (Secondary) degrees at Southern Cross University.

The Research Approach: Challenging Learners through Metacognitive Reflection

The Unit was designed within a reflective learning context and encompassed a wide range of learning and teaching opportunities, encouraging students to engage with, and reflect upon, different learning strategies. Students were required to keep a journal which documented their reflections throughout the semester. This journal data, with the permission of the students, informed the wider research project and shaped further refinement of the teaching approaches for the next intake of students.

The Unit is presented as a flexible learning resource incorporating a fully self-contained online learning resource supplemented with optional tutorials. A major component of the Unit is a “Thinking” Module where students are presented with a body of theory and literature surrounding computer learning and use, and are encouraged to reflect on their own cognitive approaches to computers and their past and present learning processes. The Unit introduces students to the notion of computer ‘capability’ and students are prompted to reflect on individuals whom they would consider to be ‘capable’ and in particular what learning strategies these individuals employ (Phelps, Ellis & Hase, 2001). Other specific theories encompassed include social-cognitive theory (self-efficacy), attribution theory, Kolb’s learning styles and the notion of ‘play’ (Phelps, Hase & Ellis, 2001). Social-cognitive and attribution theories were also presented through a self-assessment survey. Based on existing instruments, this survey was used not simply to gather data from the students but to prompt their own reflection on the influences on their learning. Students completed this survey at the beginning of the semester and then used their responses to the survey as a source of reflection while learning more about the theories. Students were again asked to complete the survey at the completion of the Unit so that they might observe changes in their own self-efficacy and attribution, and so that pre- and post-semester data might be analysed.

Students were provided with maximum flexibility in terms of the learning approaches they could pursue and were encouraged to ‘experiment’ with a range of learning contexts. For instance, a different teaching approach was employed in each of the tutorial sessions and students were prompted to reflect on these approaches in terms of short and long term learning outcomes. Teaching approaches included observation (data projection), verbal directions, exploratory learning (play) and cognitive modelling. Additionally, students are encouraged to pursue individual and small group approaches in working with the self-directed learning resources. The structure of the Unit and the implementation of these teaching approaches are represented in Figure 1.

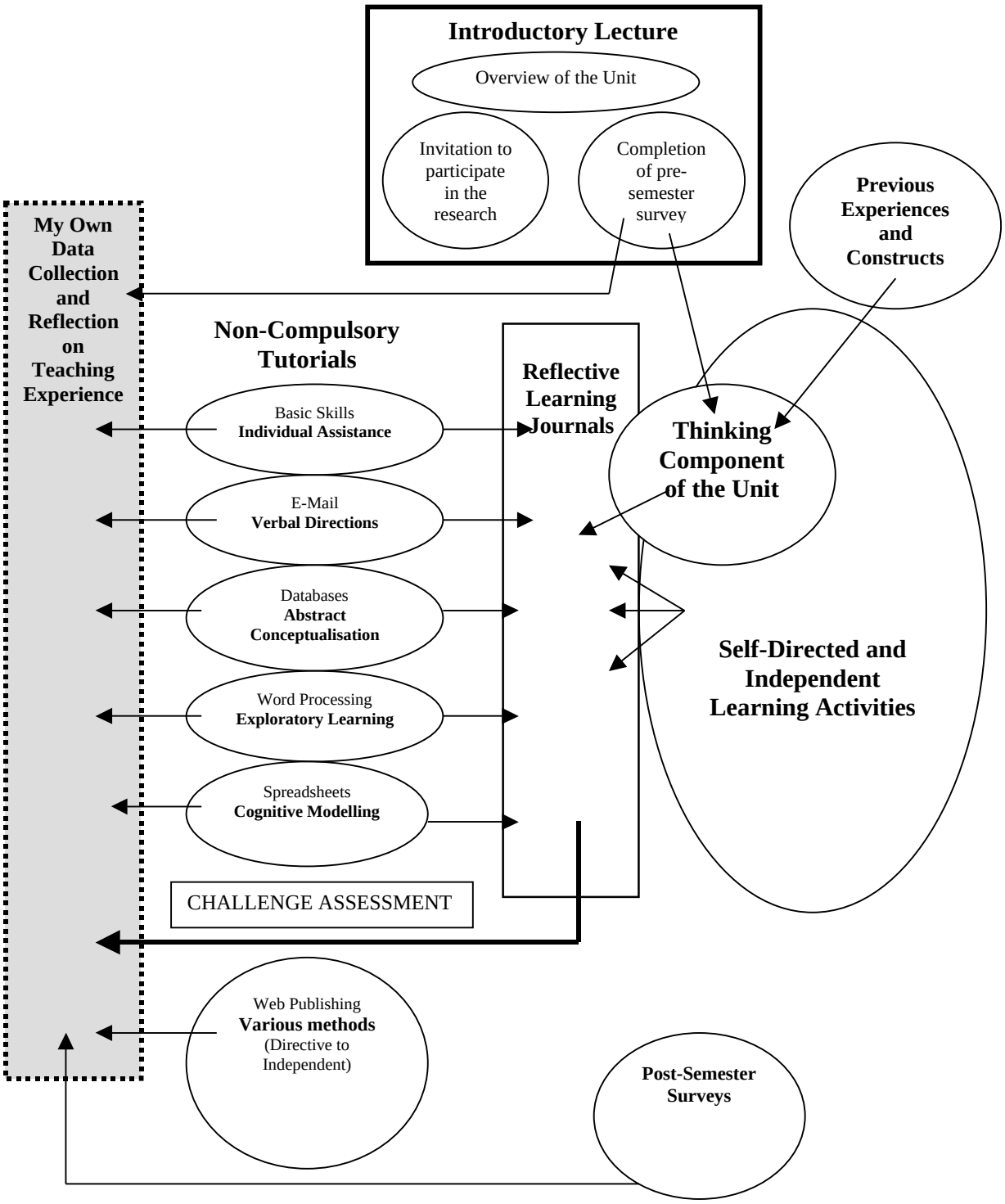
It is beyond the scope of this paper to detail the full findings of the research thus far and other aspects of the research have been presented elsewhere (Phelps, Ellis & Hase, 2001; Phelps, Hase & Ellis, 2001). This paper will focus specifically on the various teaching approaches which were employed during Semester 2, 2000 and students’ evaluations and reflections on these methods.

Data on each of the teaching methods was obtained through three sources:

- a structured evaluation sheet completed by students at the end of each tutorial;
- reflections expressed by students via their reflective journals; and
- my own reflections as a tutor.

This data is illustrative of the potential of metacognitive learning and teaching approaches in fostering computer capability.

Figure 1: Structure of the Unit Educational Information Technology



The Teaching Methods

Due to the circumstances of scheduling for the Unit in this particular semester it was only possible to employ and evaluate four teaching strategies; however the four approaches were quite diverse and ranged from highly directive to non-directive. The approaches employed are summarised in Figure 2.

Table 2: Summary of Teaching Approaches employed

Topic covered	Teaching Approach used	Details of Techniques
E-Mail	Verbal Directions	· Highly directive, step-by-step instruction · Basic then advanced concepts
Databases	Observation and Abstract Conceptualisation	· Use of metaphor · Data projection · Emphasis of basic concepts and terminology · Fully 'hands-off' · Online 'quiz' as revision.
Spread-sheets	Cognitive Modelling	· '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 · Students replicate on own computer
Word Process-ing	Exploratory Learning	· Strategies for exploratory learning were presented including use of icons, menus, defining goals and using 'help' · Task cards provided at basic, intermediate and advanced level · Students worked independently or in pairs · One-on-one assistance as needed but fostering 'problem solving' techniques.

Students were asked to complete an evaluation of each teaching approach at the end of the tutorial, responding to questions relating to the ease of each approach, the success of the approach in developing their specific and general computer skills as well as its influence on their overall computer confidence. Students were also asked to indicate whether they would pursue the learning/teaching approach in their future professional development and whether they would use the approach in their own teaching. Quantitative responses to the evaluation survey are summarised in Figure 3. This data indicates students' preferences for hands-on learning, but beyond this did not differentiate significantly between directive and non-directive approaches.

Following the tutorial, students were also asked to continue to reflect on the learning approaches and to document their reflections in their journals. This journal data, together with my own reflections as a teacher, provide a far richer impression of various strengths and weaknesses of each teaching approach and their influence on developing more 'capable' computer users. Through this deeper reflective data greater distinction could be drawn between the teaching methods and students' reactions to them. This reflective feedback is summarised in the following sections.

Table 3: Summary of Evaluation of Teaching Approaches

Median Response				
	Observation/ Abstract Concept.	Verbal Directions	Exploratory Learning	Cognitive Modelling
	N=85	N=72	N=77	N=57
Ease of Use: 1=easy and 7= difficult.	3	2	3	3
Specific Computer Skills: 1= No improv'nt; 7= Signif. improv'nt	4	5	5	6
General Computer Skills: 1= No improv'nt; 7= Signif. improv'nt	4	5	5	5
Increasing General confidence: 1= No improv'nt; 7= Signif. improv'nt	4	5	5	5
Percentage indicating this method would work for Ongoing Development:	62%	93%	94%.	82%
Percentage indicating that they would use this approach in their own Teaching:	74%	90%	94%	84%

Verbal Directions

This was the teaching method which was the most "comfortable" or familiar for me as it is the approach that most "trainers" use - and that which I have used most myself in the past. The method might be considered as a “tried and true” teaching approach, but as such perhaps, a little unchallenged. Implementing and evaluating it within a reflective framework revealed its various strengths and weaknesses.

The major advantages of this approach, from my own and students’ reflections could be considered as:

- The “hands-on” nature, seen by students as a ‘personal preference’;
- The ability to cover a set body of content and to sequence appropriately;
- Students pick up skills which they did not know that they lacked, for instance short cuts; and
- Students are ‘familiar’ with the approach.

The major disadvantages of this approach, were revealed as:

- Pacing is very difficult to cater for everyone’s learning;
- Teacher-centredness means it is difficult to stop and assist individuals;
- Inability to cater for all skill levels; and
- Individuals can become highly frustrated if things go wrong and it is not possible to stop and assist.

Interestingly there were quite contrary feelings expressed in reflective journals regarding the ability to seek support through this learning method. For instance, while one student stated that if you get stuck or lost it was easy to confront the teacher and fix up the problem; others expressed reluctance to “ask the teacher to repeat direction for fear of looking stupid” (Student 79).

While this method definitely seemed to work well for students with less developed skills it presented challenges in meeting multiple needs and for some students

greatly undermined their computer self-efficacy by emphasising their ability to "keep up" with others.

Observation and Abstract Conceptualisation

My initial thoughts about observation and abstract conceptualisation were that this would be the simplest and most appropriate method for the content area (i.e. databases). In implementing this approach I hoped to prompt students to consider learning approaches which generalised concepts across programs and contexts, hence promoting the concept of adaptability versus specificity – capability versus competency.

This approach, more than any other, evoked a vastly divergent response from students. Those students who responded positively generally felt it was a good introduction to the topic area, commenting on its visual nature, the ease of following steps, the opportunity for questions, the benefits of examples and their familiarity with learning in this way. Some students were able to relate to the benefits of developing generalised concepts:

> The rationale for not locking into the step-by-step of a specific commercially available database system made sense to me, as understanding the general processes of building a database is less limiting…. An analogy helps – in my own experience of microwaves, they all arrive at the same point (cooked food) but the process of getting to this point differs from each microwave brand (Student 28).

Many students, however, commented that while it was a good method, it needed to be followed up by a 'hands on' sessions.

Statistical analysis of the evaluation results did not seem to adequately reflect the strengths of the negative comments on the evaluation forms, and certainly those later read in the journals. In fact I was quite shocked by some responses in the journals which indicated a strength of dissent among a small number of

individuals (or small groups). A couple of students spoke of whispers in the corridors that the tutorial was a complete waste of time. Those students who did not react positively to this method overwhelmingly stated that they needed to learn "hands-on". Others noted that they felt it was "boring and far too distracting". One student noted that the pace was too slow, another that explanations were not always clear and that the examples were difficult to follow. Other comments related to the visibility of the projected computer screen.

It was also interesting to read the post-tutorial reflections of students in terms of recall. Most stated that they didn't feel that they learnt much, and would not now know how to use or set up a database; "…in retrospect I realised that I have almost no visual recall of the screen because I had not interacted with the information. I understood in theory but was not sure I could use the information in practice" (Student 105).

Again in reflection I have to emphasise that I still believed that the principles of generalising the learning which lay behind this approach were highly valuable. Despite the lack of success of the teaching method I felt that it was critical to prompt reflection on the generalisability of computer skills. However it is highly evident that the non hands-on approach did not succeed. A question which arose for me and which will be pursued in subsequent cycles, is whether the "hands-on" actually needs to be *with* computers, or whether it can be with paper and pen or other more "active" forms of abstract conceptualisation.

Cognitive Modelling

For me, as a teacher, cognitive modelling proved to be a disappointing initial experience. I had high expectations of what I wanted the lesson to achieve. I wanted to emphasise my thought processes, illustrate how I dealt with errors or worked through problems. However, in reality, this was far more difficult to achieve then I had initially thought. In terms of presenting the scenario and

context, this was easy to achieve. The “teacher recording class marks” was an easy one to keep in my imagination and one that the students could all relate to. However as the lessons progressed I felt that I was achieving little more than the directive approach in an imaginative context. There *were* some wonderful moments embedded within the lessons… moments primarily when something went awry and I needed to problem-solve – moments when I realised I had forgotten to “save” or when a “colleague” (a student) showed me a new way of achieving something. However, overall, I felt greatly disappointed and felt that the students just would not understand the strategy being implemented.

Their evaluation forms revealed that students were not as negative about the approach as I thought they would be. Those negative comments which were received were similar to those made on the verbal directions tutorial (further reinforcing the similarities). These included pace and frustration caused through explanations to individual students. However, overall, students were quite positive. Several students for instance noted the benefits of the practical and meaningful context which made it motivating and “easy to remember the skills”. Students commented that they received a sense of “all discovering together” and that the approach provided “a good platform from which we can teach ourselves”. One student noted that it enhanced her confidence to explore on her own. Another pointed out that it made use of “errors as a way to learn”. Such comments point to the metacognitive benefits of the approach: “I think the thing that impressed me so much about (cognitive modelling) was that 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).

On reflection the overall strategy has a lot to offer but practice and further investigation and evaluation is required to refine the teaching approach.

Exploratory Learning

Exploratory learning had, I felt, the greatest potential for providing longer-term benefits for students. I was, however, concerned about students' possible reactions, principally whether they would feel like they were being "thrown in at the deep end", that it was too hard or that they were not getting "value" from me as a tutor.

Surprisingly, students were in fact highly positive about the approach. Positive comments regarding this approach generally related to such things as:

- the ability to learn at your own pace, and select those tasks which you want or need to learn;
- personal enjoyment of self-directed independent learning;
- the relaxed and fun atmosphere;
- the ability to interact and seek assistance from peers and tutor;
- resultant increased confidence and motivation.

A major benefit of the approach was the ability of students to choose the level (basic, intermediate or advanced) they felt most comfortable with. All students were gaining new skills and this was highly visible as each student was only working on the things they *couldn't* do, rather than going over things they could do. It was great to see students helping each other and interacting when they felt they needed assistance.

Students began to engage in significant self-reflection and many expressed metacognitive insights which indicated the potential of this exploratory approach in prompting personal change in learning approaches. Students began to realise the value of 'trial and error' and reflected that they were involved in 'deeper learning'. Some commented that "because you discovered how to do it yourself you are more likely to retain it". One student noted that they felt 'in control'. A couple of students commented that this was how they did all their computer skills learning. Students also became aware of the value of co-operative and collegial learning while realising the benefits of trying to do something themselves before

asking for assistance. Students recognised that the approach was fostering independence and empowering learners, as well as catered for individual abilities and learning styles. Several commented that they could ask questions without holding up others. As one student noted the method was "… 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... Later I realised that I now had increased confidence in my ability to cover the goals/tasks myself. " (Student 28).

Those few students who did *not* react positively to this method commented that "if you have no idea what you're doing you spend ages working it out" or that it was "hit and miss guesswork", or that they tended to "get off the beaten track".

Discussion: Reflection on Teaching Methods as Insight into Learning

The vast majority of students were interested in, and supportive of, the experimental approach taken to the Unit. As future teachers themselves, they saw value in reflecting on different learning and teaching approaches and for many, the experiences prompted significant self-realisations about their own learning.

Comments made by a small number of students who were confronted (almost antagonised) by the abstract conceptualisation and exploratory learning approaches reinforce concerns regarding the tendency of traditional 'training' contexts to reinforce dependency. Discussions with two such individuals revealed their expectations that a course of study should (or could) "teach" them all they needed to know about computers. These students would not have considered the Unit's approach to have been beneficial or successful. However the discussion which was prompted through their dissent may have prompted some reflection

for these students regarding their own expectations of learning and teaching contexts.

Comments made by a more significant number of students, however, do reinforce 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 reached the realisation that they *could* learn computer skills independently. This is well expressed by one students who stated that:

> 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 actually 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 actually learnt – have a go and you will learn things that you would never had known if someone had taught you (Student 97).

Such realisations are likely to have a significant impact not only on themselves as learners but on their own students as they become future teachers. As one student 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 gained heart that my teaching in this action learning cycle was beginning to break down patterns of dependency for students. I felt that many students' comments were indicating that they were moving along pathways toward lifelong and independent learning. This was most 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).

Conclusion

Concepts of capability (as opposed to competency) and the construct of the 'expert learner' provide an innovative foundation for end-user computer education. The value of metacognitive approaches to end-user computer education is supported by the early findings of this research. In experimenting with, and reflecting on, various learning and teaching approaches students are more likely to challenge themselves to adopt learning approaches which are applicable for life-long learning.

The factor which would seem to limit the success of this metacognitive approach most is the individual's capacity and motivation for experimentation and reflection. Further research is aiming to refine the teaching approach and better understand individuals' reactions to these approaches to determine if metacognitive teaching approaches can provide empowerment to a greater proportion of individuals.

This research has wider implications for tertiary education contexts, organisations and professional bodies. It suggests that careful consideration needs to be given to the type of computer 'training' being offered. Competency based and directive approaches may produce sound short-term outcomes; however, in the longer

term, may reinforce dependency of individuals on ongoing training and support. Metacognitively-based learning contexts may, however, represent a better long-term investment.

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