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Promoting metacognitive regulation through an on-line environment

Mark McMahon
Edith Cowan University

Edith Cowan University

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Mark McMahon

BA (Hons), Grad. Dip, Ed., Grad. Cert. Comp. Based Inst. Des., M. Ed.

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Abstract

The constantly evolving world of work is causing a great deal of emphasis on the need for graduating students to demonstrate a range of generic skills to enable them to be both employable and able to adapt easily to new requirements. However, research indicates that secondary schooling is not preparing students adequately for learning independently.

This study sought to explore strategies for developing and supporting the metacognitive skills of higher education students. In particular, it sought to explore how university students' cognitive self-regulation could be supported in an on-line environment designed to engage them in the self-monitoring integral to metacognitive development. The field of self-regulation and metacognition was explored through a literature review leading to the articulation of an instructional model for metacognitive development. This model was used as the basis for the design of an on-line environment, Mark-UP, that had students annotate and transform text-based readings to engage them in the monitoring processes that are integral to metacognitive regulation within the domain of reading comprehension.

An inquiry was undertaken in the form of design-based research. A product was designed, developed, and trialed. The methodology, a form of action research, involved the exploration of two aims. One aim was narrow and focused on the usability of the product and the value subjects placed on it. The second aim sought to explore how the product engaged learners in monitoring their learning. There were 126 subjects participated in the research. Data was gathered in the forms of a questionnaire about subjects' self-perceptions as self-regulating and their attitudes to Mark-UP, interviews with 12 subjects, and subjects' portfolios of work developed as they used the product. Data was interpreted through a constant comparative approach to develop understandings about how subjects used the product and its value as an environment to promote the planning, monitoring, and evaluation within cognitive self-monitoring.

Findings revealed that Mark-UP was an effective means of engaging subjects in the processes of metacognitive planning, monitoring, and evaluation. However, the experience of using Mark-UP was not the same for all subjects and differences were found in outcomes among the diverse range of subjects. The research provided the basis for the formulation of guidelines for

future implementations of the product and for further research into metacognitive regulation. Some refinements to the interface of Mark-UP are proposed as well as suggestions for further exploration into the area of metacognitive regulation of learning are made.

Specifically Mark-UP was found to be most valuable for learners who are metacognitively moderate rather than those who might be weak or strong. The findings suggested that flexibility is needed to provide an adequate level of scaffolding for weaker learners while allowing metacognitively stronger students the opportunity to practice existing regulatory strategies. It was also found that the cyclical process of planning, monitoring, and evaluation is an ongoing one that requires learning environments to provide regular feedback to stimulate these processes.

The study found that the affective components of self-regulation are integral to the development of metacognitive regulation, leading to the conclusion that future environments to develop metacognition should incorporate elements to meet learners' needs with regard to self-concept, motivation, and the development of volitional strategies.

Declaration

I certify that this thesis does not, to the best of my knowledge and belief:

(i) incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education;

(ii) contain any material previously published or written by another person except where due reference is made in the text; or

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2 February 2005

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

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Finally, this thesis is dedicated to my children, Elizabeth and Declan, who are a constant and tangible reminder to me of what is really important in life.

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1 The Importance of Metacognitive Regulation of Learning

1.1 Introduction

With the rapid growth of interactive technologies and on-line learning, there is a consistent demand for graduating students to have the ability to continually upgrade their skills and knowledge through their own self-motivation and learning skills (ANTA, 1998; Australian Chamber of Commerce and Industry & Business Council of Australia, 2002; Bennet, Dunne, & Carre, 1999; Candy, Crebert, & O'Leary, 1994; Livingston & Wirt, 2004; Mayer, 1992). An important means of achieving this goal is to help students take more responsibility for managing their own learning by helping them become more strategic learners. Biggs (1999) argues that there are limits to what some students can achieve and these are beyond the teacher's control. However many claim that such skills *can* be taught, that while they may be developmentally based, the fostering of general skills still requires proactive involvement and strategy (e.g. Zimmerman, 1989). The challenge for educators then is to find teaching and learning methods that can support the generation of lifelong learning skills that are relevant to a wide variety of professional contexts.

This thesis proposes an approach to meeting this challenge that involves an e-learning environment to promote cognitive processes inherent in metacognitive regulation of learning. The purpose of this chapter is to explore:

- the nature of generic skills and their importance to higher education;
- the nature of current undergraduate students with regard to their expectations of learning as well as readiness to engage in independent learning; and
- the evolving role of universities as institutions to support the needs of student learning through flexible, technology-based approaches.

It then proposes a series of aims that were used to guide an inquiry into an e-learning environment designed to meet these needs.

1.1.1 A focus on generic skills

The world of work is evolving and the tradition of a job for life has little relevance to current university graduates. As industries respond rapidly to advances in technology and workplace practices to maintain their competitive edge, the corresponding refocus on the nature of work means that not only will some jobs become obsolete but even those that will not are in a state of constant flux. Reich (1983) argues that we are now part of a post-industrial society and the work force of the future will have to be far more highly skilled and adaptable than the work force of the past. If one is to consider how the role of a printer for example has evolved from physically setting type to electronic pre-press, then the skills required have evolved just as the job itself has evolved.

These constant shifts in the nature of work and the relationship between professionals and clients mean that educational practice that focuses on narrow skills and particular practices does not serve contemporary students for the life of their careers (Bowdon & Marton, 1998).

Lambert (2002) cites a study by the Association of Graduate Recruiters conducted as early as 1995 which identified deficiencies in post-secondary education in meeting the needs of employees for the range of experiences, skills, qualities, and areas of knowledge required for entering the workplace. In particular, the 160 graduates surveyed described how higher education had not given them:

- self-confidence;
- ability to uncover hidden opportunities;
- decision-making abilities;
- networking skills;
- relevant experience; or
- knowledge of changes in the labour market. (Lambert, 2002)

Such skills are not necessarily tied to the curriculum of specific courses. In fact, a course designed to teach 'self-confidence' is unlikely to ever be offered in a university's handbook. They are skills that are typically 'common to more than one work site, more than one occupation or more than one field of knowledge' (National Board of Employment Education and Training, 1996, p. 17). Nevertheless, these are important general skills that are relevant to both work and broader life, and an increasing awareness of this importance means the concept of *generic skills* has been receiving widespread attention over the last few years.

The Business/Higher Education Roundtable (2003) recently produced a discussion booklet authored by several vice chancellors of Australian universities, which sought to specifically

address the issue of generic skills. The topic in Australia has become an important one as, 'generic skills and graduate attributes have emerged as vital issues for both educational institutions and the communities that they serve, including students, employers and governments' (Goldsworthy, 2003, p. 1). The nature of these skills themselves is varied but attention is being placed on embedding them as attributes into universities' curricula. The University of Queensland, for example, has defined the following categories as important graduate attributes:

- in-depth knowledge of the field of study;
- effective communication;
- independence and creativity;
- critical judgement; and
- ethical and social understanding. (Gardner, 2003)

Edith Cowan University is typical of most Australian universities and has graduate attributes integrated into its courses and units, with the following key concepts:

- enterprise, initiative and creativity;
- professional knowledge;
- service;
- workplace experience or applied competencies;
- awareness of political, social and ethical issues;
- communication;
- internationalisation / cross cultural awareness;
- problem solving / decision making;
- teamwork; and
- use of technology / information literacy. (Edith Cowan University, 2003)

While many of these attributes may be viewed as specific to certain contexts (such as professional knowledge), many of these attributes are quite general in nature. Skills such as problem solving, critical judgement, independence and creativity are very broad yet essential to a person's on-going professional development.

It is not only the higher education sector in Australia that is focusing on skills that make learners better learners, but the vocational sector too has embraced the concept of generic

skills. The Australian Chamber of Commerce and Industry & Business Council of Australia (2002) defines *employability* skills as:

> *skills required not only to gain employment, but also to progress within an enterprise so as to achieve one's potential and contribute successfully to enterprise strategic directions. Employability skills are also sometimes referred to as generic skills, capabilities or key competencies. (Australian Chamber of Commerce and Industry & Business Council of Australia, 2002, p. 3)*

Emphasised within these skills are skills related to self-management and learning to learn (Gibb & Curtin, 2004). With the acknowledgement of students' ability to learn independently and manage these learning processes, the development of generic skills is therefore a process that relies heavily on students' abilities to develop skills in a self-regulated way:

> *In this outlook education becomes closely linked to what strategies learners bring to the learning process themselves, derived from social experience, from pressures and opportunities they see and feel, from challenges they already experience in everyday life. As time progresses we may, I suggest, focus less on the skills which a learner can be taught, and more on the strategies a person needs to nurture and possess in their learning armoury. The key skill will be learners' ability to develop and expand their own learning strategies, to be more imaginative in working them out and using them, to make them more useful and effective. (Lambert, 2002)*

This self-development of learning strategies is something that obviously comes from the student, but needs to be nurtured within a learning setting. Whether students have such skills, however, and whether these are fostered by schools, colleges and universities however is a matter of debate.

1.1.2 A portrait of a contemporary undergraduate student

While many students do come to university with existing skills in teamwork, information literacy, critical thinking and so on, this is not true for the majority of students (Leamnson, 1999). Some contemporary research has identified the concept of 'millennial students'. These students born in or after 1982, can be characterised as having an information technology mindset, they prefer a group-based approach to study and social activities, they seek personal growth and development and are comfortable in pursuing multiple career paths (Howe & Strauss, 2000; Oblinger, 2003). This positive disposition, however, appears somewhat at odds with their actual skills and abilities. Nickerson (1998) argues, 'Just because we can all claim

to think does not mean that we can think as effectively as we might. A number of studies have shown deficits in adult thinking strategies' (Nisbett & Ross, 1980, p. 57).

This is born out by a number studies in universities in the USA. One recent study of American colleges found that 28 percent of entering students enrolled in remedial coursework (reading, writing, or mathematics) in fall 2000; 22 percent undertook remediation in mathematics, 14 percent in writing, and 11 percent in reading (Livingston & Wirt, 2004, p. 17). This perceived need for further grounding in the basics of learning is reinforced by the US Department of Education, which found:

> *Too many students reach college ill-prepared to succeed there. Opening up access to quality postsecondary education for all Americans requires a continued and intensified emphasis on preparation for college and stronger relationships between colleges and universities and K-12 schools. (US Department of Education, 2000)*

This lack of an effective link between secondary and post-secondary schooling is a cause of concern. Typically, schooling has not focused strongly on developing students' abilities to think for themselves:

> *Mass education was, from its inception, concerned with inculcating routine abilities: simple computation, reading predictable texts, reciting religious or civic codes. It did not take as goals for its students the ability to interpret unfamiliar texts, create material others would want and need to read, construct convincing arguments, develop original solutions to technical or social problems. (Resnick, 1987, p. 73)*

It is hardly surprising, therefore, that the transition to university is a difficult one, with McInnis, James and Hartley (2000) finding that a 'lack of information, poor course choice, unrealistic expectations of the amount of work and time involved in University study, were major concerns for first year students' (McInnis, James, & Hartley, 2000, p. xi).

The obvious place to address these issues would be in primary and secondary schooling itself: 'It is quite clear that improving access and success in college requires a continued push to improve the education students receive in their elementary and secondary schooling. This emphasizes quite clearly how closely linked K-12 and postsecondary education are.' (US Department of Education, 2000). However, to argue the need for preparation for university in earlier years is to ignore the plight of the current millennial students who are now entering post-secondary education without a strong set of existing generic skills. This group has already been 'processed' through secondary education and are expected to adjust very quickly to a learning environment characterised by limited contact hours with no direct supervision.

1.1.3 Technology, flexibility and the evolution of higher education

The importance of generic skills, and their integration into quality systems within universities, has already been noted. In fact, universities are now adjusting to a significant change in their role as educational institutions, that embraces generic skills, but also the broadening and commoditisation of education as a service industry in general. This has created a broader mix of students including more mature students, more women, more part-time students, modularisation of the curriculum, and greater flexibility of choice as well as a renewed focus on higher education's contribution to society's skill-base (Dunne, Bennett, & Carre, 2000).

This focus on flexibility has been one of the driving forces behind the move into on-line learning. One study in the USA found that between 2000 and 2001, 56 percent of all postsecondary institutions offered distance education courses (up from 34 percent 3 years earlier) and at the same time course enrolments increased from 1.7 million to 3.1 million (Livingston & Wirt, 2004, p. 18). In Australia, the concept of e-learning has been pioneered by a number of projects designed to promote both flexibility and access to education and training. One such innovation, the ANTA Flexible Learning Toolbox project, was a multi-million dollar initiative that took place over several years to create web-based learning 'toolboxes', which were designed to cover national training competencies in vocational training. The toolboxes consisted of on-line resources that were designed with modularity, reusability, and access in mind, with many projects addressing national priority areas such as indigenous issues, numeracy and literacy, and created with a view to enhance their flexibility and availability by their abilities to be components of a digital repository of learning resources (ANTA, 2004).

All of this is in line with the focus on technological literacy as an important generic skill. It also appears to meet students' increasing expectations for flexible learning:

> *Both Internet-savvy younger students and working adult students now demand integrated, comprehensive, and personalizable online self-service. That last phrase is long, but it embodies the purpose and function of a campus "portal" based on technology that provides authenticated access to a one-stop, Web-based service environment integrating a range of academic and administrative services and transactions. (Morrison & Graves, 2002)*

A great deal of research shows that this increasing flexibility and the impetus for the use of technology as a learning medium may have many learning benefits, particularly with regard to on-line learning, with studies as far back as the late 1980s touting its benefits to learners (Crook, 1994; Harasim, 1989; McAteer, Tolmie, Duffy, & Corbett, 1997). However, diligence

is needed when evaluating the role of new technologies and learning media. Clarke's seminal contention that media does not influence learning any more than a grocery or ice cream truck influences the quality of the product it delivers is still relevant (Clarke, 1994).

Simply placing students in modes of learning that are independent and involve technological literacy does not necessarily mean that these generic skills will be successfully acquired by the learner. Indeed, there may be severe disorientation for students when placed in modes of learning that require a significant level of self-regulation, and this therefore reinforces the need for an appropriate learning approach to underpin the mode of learning that is undertaken. While 'the Internet increases access to knowledge resources and further lubricates self-study, it does not eliminate the need for instructor mediation. It simply forces us to reconsider the form and substance of instructor mediation' (Morrison & Graves, 2002). Nevertheless, the potential of technology not only as a tool for learning, but also as a means of increasing productivity and efficiency of learning ensures the continuing role of on-line learning for higher education institutions (Laurillard, 1993).

Ultimately research relating to on-line learning as a means to provide for the needs of contemporary students with regard to the provision of flexibility and promotion of generic skills is mixed. One study sums up many of the issues:

> *The general finding from this study is that on-campus students are significantly more satisfied with the experience of studying on-campus than off-campus and that their satisfaction is associated with traditional elements of on-campus study such as regular and conveniently timetabled classes, face-to-face communication with teachers, and contact with other students. However, students are also shaping their own learning environments by participating in paid work while they study and, therefore, choosing to supplement class attendance with other study materials. This study found that the satisfaction of those in paid work was positively associated with being able to substitute some class time with DE materials. In addition, to supplementing their on-campus experience, students in some universities are able to enroll in off-campus units. Some do so to fit in with their work commitments and because they are attracted to this mode of study. In this situation, students are satisfied with off-campus study. However, the results of this study also suggest that when traditional on-campus students feel forced to enroll in off-campus units because of a university's resourcing decisions, their satisfaction is negatively affected. (Hagel & Shaw, 2003, p. 270)*

1.1.4 Summary

This introduction has identified the importance of generic skills to higher education and the broader world of work, and has discussed these in terms of student expectations of learning, and the evolving higher education system, particularly with its focus on flexible and technologically-assisted modes of course delivery.

As has been shown, many of the generic skills valued by employers relate to individuals' abilities to work independently and engage in cognitive processes that are broad enough to transfer across domains as the nature of work practices evolves. This self-regulation of learning is therefore a highly prized skill. In the end, students must be responsible for their own learning. After all, 'learning is not something that happens to students; it is something that happens by students,' (Zimmerman, 1989, p. 21). However, it is unreasonable to assume that students will be coming into a course with the skills to regulate their own learning. Boekaerts (1997) described formal schooling as 'outcome based practice sessions' with teachers as experts and students as novices. In more flexible approaches, as in on-line tertiary education, this paradigm is no longer appropriate. Students need to become protagonists in their learning process, using the Internet as a resource for their own learning goals.

Contemporary technologies appear to provide the potential for an approach to on-line learning that could be used to assist in the development of students' self-regulatory skills in order to bridge the gap between students' limited expectations and experiences upon enrolling, and the imperatives of higher education institutions with regard to flexibility, accessibility, and their need to produce graduates with a range of generic attributes.

1.2 A rationale for an environment to promote metacognitive regulation within a domain of learning

Care needs to be taken when attempting to define environments to support self-regulation, particularly technology-mediated learning experiences which by their very nature seem already to make demands on students' abilities to regulate their learning. There is a high drop-out rate for students with poor study skills when they venture on-line (Loomis, 2000). Brooks (1997, p. 135) claims that students 'who are poor at self regulation easily can be slaughtered in WWW-based courses'. This does not however acknowledge some of the main benefits of on-line learning – that it is an efficient and flexible environment for users to meet their own learning goals. Attempting to remodel on-line learning on a face-to-face paradigm would dilute these benefits. Perhaps most importantly, there is also a need to acknowledge that self-regulated learning is a desirable thing that is important to life as much as to school (Boekaerts,

1997). If an educator's role is to assist students in becoming better learners, then courses need to be designed not just to meet specific unit outcomes but also to scaffold the development of learner's self-regulatory skills. This student-centred focus, characteristic of contemporary educational philosophy, seeks to empower the learner rather than to 'teach' the learner through a traditional learning approach based on knowledge transfer (Jonassen & Land, 2000) and is a frequently cited focus of on-line learning, where students are expected to engage in academic texts with typically little or no direct instruction on their comprehension (Reeves & Reeves, 1997).

One important use of the Internet is as a means of accessing course readings, either in the form of Web pages or as electronic documents, such as PDF resources. It provides an efficient and maintainable means of dissemination. The approach of providing several electronic readings rather than a single text also promotes the multiple perspectives inherent in contemporary approaches to learning, such as those espoused in cognitive flexibility theory (Spiro, Feltovich, Jacobson, & Coulson, 1992). However, it is erroneous to assume that students entering tertiary education are able to engage effectively in readings in a self-regulated way. There is a difference between learning to read and reading to learn. Most students have little difficulty with the building blocks of reading such as phonics, but even by Year 12, studies have shown that only 40% of students can be identified as 'proficient' at the level of reading that involves engagement 'in higher level, problem solving literacy of the kind required in an information generating and information transforming economy' (Greenleaf, Schoenbach, Cziko, & Mueller, 2001, p. 83).

Reading comprehension itself can be classed as a generic skill. While the purpose of this study is not to attempt to promote reading comprehension skills per se, the metacognitive processes inherent in the task makes for a strong relationship to self-regulation:

> *The ability to read critically is widely regarded as one of the essential generic skills that should be gained through university education. It is often assumed that students will acquire the ability to read critically simply by virtue of studying at University without active intervention from their teachers. We aspire for our students to read with a critical eye in order to develop their own reasoned and ethical position. However, the reality is that students often read as passive consumers of information. (Wilson, Devereux, Macken-Horarik, & Trimingham-Jack, 2004, p. 341)*

Research has shown that metacognitive knowledge and self-regulation facilitate reading comprehension (Collins, Dickson, Simmons, & Kameenui, 2001) but this is an end-product rather than a process. One cannot assume that simply placing students in a mode of study that

requires self-regulation will help to promote it. Rather than throw students 'in at the deep end', mechanisms must be in place which bridge the nexus between supported and self-regulated learning.

Proactive measures need to be taken to assist students in developing the necessary skills to learn independently. This rationale provided impetus and direction for this thesis to explore ways of engaging students in activities that could assist in the development of self-regulatory skills, particularly with regard to the cognitive processes inherent in the task of reading comprehension. It would seem possible that an appropriately designed and implemented on-line environment could both minimise student disorientation in new forms of learning, while maximising the opportunities associated with the flexibility afforded by on-line technologies and their potential to have learners engage in tasks in self-directed ways. It should be noted that such an on-line environment would not be a replacement for face-to-face learning:

> *Accepting the challenge and embracing these forms of delivery and assessment as a replacement of traditional methods is not always appropriate. Instead, the findings suggest that these approaches offer real benefits to some students in particular situations and therefore should be viewed as worthwhile supplements to offer all students more flexibility and the opportunity to enhance their tertiary education experience by encouraging and supporting self-directed and independent learning skills. (Kehoe, Tennent, & Windeknecht, 2004, p. 55)*

Such a product would not have a role purely in distance education, but would have potential for all students who may be grappling with engaging in reading concepts and where an on-line component can be integrated to support students' developing skills as self-regulating learners.

1.3 Research Aims

The overarching goal of this research was to explore how cognitive self-regulation could be supported within an on-line learning environment. The study had two main aims:

1. To explore how students use an on-line learning environment designed as an instantiation of a model for facilitating cognitive self-regulation of reading comprehension; and
2. To explore the forms of self-monitoring that take place when students use this as an environment to support cognitive self-regulation.

To support these aims, the following steps were undertaken:

- a literature review of self-regulation and metacognition was carried out to identify the salient aspects of the research field;
- a model of metacognitive regulation was developed to provide the basis of research;
- the understandings developed from this and from a broad review of educational theory were used to propose a model for facilitating the cognitive processes necessary for self-regulation;
- an on-line environment that embodied the proposed learning model was designed, developed and implemented within a domain of study; and
- the value of the product both in terms of its inherent worth and its ability to support the processes inherent in the proposed model of cognitive self-regulation was investigated.

The thesis is based around the design, development and implementation of an on-line learning environment called Mark-UP that was created to support students' understandings of text-based readings. The design of the product was informed by a literature review and the development of a conceptual framework and design model to support metacognitive processing. The product was implemented with a cohort of undergraduates studying interface and information design at an Australian university. Subjects were required to engage in readings around a topic. This process was facilitated through an on-line environment that supported various activities involved in reading comprehension, such as discussion, finding extra sources, annotation, summarising and so on. These activities were framed within the cognitive processes inherent in self-regulation such as planning, monitoring and evaluation. Learning support was provided for these activities and processes that was faded over time to promote independent use.

Findings are reported in a series of chapters that focus on each of the main stages of the research. The thesis, therefore is organised around the following structure:

Chapter 2: Literature Review and Development of a Conceptual Framework

The literature concerning self-regulation and metacognition is explored to develop a model of cognitive self-regulation that could then be applied to the domain of reading comprehension as an instructional model to inform the design of the on-line setting, Mark-UP.

Chapter 3: Design and Development of Mark-UP

This chapter describes the process undertaken during the development of Mark-UP. It includes a design rationale, exploration of appropriate technologies, and a description of the

prototyping and development process. The chapter concludes with a detailed description of the design and functionality of the version of Mark-UP to be implemented in the research.

Chapter 4: Methodology

This chapter examines relevant research methods for conducting research into metacognition and e-learning environments. Research questions are defined to support the aims of the study, and the methodology of design-based research to be implemented is described along with a rationale for the approach taken to data gathering and analysis.

Chapter 5: Findings Relating to how Subjects Use Mark-UP to Annotate Readings and Solve Problems

Results are presented and discussed that relate to the value of Mark-UP in terms of its useability and the subjects' perceptions of the product. The chapter is organised around the pertinent issues relating to the product's interface, the ways in which subjects used it, and factors relating to the subject group and implementation that affected its use.

Chapter 6: Exploration of how Mark-UP Supported Subjects' Planning as a Component of Self-Monitoring

This chapter presents findings about the planning processes promoted by Mark-UP and the metacognitive nature of these. The chapter identifies characteristics of the existing metacognitive levels of subjects and includes an analysis of the goal orientations of subjects, and their plans for improvement made during the implementation of the product.

Chapter 7: Exploration of how Mark-UP Supported Subjects' Evaluation as a Component of Self-Monitoring

The evaluations made by subjects of the content of readings, the product, and their learning as a whole are discussed to explore the metacognitive nature of these and how they evolved with a view to exploring role of the product in engaging subjects in metacognitive evaluation.

Chapter 8: Exploration of how Mark-UP Supported Subjects' Monitoring as a Component of Self-Monitoring

This chapter is organised around a discussion of the tools available within Mark-UP and how they facilitated subjects monitoring by engaging them in reflective processes such as information seeking, questioning and summarising and how these aligned with subjects' interpreted metacognitive levels.

Chapter 9: Summary and Conclusions

The thesis concludes with a summary of the findings and discussion of the main issues raised with a view to potential improvements to the product and the implications for future research into metacognitive regulation.

2 Literature Review and Conceptual Framework

In order to design solutions to assist students in developing self-regulatory skills, a necessary step is to develop a clear concept of what self-regulation is and how it can be promoted. While the concept of independent learning is certainly not new, a good deal of the research into self-regulated learning, as it is interpreted in this thesis, has been conducted particularly within the last 15 years. This chapter defines self-regulated learning and explore models of self-regulation that can be synthesised to form a conceptual framework to inform this study. The chapter therefore is structured around the following sections:

- a definition of self-regulation;
- a model of self-regulation;
- the various components of self-regulation;
- self-regulation as a cognitive process;
- the role of metacognition in cognitive self-regulation;
- promoting metacognitive regulation through engaging in its subordinate processes;
- the development of a conceptual framework for promoting metacognitive regulation; and
- the elaboration of a design model able to promote metacognitive regulatory processes within a chosen domain.

The breadth of self-regulation as a psychological and practical process means that only the cognitive processes that underpin it were the subject of this study. Nevertheless, before any guidelines could be developed to inform the design of a product to support these processes a thorough understanding of self-regulation as a research area needed to be developed.

2.1 Self-regulated learning

Self-regulation is somewhat easier to define than understand. It has been described as 'the process whereby students activate and sustain cognitions, behaviours, and affects, which are systematically oriented toward attainment of their goals' (Schunk & Zimmerman, 1994, cited

by Boekaerts, 1997, p 171). This definition is reinforced by Brooks (1997) who argues that that it is active and goal directed, resulting from self control of behaviour motivation and cognition. In fact self-regulation could really be defined as an outcome rather than a process. Teachers usually recognise self-regulation through students' abilities to apply themselves to their work, their abilities to generate learning strategies, and in behavioural terms actual measurable outcomes such as attendance, timely submission of assignments, and so on. However, such outcomes are inevitably underpinned by a variety of cognitive and emotional processes. This emphasis on multiple constructs places self-regulated learning at the junction of several fields of research (Boekaerts, 1997). It emphasises students' reliance on their own internal resources to govern their learning, but these resources are not easy to delineate. Self-regulated behaviour is an end process, dependent upon the affects and cognitions that precede it. These are to a certain extent inaccessible, since they are internally constructed and not always explicitly articulated by individuals.

Also, the notion of self-regulation is prone to multiple interpretations based upon educational philosophy. Zimmerman (1989) identifies it in terms of phenomenological, social cognitive, volitional, Vygotskian and cognitive constructivist theories. All of these approaches bring a unique perspective to the concept. Behaviourist approaches emphasise self-monitoring, self-instruction and self-reinforcement, while a phenomenological approach defines it in dimensions such as self worth, planning, and goal setting. Common to most of these however, is an acknowledgment of the interaction of affective and cognitive processes at a level of abstraction. Self-awareness at a cognitive and emotional level would appear to be the key enabling process in the development of self-regulatory strategies.

2.1.1 A model of self-regulation

A number of models have been developed to explain the processes that underpin self-regulated learning. Boekaerts (1997) provides a six component model based upon the following notions:

- vontent domain (conceptual and procedural knowledge, misconceptions and inert knowledge);
- cognitive strategies (such as rehearsal, elaboration, generating questions and so on);
- cognitive regulatory strategies (mental representations of learning goals, defining a plan, monitoring and evaluation, goal achievement);
- metacognitive knowledge and motivational beliefs (beliefs, attitudes and values related to tasks within a domain);

- motivational strategy use (such as coping processes, effort avoidance and so on); and
- motivational regulatory strategies (mental representations of behavioural intention, linking this to an action plan, and maintaining that plan in the face of obstacles).

The elements in this model can be explained by defining a fictional 'self-regulated learner'. Since the ultimate goal of most education is in the end mastery of the knowledge and skills inherent in the domain of learning, Boekaerts' (1997) depiction of the content domain suggests the self-regulated learner would be able to master such content. Put simply it suggests that self-regulated learners can do the job that they are being trained for. He or she may be able to demonstrate knowledge about an area, and an understanding of how it relates to the broader sphere.

Expanding on this, Boekaerts' notion of the integration of cognitive strategies suggests the self-regulated learner is also capable of applying strategies to enhance mastery of the domain, which may include techniques to assist in remembering processes, such as relating information received in class to prior understanding, drawing inference from these, knowing the correct questions to ask and so on. At a more abstract level beyond domain-dependent cognitive strategies, a self-regulated learner also has cognitive *regulatory* strategies. In describing these in terms of planning, monitoring and evaluation of goals, Boekaerts (1997) suggests that the self-regulated learner develops plans for learning. These are obviously still tied to the content domain, and the cognitive strategies within it, but the actual process of planning is defined here as more broadly a regulatory one.

As these plans are implemented, Boekaerts' (1997) emphasis on the iterative development of plans suggests that self-monitoring takes place in the light of developing knowledge. For example, the self-regulated learner may have to examine a plan to conduct field experiments due to limited resources, or a sickness in the family may prevent initial plans being realised. Also in this model plans need to be evaluated to gauge the effectiveness. This implies that the self-regulated learner may ask him or herself, for example, whether a planned approach to memorise 30 new words a day for a language class was an appropriate one, given that the learner is now experiencing difficulty in using those words in sentences.

Boekaerts' description of metacognitive knowledge and motivational beliefs in terms of beliefs, attitudes, and values related to tasks within a domain suggests that the self-regulated learner would have an ability to judge the value of classroom activities. For example, the learner might see the value in conducting an experiment to gauge the minimum physical distance between which two simultaneous pin pricks on a forearm can be individually felt, because despite its apparent fatuousness, the student can understand it as a means of generating basic principles of psychological testing. This integrates the element of

motivational strategy use. Boekaerts (1997) acknowledges that not all activities are inherently motivating and the self-regulated learner therefore may develop ways of coping with this such as rewards at certain intervals of achievement, taking time out to watch television, having a coffee and so on. At a broader level, it would appear that the self-regulated learner engages in ways of managing the motivational process in a deliberate way, for example marking off study days on a calendar and sticking to a minimum amount of time before taking breaks.

Ultimately it must be realised that these elements are co-dependent and interact with each other in the application and development of three distinct constructs: goals (cognitive and motivational regulatory strategies), strategies (motivational and cognitive) and domain-specific knowledge (content domain, metacognitive knowledge and motivational beliefs) (Boekaerts, 1997).

In an alternative model, Garcia and Pintrich (1994) articulate self-regulation in terms of knowledge and beliefs, strategies used, and outcomes. Each of these is moderated by motivational and cognitive components such as personal beliefs and conceptual knowledge, motivational and cognitive strategies, and quantity and quality of effort.

Common to both models is an integration of both affective and cognitive issues. 'Neither motivational nor cognitive models alone can fully describe the various aspects of student academic learning, yet the two types of models are complementary due to the respective strengths and weaknesses of motivational and cognitive models.' (Garcia & Pintrich, 1994, p. 127).

Figure 2.1 represents a synthesis of the above frameworks. It is defined as a series of levels. At the highest level, described here as psychological states, metacognition and self-concept exist as the primary enabling constructs for self-regulation, but these are developed through subordinate processes – in this case self-monitoring and motivation.

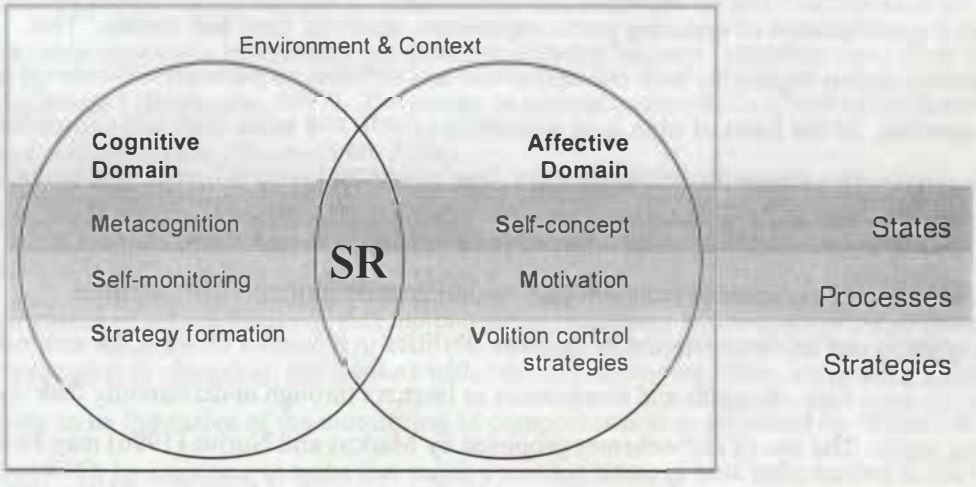


Figure 2.1: An integrative model of self-regulation

The end products in terms of behavioural objectives of self-regulation are the ability to develop cognitive strategies and approaches to control volition. This model therefore accommodates the role of both affective and cognitive aspects of self-regulation, but also acknowledges the effects of external environmental factors upon an individual's ability to regulate their learning. Each of the components of this synthesised model is discussed in turn.

2.1.2 Self-regulatory states - metacognition and self-concept

Self-awareness has always been an important educational construct. *Metacognition* can be defined as 'knowledge and beliefs about thinking and the factors affecting thinking' which regulate 'the articulation of strategy and knowledge' (Pressley, 1998). As such it is a necessary precursor to self-regulation. Flavell (1987) identified three types of metacognition: knowledge of self, knowledge about various cognitive tasks and strategy knowledge (cited in Boekaerts, 1997).

The first of these should not be confused with *self-concept*, which appears to be quite a subjective element, although there have been attempts to delineate it in a more hierarchical way (Zimmerman, 1989). While metacognition is often associated with issues such as *self-efficacy*, which involves 'personal judgements of one's capabilities to execute courses of action to attain academic achievement' (Bandura, 1977), self-concept is more aligned with self-esteem, a personal and less concrete construct. When one considers that students who don't see themselves as 'smart' or able enough often adopt self-handicapping strategies or overcompensate with effort, the centrality of self-concept to self-regulation is immediately apparent (cited in Brooks, 1997).

Markus and Nurius, 1986, cited by Garcia and Pintrich (1994, p. 129) introduce the notion of *self-schemas*, which combine the cognitive and affective elements of self awareness as 'the cognitive manifestation of enduring goals, aspirations, motives, fears and threats.' This overarching notion highlights both the similarities and differences between self-concept and metacognition. At the heart of each is an awareness of self, and while high self-consciousness is associated with a desire for self-knowledge, low self-consciousness breeds intellectual defensiveness.

In a practical way the descriptions provided by Garcia and Pintrich (1994) suggest metacognition can be demonstrated in students' abilities in a number of ways, for example, to accurately state their strengths and weaknesses as learners through understanding their own learning styles. The use of self-schemas proposed by Markus and Nurius (1996) may be found in students who can state a preference for visual rather than verbal learning, and can also explain what they know and what they don't know. The self-awareness which Garcia and

Pintrich (1994) use to distinguish self-concept from metacognition suggests a metacognitive learner as one who may seek help from a tutor because he or she is aware of a difficulty in completing a task, and can articulate that weakness. To know something is not the same as valuing however. Self-concept's subjectivity on the other hand, may be evidenced when a student is having difficulty with a task. The descriptions of Markus and Nurius (1986) suggest that students with a strong self-concept should be able to separate the difficulty from their belief about themselves as learners. For example, rather than saying 'I am dumb' or 'this program sucks!' it would seem they would be more likely to address the problem by identifying gaps in their knowledge (e.g. 'I am having difficulty with this 3D package because I'm having trouble making sense of 3D space on the 2D screen').

2.1.3 Self-regulatory processes - self-monitoring and motivation

Weinstein & Mayer (1986) describe all metacognitive activities as involving the monitoring of comprehension, and it would appear that this ability to monitor oneself is what distinguishes metacognitive activity from domain-specific cognition. *Self-monitoring* is an initial step towards the development of cognitive strategies, but as will be shown later, continuous self-monitoring is also a strategy in itself. Depending on one's theoretical orientation, this component can manifest itself as social cognitive self-observation, Vygotskian inner speech, or behaviourist self-recording (Zimmerman, 1989). Regardless of whether one views cognition itself as an important construct, however, self-monitoring is a pervasive key process to self-regulation.

Motivation results from the actualisation of self-concept. Anxiety, for example leads to a low level of motivation (Zimmerman, 1989). While it may be argued that all people are inherently motivated to learn, most of us have experienced difficulties in maintaining motivation, and research has shown that in education, intervention that impinges on self-concept such as unfavourable appraisals by teachers can result in drawing learners' attention away from the learning process (Boekaerts, 1997). The ability to maintain motivation is one of the main tenets of self-regulation (Zimmerman, 1994).

Motivated learners are not difficult to identify. Regular attendance at class, enthusiasm for subject matter and a willingness to persevere can be quite visible processes. Despite the internal nature of self-monitoring, this too can be demonstrated by students in behavioural ways. Engaging in classroom discussions with others, challenging ideas, and asking questions, all appear to be indicative of the monitoring of comprehension as proposed by Weinstein & Mayer (1986), by engaging in tasks that require making sense of new information in the light of existing understandings.

2.1.4 Volitional and cognitive strategy formation

Self-monitoring and motivation are the primary internal processes that mediate self-regulation. However, as the end product of self-regulation, students are able to activate strategies which enhance their learning. These take the form of volitional strategies, as well as cognitively based learning and regulatory strategies. It has been argued that self-regulated learning is 'a fusion of skill and will' (Garcia, 1995, cited in Brooks, 1997, p. 139), and certainly effort, stemming directly from motivation, is a concept that most students are able to recognise as a controllable aspect, using it to explain their performance to themselves rather than other explanatory mechanisms (Pressley, 1998).

Volition differs from motivation in that motivational processes mediate the formation of and promote decisions, while volitional processes enact and protect them (Corno, 1994). Therefore motivational self-regulation is dependent upon strategies that activate effort to achieve learning goals (Garcia & Pintrich, 1994). There are several strategies that students use to control effort.

Self-handicapping is the withholding of effort or putting obstacles in the way to maintain self concept, while *self-affirmation* maintains self concept through reassessing the value of different domains (Garcia & Pintrich, 1994). In interpreting these definitions it would appear that the difference between the two could be highlighted by imagining a student who fails to submit an assignment on time. Students may exhibit self-handicapping by diverting their attention away from study to other problems that may or may not impact strongly on it. Having to attend to a sick relative, or not having access to adequate transport can all be strategies used to preserve self-concept. Garcia and Pintrich's (1994) description of self-affirmation in terms of reassessing the value of different domains, on the other hand, is more suggestive of a critical perspective, such as a contention that the assignment was badly constructed in the first place, or that the requirements were not adequately explained in class.

Defensive pessimism is a coping process that enacts effort through the fear of failure (Boekaerts, 1997). This can have both positive and negative effects. Fear of failure can cause a student to work harder or to withdraw effort. In either case, students expect a negative result, and therefore are less disappointed when they finally get their results.

Motivational attributions refers to the causality students use to explain performance both retrospectively and prospectively: for example, blaming a weak exam performance on the fact that they went out the night before, or their children did not give them much sleep would appear to fit well with Garcia and Pintrich's (1994) depiction of externalised attribution. Regardless of the strategy, however, and whether they eventually lead to the enactment or

withdrawal of effort, they are all affectively laden processes that are related to an individual's self-concept, usually as an act of preserving self-esteem.

At a more objective level, students use self-monitoring techniques to support their learning as well as to regulate external factors. Cognitive learning strategies include rehearsal, elaboration, and organisational strategies, as well as memorization through clustering, imagery, use of mnemonics and so on (Weinstein & Mayer, 1986). Lin (2001) identifies strategies such as error detecting, effort and attention allocating, elaborating, self-questioning, self-explanation, constructing visual representations, activating prior knowledge, rereading difficult text sections, and going back to revise as examples of cognitive strategies.

Typically, deeper cognitive processes such as transformation, the creation of something new out of existing information, are more successful than ones which engage in knowledge as a static entity, such as rehearsal (Risemberg, 1996). It is important to note, however, that knowledge of these learning strategies is not enough to ensure that they take place. Regulation strategies must be implemented to co-ordinate effort and task.

Garcia (1994) identifies three regulatory strategies that are highly correlated but do have some differences. These are *planning*, *monitoring* and *regulation*. While learning strategies are usually internally developed, regulation strategies have a role in accommodating the environmental and contextual factors discussed above.

With regard to planning as a strategy, one central feature is *goal formation.* Typically, teachers' goals are more distant and abstract than students', and those students who set more proximal goals tend to perform better academically (Boekaerts, 1997). Proximal goals can be tied to time or a stage of a process. This suggests therefore that they can involve completing a single step of a large activity, for example a needs analysis for an advertising strategy, or they can be related to schedule, such as identifying a project topic by the next week. Regardless of the nature of the goals, however, they are best when they are developed by the student rather than imposed by the teacher, in which case they tend to be viewed as obligations (Brooks, 1997). While achieving good grades is a frequently stated goal for students (Pressley, 1998), process rather than product goals are more closely correlated with self-regulation (Ertmer, Newby, & McDougal, 1996). This finding suggests therefore, that student learning articulated as a desire to find out about something is more likely to be indicative of self-regulation than the student who claims he wants to pass or he wants to please his family.

Monitoring strategies can include tracking of attention, self-testing and self-questioning, as well as monitoring comprehension during learning activities. These are closely linked to regulation which manifests itself as a controlling process that results from monitoring (Garcia & Pintrich, 1994). An example of this might be a student who reads passages in a text more

slowly upon arriving at a section that he or she finds conceptually challenging. A final cognitive strategy is resource management. Tied in directly with environmental factors, these involve the regulation of external aspects such as time, study environment, and help-seeking, as well as teacher and peer interaction (Garcia & Pintrich, 1994).

In a higher education setting it is important to acknowledge that there is already an expectation for students to have these skills. While many universities employ learning skills advisors to assist students in developing learning and self-management strategies, ultimately a curriculum which consists of 12 hours per week contact time, with little external monitoring outside of those hours is quite different from traditional schooling where a regular plan of work is set for students and they attend class for up to seven hours per day. In a university unit of study, assessment may consist of two assignments and an examination. Students are rarely given 'homework'. They must develop their own proximal goals for assignments, and monitor these as they're going. With the only real feedback received being when they get their assignments back, they must therefore regulate their performance, working independently throughout the semester. This situation is exacerbated when one considers that fact that undergraduate university students typically have busy lives outside of their study that also make demands. Therefore, beyond the internal aspects of self-regulation, external and environmental factors must also be considered.

2.1.5 External factors - environment and context

Social cognitive approaches have long asserted a bi-directional relationship between external and internal states - role models who overcome adversity might encourage observers to try a task for themselves, for example (e.g. Zimmerman, 1989). Not only the quality of teaching, but other factors beyond the learning situation have a direct effect on self-regulation. The American National Centre for Education Statistics (NCIS, 2002) identified three quarters of the current student population as being 'non-traditional students' characterised by:

- delayed enrolment (not entering university immediately after high school);
- part-time enrolment for all or part of the academic year;
- full-time work (35 hours per week or over);
- financial independence;
- having dependents;
- being single parents; and
- entering university through alternate paths than high school diploma. (NCIS, 2002)

This diversity of students can undermine the notion of the typical student who does not work and who is supported by parents. While it would be fair to expect that a number of these students would be of mature age and may already have existing self-regulatory skills, the fact the remains that there are many external factors that impact on the lives of students – and these are not often with the control of lecturers or course designers.

Ertmer Newby and McDougal (1996) claim, 'outside pressures in students lives may increase their vulnerability to other instructional factors (type of case, time of day, length of lab) that impede [students'] use of self-regulation skills' (p. 747). A young parent who has been working all day and had an uninterrupted sleep the night before for example, is therefore in a tenuous position with regard to study which may be ultimately seen as peripheral to that person's life.

Ertmer, Newby and McDougal (1996) use case studies to examine self-regulated learning and this highlights another important issue: the nature of a discipline itself is a unique context, with differences in both teachers and students' beliefs about learning. VanderStoep (1996) observed different levels of regulation across multiple disciplines, and this has a profound significance for self-regulation, because while self-regulation itself may be viewed as a generic skill, some of the strategies employed may be pertinent only to specific domains. This suggests that any study into self-regulation must therefore be clearly defined. Despite the nature of self-regulation as a general set of student attributes, there are many dimensions that underpin it. One of the purposes of this chapter has been to explore those dimensions and it has been found that both cognitive and affective components combine within a context to describe the process of self-regulation. As well as the external environment an important aspect of this context is the knowledge or skills that are being developed. Self-regulatory skills can differ between these domains so the nature of the skills being learned is paramount.

2.1.6 Summary and conclusions about self-regulation

This section has explored the concept of self-regulation and identified a number of models of self-regulation. The literature suggests self-regulation is a concept that is best in terms of both affective and cognitive dimensions and involves three levels of processing. At the highest level of awareness, metacognition and self-concept are used to mediate the way students view themselves and value themselves. These are the executive control states that both impact on and are developed from the subordinate processes and strategies that underpin them. At the process level, students' self-monitoring and motivation both impact on their judgements and views about themselves. Ultimately self-regulation is evidenced at the strategy level, where students use volitional strategies to both maintain and withhold effort with a view to

preserving self-concept, and also through cognitive strategies, which can be both tied to a domain of learning but also are regulatory in nature in that they are the tools that students use to enact their learning plans, monitor their performance and understandings, and evaluate them with a view to reconfiguring their understandings. The external environment too impacts greatly on students' abilities to regulate themselves and with the increasing prevalence of external pressures such as full-time work, these issues need to be accommodated to support students' development of self–regulation. Finally, it has been argued that the breadth of self-regulation as a psychological construct makes studying it particularly difficult. A clear focus on the aspects of self-regulation pertinent to this research must be developed, and this thesis ultimately focuses on the cognitive aspect of self-regulation while accommodating the affective dimensions of it, and acknowledging the need to ground the study within a domain of learning. The next section explores cognitive self-regulation with the goal of articulating a model to inform the design an on-line instructional environment to support its development within a given domain.

2.2 Developing cognitive self-regulatory skills

There is a large body of work that has examined ways in which the affective components of self-regulation can be targeted to increase students' motivation and persistence in their learning. Emotional factors are generally seen to be more accessible and amenable to change than the cognitive aspects. In fact, the two are not unrelated. Corno (1986), for example, argues for metacognition as the dominant controlling process; that 'affect is the subjective perception of emotional states; thus associated attempts to control negative affect fall within the domain of metacognitive control' (p. 334).

As the primary enabling state for cognitive self-regulation, metacognition is a concept that is fraught with contention. Some have argued that it is an inherent psychological state that cannot be changed, although this view has come under increasing criticism of late. There is a growing consensus for example, that metacognition is only mildly correlated with supposedly stable measures of ability such as IQ (Schraw, 1998). Recent theorists have started to examine the construct of metacognition from social and environmental perspectives. Rather than being developmentally fixed, the acquisition of metacognition may be subject to instructional intervention (Boekaerts, 1997). This places a new emphasis on the cognitive/rational components of self-regulation. The question then becomes one of how cognitive self-regulation can be promoted in an on-line environment.

2.2.1 The problem with metacognition

Wilson (1999) argues that the term *metacognition* can be used in 'vague, confusing, and often contradictory' ways and can be used to describe a range of disparate higher level cognitive skills. In spite of this apparent ambiguity of the concept, however, she attempts to distil these disparate elements and defines metacognition as 'awareness individuals have of their thinking and their evaluation and regulation of their thinking'. In this definition it is both a state and a process, with three functions:

- metacognitive awareness – individuals' awareness of their learning process, knowledge about content knowledge, and knowledge about their own strategies;
- metacognitive evaluation – individuals' judgments of their capacities and limitations; and
- metacognitive regulation – the conscious modification of thinking using cognitive resources.

From this perspective, metacognition is seen to involve regulatory processes and is therefore not so different from self-regulation itself. In fact it could be argued that evaluation is similar to self-monitoring, and regulation is the formation and application of strategies. Inevitably, discussions of metacognition are tied in with discussions of the overt use of monitoring and strategy development, as that is how it is manifest. Schraw et al. (1995) states, 'Examples of general metacognitive awareness include evaluating the adequacy of relevant domain knowledge, selecting strategies that are situationally appropriate, and allocating cognitive resources to a degree that matches task demands' (p. 444). This position is further reinforced by Jacobson (1998) who defines metacognition both as 'knowing the process by which one learns' (p. 3) and, in citing Borokowski, Carr, and Pressley (1987) as 'the self-monitoring of, and conscious use of learning strategies' (p. 4).

This apparently contradictory position of being a both a state and a process can be reconciled by acknowledging the dependence of metaknowledge upon domain-dependent cognitive processes. In their research on metamemory, Nelson and Narens (1994) identify the relationship between the meta-level and the object-level of cognition through a reciprocal flow of control and monitoring (Figure 2.2). While the model itself is perhaps a little simplistic, it does give some hope to those floundering in the problem of how to encourage metacognition in students. In Nelson and Narens' concept, one can view metacognition as a pet puppy – in order to grow and become strong it must be fed and exercised. The process of monitoring nurtures metacognition, likewise the activation of control processes exercises it.

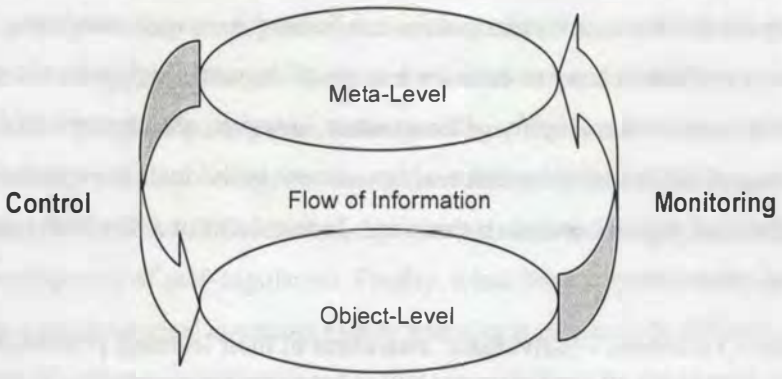


Figure 2.2: A model of metacognition (Nelson & Narens, 1994)

It can be argued, then, that metacognition is not something that can be tackled as a discrete entity – just as well, since it is quite inaccessible as such – but can be enhanced through engaging at the subordinate levels of self-monitoring and strategy development. These appear to be much more amenable to instructional intervention. The implementation of strategies enables metacognitive control to be actualised. For example, Hunt (2000) argues the distinction between regulatory strategies and cognitive skills in terms of their intentionality. While cognitive skills can be automatic, regulatory strategies 'are skills which have had intent added to them and are available for closer inspection' (Hunt, 2000, p. 2). Likewise, self-monitoring is a conscious process too, that can be visible through artefacts that demonstrate reflective activity. These artefacts can, for example, include peer interaction:

> *Metacognition is reflection on thinking and this can come from oneself or from others. Vygotskian theory emphasises the prime role of talk for the sharing of knowledge and an important aspect of metacognition is that it can be discussed and shared. (Hunt, 2000, p. 4)*

It appears therefore that it is possible to create environments that can both promote and demonstrate metacognition. The key factors identified here are conscious intention and informational interchange. Since these both have potential to be visible (for example, a student may be required to justify a strategy, or the interactions between peers can be recorded) the development of learning environments that directly target the processes and outcomes of metacognition becomes a possibility. The next section of this review therefore explores ways in which self-monitoring and strategy use can be exposed and manipulated, with a view to developing metacognition.

2.2.2 Facilitating development of cognitive regulation

The reconciliation of metacognition with its subordinate processes may provide assistance in identifying the means by which cognitive self-regulation is developed, however, the question of how to teach cognitive self-regulation is still problematic. After all, it is something that comes from the student rather than being externally imposed (Brooks, 1997). This paradox is obviously untenable. For students to develop cognitive self-regulation strategies, they need to engage in the process of self-monitoring and employ strategies to control their cognition. The previous section has already hinted that such processes can be made deliberate and can also be demonstrated. The question, then, is: how best can on-line instructional approaches activate these processes and provide support for their development?

Here, the very concept of self-regulation becomes prone to the usual philosophical debates of learning theory. While it is inherently cognitive in nature, it can be viewed through various theoretical lenses such as behaviourist, phenomenological, social cognitive, volitional, Vygotskian and cognitive constructivist theories (Zimmerman, 1989). Common to all of these is the acknowledgement of a specific set of conscious strategies that are employed and developed through a process of self-monitoring, whether this self-monitoring is identified in terms of Vygotskian inner speech or behaviourist self-reinforcement.

Rather than argue from a single theoretical perspective, each approach offers a view as to how firstly to engage the self-monitoring crucial to metacognitive regulation, and secondly to assist students in the conscious formation of cognitive strategies. There is significant debate as to whether executive control strategies can be effectively taught directly, or whether they must be acquired indirectly over a long period of time. Nickerson (1988) cites opposing viewpoints. Gagné (1980) for example argues that they cannot be taught directly, while Greeno and Simon (1984) and Tuman and Rief (1980) are more open to the possibility. It is certainly true that those who are poor regulators aren't likely to be changed quickly; even when students know *what* to do, it doesn't necessarily mean they'll do it (Brooks, 1997). Therefore any approach to learning for self-regulation must adopt a multi-pronged approach.

Lin (2001) advocates two basic approaches to supporting metacognitive development – strategy training and creating a supportive social environment. Within each, the focus can be domain-specific (e.g. reading comprehension, writing skills, problem solving) and domain-independent, dealing with knowledge of oneself as a learner. The model is summarised as follows (Table 2.1):

Table 2.1: Instructional goals and design characteristics for two approaches supporting metacognition (Lin, 2001)

Instructional Approaches	Contents that are Taught	
	Domain-specific knowledge	***Knowledge of self as learner***
Strategy training		
Underlying goals	• Teaching effective strategies	• Teaching self-oriented strategies (eg self-rewarding, setting personal goals etc)
	• Monitoring conflicting thoughts	• Developing a strong sense of self as learner
Design Characteristics	• Modelling	• Social or peer modelling
	• Prompting	
Creating Social Support		
Underlying Goals	• Building supportive metaculture	• Developing a strong sense of self as learner
	• Developing deep learning principles	• Building an identity
	• Fostering community metadiscourse	
Design Characteristics	• Creating communities of practice	• Changing social context for learning a specific domain
	• Creating virtual community	• Providing choice for roles
		• Creating virtual social support

It would appear that the two aspects of creating social support and strategy training work in tandem. Lin's (2001) model appears to imply that the strategies themselves need to be exposed in obvious ways to the student. Modelling and prompting can work together to do this. For example a teacher can demonstrate an approach to solving a mathematical problem by talking aloud as he or she completes the working out on a white board in front of the students. Prompting is even more direct, perhaps questioning the students as to whether they think this would solve the problem and removing the locus of control away from the teacher with passive observance, to active processing on the learner's part. However, this does not really address the self-monitoring aspects of the metacognitive activity. The social support suggested by Lin (2001) suggests that reflection comes from within communities of learners. As they interact, perhaps solving problems in a group, students are then required to actively identify their knowledge or lack of it within the activity.

The distinction between *domain-specific* and *domain-independent* functions is also an important one. In questioning 'does a general monitoring skill exist?' Schraw et al. (1995) conducted two experiments to determine whether self-monitoring is a domain-specific or a

domain-general skill. Their findings lend 'qualified' support to self-monitoring as a domain-general activity, concluding 'domain-general monitoring skills emerge late in development, are preceded by modularised monitoring skills, and emerge only after considerable effort has been devoted either implicitly or explicitly, to integrating monitoring skills across domains' (p. 442). Markman and Gentner (2001) concur, stating 'even in the seemingly abstract domain of mathematics, cognitive performance is affected by domain content' (pp. 223-224). Markman and Gentner (2001) also cite several studies that highlight the context-laden nature of cognition.

In conclusion, therefore, both self-monitoring and strategy use appear to be integral to the process of developing metacognition. The implementation of conscious strategies, both context-laden and independent of a domain, enables the exercise of metacognition, while the reflection inherent in activities such as those proposed by Lin (2001) suggests that a range of interactions, that can be internal but also involve social intercourse, can promote the self-monitoring necessary to feed metacognitive awareness. One of the most salient conclusions is the role of the learning domain as a necessary grounding for such activity. The implication of this for any teaching model for self-regulation is that instruction need not be contextless, and indeed the abstraction of domain-specific metacognition to a general awareness is an ideal but intangible goal, that must firstly be grounded within a specific domain. Therefore, the stage therefore of this review is to extend from these general principles to develop a model of metacognitive self-regulation that acknowledges the role of strategy, self-monitoring and the learning domain and that also accommodates the reality of educational practice and can be used as a means to inform design of an applicable learning strategy.

2.2.3 A model for developing metacognitive regulation

It has been shown that metacognition is a complex phenomenon that is underpinned by a variety of cognitive processes. The discussion of the role of context, skills and regulatory strategies indicates that activation of all of these processes contributes to the development of metacognitive awareness. Figure 2.3 presents a framework that maps possible relationships between these as a process of directional causality and intersection.

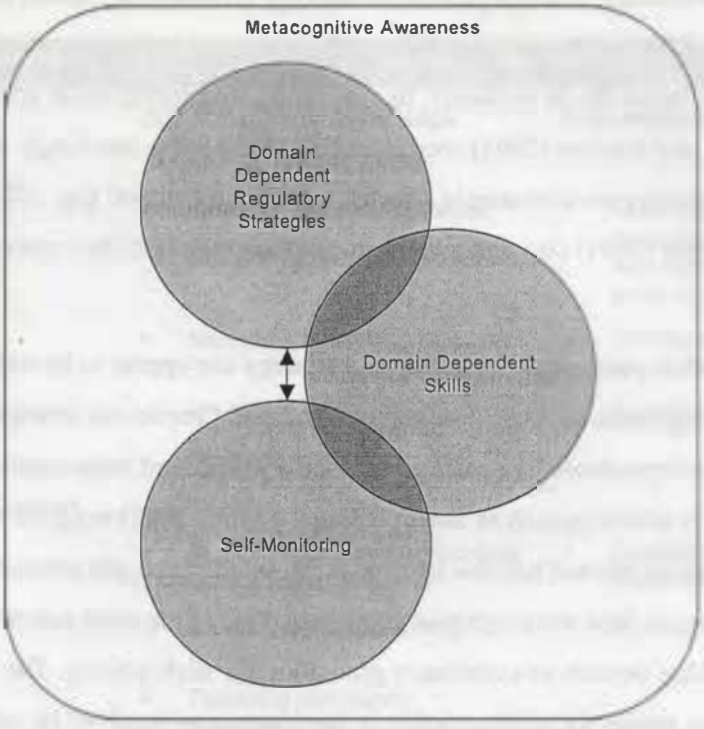


Figure 2.3: A metacognitive framework for developing domain-dependent skills

At the heart of the process is the set of domain-dependent skills that are being taught. These are skills that are tied to a context of learning and, while general in nature, can be defined by a specific set of attributes. This can be exemplified by examining some university learning support websites that list a range of skills that are relevant to academic practice, and that cross disciplines. These can include problem solving, research, teamwork, writing, critical thinking, referencing, time management, statistics and organisational skills (Edith Cowan University, 2003; James Cook University, 2003; University of Wollongong, 2003). The ability to work in a team for example, can be described as a domain-dependent skill because while not tied to a specific 'subject' (it is relevant across a range of academic and vocational tasks) it is ultimately grounded within the broader domain of social interaction and collaborative learning. In order for such skill development to be tied to metacognitive awareness, then the process of learning domain-dependent skills must also be linked to the domain-dependent regulatory strategies and self-monitoring. Metacognitive awareness is represented here as intersecting rings to emphasise the integral nature of these processes to the domain-dependent skills.

Using Nelson and Naren's (1994) depiction of metacognitive control of the object-level as a corollary to the use of domain-dependent regulatory strategies to mediate domain-dependent skills, one can conjecture that in the case of teamwork at the 'object' level, such skills can be

enacted through strategies such as communication, clarifying problems, achieving consensus and so on. These would appear 'regulatory' within Hunt's (2000) depiction of these strategies as intentional. However, intentionally engaging in clarifying problems to improve teamwork, while regulatory, would not appear to be necessarily metacognitive without the reflective process of self-monitoring. Inevitably this is linked to the domain-dependent skill. In this case, Zimmerman's (1989) multi-theoretical depictions of self-monitoring as self-observation, inner speech and other forms of reflection would appear to be well depicted in the example of teamwork as a monitoring of oneself and one's role in the team.

However, as well as self-monitoring being integral to the domain-dependent skill, there may also be a link between the monitoring process and the regulatory strategies themselves. After all, the intentionality of regulatory strategy use, and the reflexiveness of monitoring suggest that such self-monitoring may be framed within the application of regulatory strategies; and the regulatory strategies themselves may in turn be modified through the process of self-monitoring. Such a contention would appear to best exemplify the cyclical relationship of control and monitoring in Nelson and Naren's (1994) model of metacognition (Figure 2.2) and is therefore represented in this framework in the form of bi-directional arrows between the two.

Referring back to the example of teamwork, a learner who is developing the domain-dependent skill of teamwork does so by applying regulatory strategies such as clarifying problems. The metacognitive element comes in when the learner monitors his performance in the light of the object-level, namely the teamwork skills that are produced as a result. However the learner also monitors him or herself in the light of the utility of the strategy, in this case, the problem clarification. Ultimately the metacognitive process may influence the revision of the strategy and a further review of the skill of teamwork itself.

As complex as this framework appears, ultimately it defines the processes in which a learner might engage, but does not actually propose an instructional intervention to promote these processes. To fully develop the framework into an instructional model it is necessary to identify the locus of instruction needed to help support the development of self-regulatory processes.

It has already been stated that self-regulation is a concept that is not bound by any specific theory of learning. Therefore, any model of teaching must be informed by a variety of pedagogical perspectives. As can be seen from Lin's (2001) model (Table 2.1), metacognition can be stimulated through a variety of approaches that in this case at least, are predominantly social constructivist in nature. One can assume for example, that self-monitoring here takes place within a social framework through the creation of a community, and that strategies are

developed through peer or teacher modelling. While this may provide one strong foundation, other theories of teaching may still have relevance.

Oliver (1999) argues that the process of learning can broadly be defined as the arrangement of supports, activities and resources to promote learning. Put simply, learners engage in activities for learning by completing activities using resources. A research assignment therefore involves the activity of reading, and synthesising, using the resources of the information to be researched. The learning however is developed through the guidance that is provided to the learner to assist in using these resources. It is the integration of all three of these aspects that leads to the durable outcome that is learning. These three components are integrated into the framework to develop its role as an instructional model beyond its role as a means of describing a process (Figure 2.4). The subsequent model has been called the Instructional Model for Metacognitive Development (IMMD).

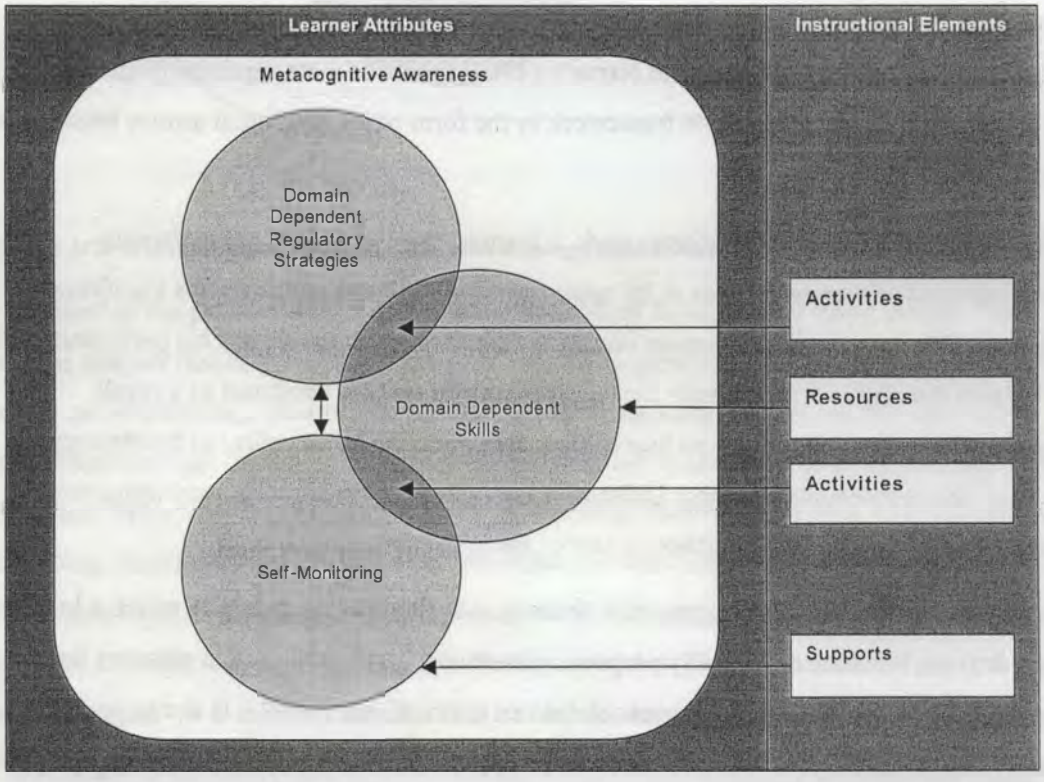


Figure 2.4: The Instructional Model for Metacognitive Development (IMMD) of domain-dependent skills

Such activities, resources and supports for learning are based within the learning environment rather than the learners themselves. Therefore in the IMMD they sit as instructional elements outside the main figure, which encompasses learner attributes. Nevertheless, they frame the users' activity within the learning environment. Domain-specific skills are learnt through the provision of activities that exist as two types – activities involving self-monitoring, and activities involving the use of regulatory strategies inherent in that domain. Therefore they

exist as inputs to the intersections of self-monitoring and regulatory skills within the set of skills to be learnt. Resources are, of course, relevant to the domain to be learnt so the arrow leads directly into that circle on the diagram. Since they are essentially inert they do not intersect directly with the monitoring or regulatory processes that are defined within the model. The final input into the system exists in the form of learning supports. These are predominantly self-monitoring in nature. The role of instructional support is to assist the learners in monitoring their performance and cognitions as they do the activities in the learning environment. It is this self-monitoring, encouraged through the provision of support that is the key to the self-regulated use of the strategies defined for a domain. Since the relationship between monitoring and regulatory strategies has already been defined, one can see in this model how regulatory strategies are indirectly affected by learning supports through the self-monitoring that mediates them.

While activities, resources and supports are integral to learning in any approach, their selection to support self-regulation must be considered. For example, within a drill and practice scenario, the main support would be provided through behavioural reinforcement rather than strategies to engage self-monitoring processes. Research into self-regulated learning has proposed many approaches to the design of activities supports and resources to encourage these processes. Activities that stimulate reflection, such as journals, have been promoted as effective prompts for students' own initiated approaches, integrating techniques such as progress worksheets and behavioural graphs (Zimmerman, 1989). Also, encouraging students to solve problems while simultaneously reflecting on their own problem solution process can improve their metacognitive knowledge & skills as well as performance (Boekaerts, 1997). Activities can also be grounded in authentic and relevant situations to enhance their level of motivation (Keller, 1983), and it has been argued that 'challenging tasks stimulate self-regulation better than do routine or boring tasks' (Brooks, 1997, p. 141).

At the resources level, motivational self-regulation can be assisted by techniques such as instructional games which can provide the impetus to assist in volitional control while narratives can engage the curiosity inherent in motivation (Malone, 1981). For promoting metacognition, a focus on contemporary learning theories such as situated cognition (Brown, Collins, & Duguid, 1989) suggests that resources should be complex and real. Having several from which to choose, and providing multiple rather than single perspectives can enhance both their relevance and challenge, as well as stimulate the depth of processing required for self-monitoring.

This is not to say that the learning environment should be excessively ill-structured. Indeed, having a narrow focus for self-monitoring gives better results than having a broad focus (Brooks, 1997). However, 'the most strongly advocated approach to including opportunities

for student self-regulation is to give students choices' (Brooks, 1997, p. 15). Offering them different ways of learning material and having them compare them, for example, can be an excellent way of allowing users to customise their own relationship with the environment and help their metacognitive processes. Thus, environments that can be customised can assist users in setting their own learning goals.

It would appear therefore that in terms of the activities and resources for learning, contemporary approaches such as constructivism may have most relevance to learning environments to promote metacognition. Some of the tenets of constructivist learning proposed by Honebein (1996) for example have clear relevance to the concept of cognitive self-regulation:

- provide experience with the knowledge construction process;
- provide experience in and appreciation for multiple perspectives;
- embed learning in realistic and relevant contexts;
- encourage ownership and voice in the learning process;
- embed learning in social experience;
- encourage the use of multiple modes of representation; and
- encourage self-awareness in the knowledge construction process.

While these may appear somewhat broad, they act as a sound foundation for the development of more specific strategies since they cross most constructivist androgogies, and all have a focus on the student monitoring understandings through deep processing either at an individual cognitive, or social level. Many of the activities and resources proposed above do exemplify the tenets stated above. In terms of supports for learners, Honebein's (1996) constructivist principles suggest that these should promote knowledge construction, particularly within a social context and encourage the internalisation and individualisation of understanding rather than acquisition of external forms of knowledge. Therefore supports such self-assessment, as well as peer and tutor interaction, appear the most relevant. Techniques such as bulletin boards and collaborative work groups are examples of this. Despite the open-endedness of such supports, it doesn't mean that the teachers' role is reduced to that of security blanket or background facilitator – there is still a role for direct instruction, particularly in making explicit the implicit conventions of discipline specific knowledge. In fact teaching students *about* self-regulation is important (Brooks, 1997).

In terms of controlling the external environment this can involve telling students to find a quiet place to study, planning adequate time and so on. As an approach to promoting the

development of metacognitive strategies, having formal activities in which students consolidate and organize what they have learned combined with more implicit forms of support such as expert modelling, engages the user in self-monitoring approaches and therefore would seem to have the best potential for making strategies purposeful for them.

As a final iteration in the evolution of this instructional model for promoting metacognitive regulation, the domain-independent nature of metacognition must be accommodated. One of the salient characteristics of metacognition is that, 'it occurs on both global (general executive processes) and local (task-specific instantiations of ... executive processes inextricably connected to domain-specific knowledge) levels' (Clements & Nastasi, 1999, p. 5). It is an understandable goal of metacognitive development therefore that awareness that can be transferred beyond a single domain. For example, a learner who metacognitively regulates her work in a team may also be able to apply metacognitive processes to problem solving. The link between domain-dependent and domain-independent metacognition, however, is tenuous. In exploring the processing that students engaged in when taking tests, Schraw (1997, p. 145) argues that, 'individuals rely on two relatively independent sources of knowledge when completing a test. One source is domain-specific content knowledge that leads directly to better performance. Another source is domain-general metacognitive knowledge that guides performance assessment and confidence judgments'. The actual development of domain independence however is much less easy. Schraw (1997, p. 146) conjectured that, 'monitoring experience within specific domains is gradually generalized until it becomes a metacognitive skill that spans all cognitive domains.' Schraw notes that this is not a rapid process – a finding supported by research by Shneider and Pressley (1989) and Borkowski and Muthukrishna (1992) which suggests that in order to develop metacognition, learners must:

- first acquire specific strategy knowledge within a domain; then
- use this knowledge to construct conditional metaknowledge about when and where to use strategies; and
- eventually construct general strategy metaknowledge that is applicable across multiple domains.

In order to represent the importance of domain-independent metacognition while accommodating the nature of domain-independent regulatory strategies as a secondary outcome of the development of domain-dependent skills, this final elaboration of the model portrays the concept through tenuous links from both the domain-dependent strategies and self-monitoring. Since the domain-dependent strategies appear to be a precursor the development of independent strategies, this link is best represented as a uni-directional dotted arrow. Since the self-monitoring required for such development, however, is reflexive as in

the case of the development of domain-dependent regulatory strategies, it is represented here as a bi-directional dotted arrow.

In summary, the Instructional Model for Metacognitive Development shown in Figure 2.5 has been developed through an understanding of metacognition as a reflexive process of control and monitoring. This discussion has suggested that the key to their development is in engaging students in learning that supports the monitoring and regulatory strategy use that underpin it. A series of activities, supports, and resources have been proposed that are primarily constructivist in nature but are inevitably student-centred and lead to independence. It has also been argued that metacognitive regulation, while potentially domain-independent in nature, requires initial domain dependence and only occurs gradually over time. If one is therefore to acknowledge the domain dependence of developing metacognitive regulation, the question then becomes the selection of a domain in which to ground the development of metacognitive regulation and the choice of activities, supports and resources that are specifically relevant to that domain to support this process.

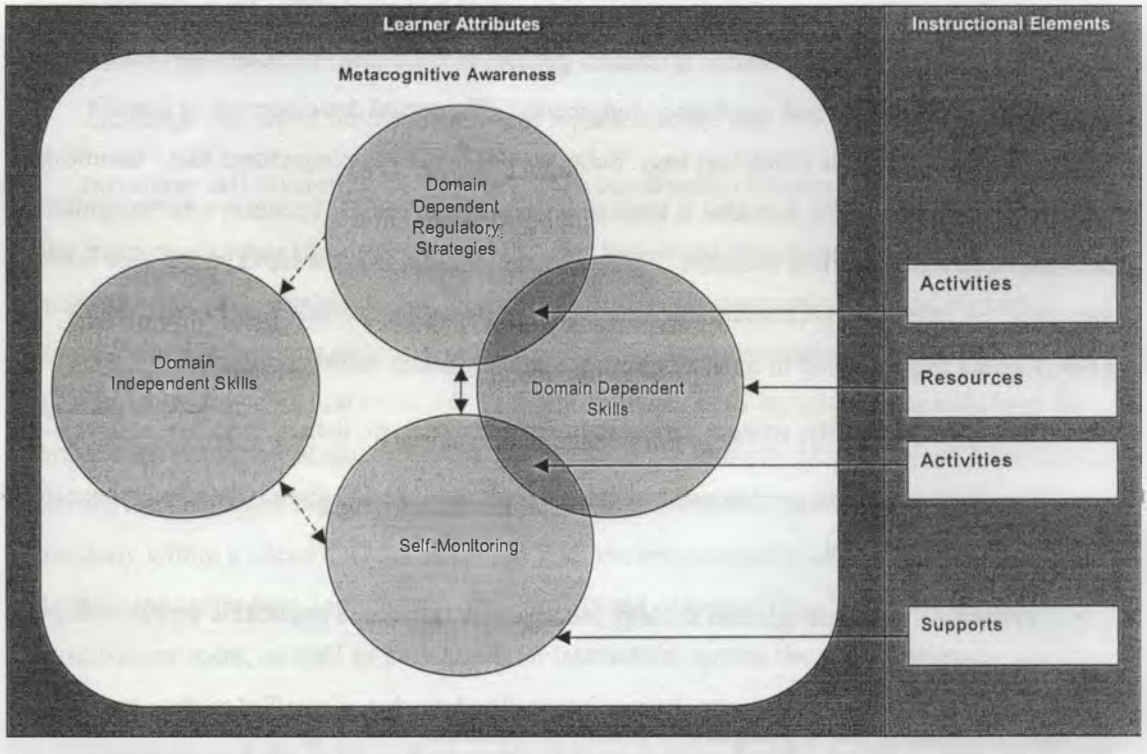


Figure 2.5: The Instructional Model for Metacognitive Development (IMMD) integrating domain-dependent and independent components

The next section explores the research into developing cognitive self-regulation in particular with regard to the instructional strategies that are relevant to this. A domain is then selected – in this case reading comprehension – and appropriate activities supports and resources are proposed. These are then used to inform the design of a product to support the development of

metacognitive regulation within this domain, with a view to exploring how the metacognitive processes take place.

2.2.4 Strategies for enhancing metacognition through self-monitoring and strategy instruction

A number of general tenets are claimed within the literature for what characterizes effective environments for metacognition. Blakey and Spence (1990) cite Dirkes' synthesis of much of the literature on metacognition into the following features:

- connecting new information to former knowledge;
- selecting thinking strategies deliberately; and
- planning, monitoring, and evaluating thinking processes (Dirkes, 1985).

Each of these tenets aligns closely to the model proposed above. Connecting new information with former knowledge is primarily driven by the context of learning, and within a framework of skills inherent in a specific task. Thus it is integral to domain-specific skills. The second tenet involves the actual development of use of regulatory strategies applied to a task. Planning, evaluating and monitoring, however, define the internal processing used to support the acquisition of domain-specific skills and inform the application of regulatory strategies. These can collectively be considered as self-monitoring as they all foreground the reflective process that informs the creation and revision of plans through an evaluative feedback loop.

Blakey and Spence's (1990) description of these tenets suggests that a case may be found in education students learning to plan lessons. They must frame new information about teaching strategies in the light of their own experiences in the classroom for example. Using this understanding they then may select thinking strategies, for instance using a heuristic such as ensuring classroom activities are only 20 minutes in length to guide their approach to lesson planning. The planning, monitoring and evaluation inherent in these activities represent the internal processing the student engages in as they reflect on the validity of this approach. Obviously this processing does not occur in a vacuum. Activities, resources and supports proposed by the Instructional Model for Metacognitive Development (Figure 2.5) assist in these self-monitoring processes. For example, resources such as videos of existing lessons, activities such as discussion or role play in which other students act out the plan, and the support provided by the peer feedback inherent in the activity all provide the monitoring necessary for the evaluation and reformulation of the thinking strategies.

In developing an approach to learning design, then, three questions need to be answered for an environment to promote cognitive self-regulation:

- what types of resources are necessary to assist in the creation of domain-specific skills?
- what activities have the user engaging in regulatory strategies and reflective practices within a specific skill set?
- what supports are required to activate the monitoring required to ensure such skills and regulatory strategies become directed by the learner rather than by the nature of the environment itself?

The first two questions are predominantly influenced by the outcomes defined for a specific course or unit of instruction. Such outcomes can be lower order in nature, based around content acquisition, or higher order, as is the case for most university tasks. Examples of these such as reading comprehension, research, and collaborative skills (Edith Cowan University, 2003; James Cook University, 2003; University of Wollongong, 2003) have already been discussed. These skills are inherently grounded within content but are also more generic in nature. Their domain specificity comes from the academic context that frames successful university studies.

The third involves the internalisation of the learning towards self-directed practice. It is in providing such supports that differing theories abound. There are many general guidelines for framing activities, supports and resources for metacognition. Grabinger (1996) for example cited the following strategies:

- students should be asked to identify consciously what they 'know' as opposed to 'what they don't know';
- students should keep journals or logs in which they reflect on their learning processes, thinking about what works and what doesn't;
- students should manage their own time and resources, including estimating time requirements, organising materials and scheduling the procedures necessary to complete an activity; and
- students must participate in guided self-evaluation through individual conferences and checklists to help them focus on the thinking process.

Another set of suggestions from Blakey and Spence (1990) identify:

- identifying 'what you know' and 'what you don't know';
- talking about thinking;
- keeping a thinking journal;
- planning and self-regulation;

- debriefing the thinking process; and
- self-evaluation.

If one is to interrogate such strategies, one can see that the can come from many sources, and are identified at the levels of resource and activity as much as learner support. Ultimately, self-monitoring requires feedback, and this feedback can come from many places including the teacher, other students, and the activities and resources themselves. Nevertheless, they are all characterised by approaches that are student-centred, and have aspects that are familiar to the constructivist tenets proposed by Honebein (1996).

In order to explore the application of this model to an instructional setting, a domain is needed. There are many areas of study that are relevant to higher education and manifest metacognitive processes. One such domain is that of *reading comprehension*. As discussed earlier, reading comprehension is important to the development of content literacy (Manzo, Manzo, & Thomas, 2005) but is also an important generic skill across a range of academic tasks (Willhelm, 2001). Students in higher education settings are often required to synthesise ideas directly from texts, which requires a high level of such skills. The final stage of this review therefore describes how the IMMD (Figure 2.5) can be contextualised within the domain of reading comprehension. This context formed the basis of the setting used in this study.

2.2.5 A model for developing metacognitive regulation through reciprocal teaching strategies for reading comprehension

Many units in higher education require students to engage in reading journal articles and text chapters. The types of content in these are not always formally 'taught' – it is expected that the students will be able to engage in this process in an independent and self-regulated way. These skills in reading comprehension therefore need to be formalised at a metacognitive level to ensure their application across a range of texts and contexts.

Dole, Duffy, Roehler, and Pearson (1991) synthesize the research on reading comprehension to identify the following regulatory strategies that are inherent in the skill:

- determining importance;
- summarizing information;
- drawing inferences;
- generating questions; and
- monitoring comprehension.

While at one level they involve defined activities, they are also general regulatory strategies that can be applied to any text within the skill of reading comprehension. An important question that arises relates to the supports, activities, and resources necessary to promote the metacognitive use of these.

Palinscar and Brown (1984) propose an approach to teaching reading comprehension called *reciprocal teaching*. In this theory, there are three main components to supporting learning:

- dialogue between students and teacher, each taking a turn in the role of dialogue leader;
- 'reciprocal' interactions where one person acts in response to the others; and
- structured dialogue using four strategies: questioning, summarizing, clarifying, predicting.

Inherent in these components is the concept of dialogue and reciprocation. Learners take on the roles of teachers as well as learners, and learning takes places through a process of discussion, and negotiation. It is this which provides the support necessary for self-monitoring to take place. What makes it pertinent to metacognitive self-regulation is that it is an approach which, while initially structured and teacher-driven, has the ultimate goal of moving from guided practice through the gradual release of responsibility to students' independent development and use of such strategies (Duke & Pearson, 2002).

The activities of questioning, summarizing, clarifying and predicting can offer a gateway to the strategies inherent in reading comprehension. However, simply the practice of such strategies will not necessarily lead to the self-regulatory use of them. It would appear that activities must also be grounded in self-monitoring activities and a feedback mechanism or support to mediate that self-monitoring.

Rosenshine & Meister (1994) ally reciprocal teaching with three particular approaches to support: the zone of proximal development (Vygotsky, 1978); proleptic teaching (Wertsch & Stone, 1979); and scaffolding (Wood et al., 1976). All of these are closely tied to social constructivist theory. Indeed, while Vygotsky never used the term *scaffolding*, his descriptions of interventions where 'new means of solving tasks' are made available through social discourse inform the approach. Proleptic teaching specifically has learners as 'apprentices' who 'as they become more experienced and capable of performing more complex aspects of the task ... modeled ... time and time again, they are ceded greater and greater responsibility until the become experts themselves' (Brown & Palinscar, 1989, p. 410). As the name suggests, scaffolding involves the provision of supports that are geared towards a student's particular capacities (within their zone of proximal development) and are removed as the learner develops the ability to perform tasks independently. In this sense it can be argued that

such approaches are similar to other forms of guided practice (e.g. Hunter, 1982; Good & Grouws, 1979) but in reciprocal teaching emphasis is placed on encouraging students to provide instructional support for one another, instead of simply relying on the teacher as coach and mentor (Rosenshine & Meister, 1994). Scaffolding procedures include 'reducing complexity to manageable amounts, marking critical features, and demonstrating solution when the learner can recognize them' (Rosenshine & Meister, 1994). In summary, when embedded in the instructional process of reciprocal teaching, learning is characterized as a process of emerging expertise, that is adaptable and intentional, and that comes about through scaffolding, where learners adopt modes that are highly interactive and reciprocal. (Dole et al., 1991)

Dermody and Speaker (1999) and King and Parent Johnson (1999) describe studies of reciprocal teaching that identify aspects of the process in practice, and which may serve to contextualise this discussion. In Dermody and Speaker's (1999) research, reciprocal teaching was started through discussion groups, with Year 3 students reading a novel. The teacher engaged students in the strategy of prediction by showing them the cover of the book and then asking what they thought it would be about. The teacher then modelled the process of generating questions, asking the group to clarify words that they did not understand. The questions would be generated by the context of the word within the sentence. As the students started to master the strategies of prediction and question generating, additional question types were then modelled in other literature. As the process of elaboration took place, the role of question generating was ceded to the students. The role of the teacher was then to identify the question type. Examples of questions that students created included:

- what does the word kidnapped mean?
- what happened to Fatou as a young child that changed her life?
- what are slaves? and
- why do you think Phillis was so lonely? (Dermody & Speaker, 1999)

The nature of these questions included clarification, and question/answer relationships proposed by Raphael and Wonnacott (1984) and described by Dermody & Speaker (1999) as *Right There*, *Think and Search*, and *On Your Own* (the first question for example was a clarification question, while the second was a *Right There* question since the answer was in the text). These categories of questions were explicitly described to the students in the studies and they engaged in them in a formal and conscious way.

Scaffolding was evident in this reciprocal teaching of predicting and questioning through the ways in which students eventually become the prime drivers of the process:

> *A natural transfer of teacher led literature discussion groups to student led discussion groups then follows the strategy instruction. Students at this time are ready to take the lead in asking for predictions on literature selections, and creating their own questions in the categories of clarification, Right There, Think and Search, and On My Own. (Dermody & Speaker, 1999, p. 22)*

King and Parent Johnson's (1999) research dealt with the teaching of similar reading strategies, such as clarifying, predicting, questioning and summarizing. The target group however was older students – in this case, students of education who were actually learning how to use reciprocal teaching strategies. This study cites several examples of dialogue between teachers and students, and between students to identify the patterns of reciprocal teaching. These occurred in one example by the teacher introducing a text and then asking students to consider what it was about, based on the title. The teacher than started reading the text of the topic and at the same time 'she slowly elicited student participation ... focusing on using [the strategies of clarifying, summarizing, prediction and questioning] to elaborate on ideas found in the text' (King & Parent Johnson, 1999, p. 170). This was done here by having students articulate their understandings of tornados, bombs and dynamite to develop an understanding of how volcanoes are powerful forces. As with the study conducted by Dermody and Speaker (1999), these strategies were scaffolded to the level where students could engage in them independently:

> *Initially students needed time to practice the ... strategies. When they had gained confidence and had sufficient practice, students used the strategies to explore text and create meaningful dialogue. Through their group interactions students also became aware of the importance of peer feedback and support. Students eventually learned to monitor their comprehension and gained deeper insight into text concepts (King & Parent Johnson, 1999, p. 184).*

As the above examples demonstrate, the continuous focus on depth of processing, through monitoring of comprehension all make the approach of reciprocal teaching one that is very amenable as a support for the development of cognitive self-regulation of reading. These tenets can be implemented in an environment that promotes deep engagement with texts and has activities and a set of resources that promote monitoring of comprehension.

The final section therefore proposes a series of activities and resources within the domain of reading comprehension and through the approach of reciprocal teaching, all guided by the Instructional Model for Metacognitive Development (IMMD) shown in Figure 2.5. The result is the design of a product that could be used to explore how students engage in self-monitoring as a process integral to metacognitive regulation.

2.3 An on-line environment to support the development of metacognitively self-regulated reading comprehension

The choice of activities for the development of metacognitive regulation appears to be guided by the nature of the regulatory strategies inherent within the domain as well as the monitoring required to develop the metacognitive use of these. Therefore, activities can be described as strategic activities or monitoring activities, depending on their type. A range of regulatory strategies pertinent to reading comprehension have already been described in the example studies by Dermody and Speaker (1999) and King and Parent Johnson (1999). Not all are relevant to the purposes of this study. The students that would form the subjects of this thesis were to be higher education students and the intention was to specifically explore on-line approaches to supporting self-monitoring in the reading of academic texts. Therefore the regulatory strategy of predicting could potentially appear as artificially constructed by higher education students since they typically have access to the whole text, and the environment would not engender the same rigidness of teacher facilitation as those in the examples discussed. Also, higher education texts tend not to be narrative in nature, and therefore prediction while still a valuable regulatory strategy could be viewed as less important than, say, the regulatory strategy of determining importance. In academic texts it is fair to say that some ideas may be more important than others, depending on the student's needs. Therefore, the regulatory strategies defined in this model are those proposed by Dole, Duffy, Roehler, and Pearson (1991), specifically, summarizing, drawing inference, questioning and determining importance.

The strategic activities that underpin these strategies appear to be the methods which students use to engage in these processes. These would be familiar to most competent readers. Activities such as adding notes, writing summaries, posing questions, and in the case of determining importance, highlighting sections of the text, all engage learners in the regulatory strategies proposed above.

Monitoring activities are those which engage students in self-monitoring. This has already been defined by Dirkes (1995) as planning, monitoring and evaluating the thinking process. Those activities that involve students in such processes are inherently reflexive in nature. In the classroom environment described by Dermody and Speaker (1999), discussion was the main activity. Other monitoring activities may include comparing notes, which provides for differences in perspective in a similar manner to discussion, as well as clarifying, which while described as a regulatory strategy by King and Parent Johnson (1999) appears also to be a monitoring activity since it involves the learner in comparing their understandings with some

other interpretation. This monitoring is done within activity that is framed by the use of resources relevant to reading comprehension, such as in the case of undergraduate reading, web links, readings, peer comments, and strategy information (information about how to summarize, for example). The monitoring is also supported by the processes inherent in reciprocal teaching, namely a dialogue that takes place between teachers and students and within student groups, and which is scaffolded.

The Instructional Model for Metacognitive Development proposed in Figure 2.5 therefore can be contextualised by adding the regulatory strategies and monitoring inherent in metacognitive reading comprehension with the activities, supports and resources proposed above (Figure 2.6).

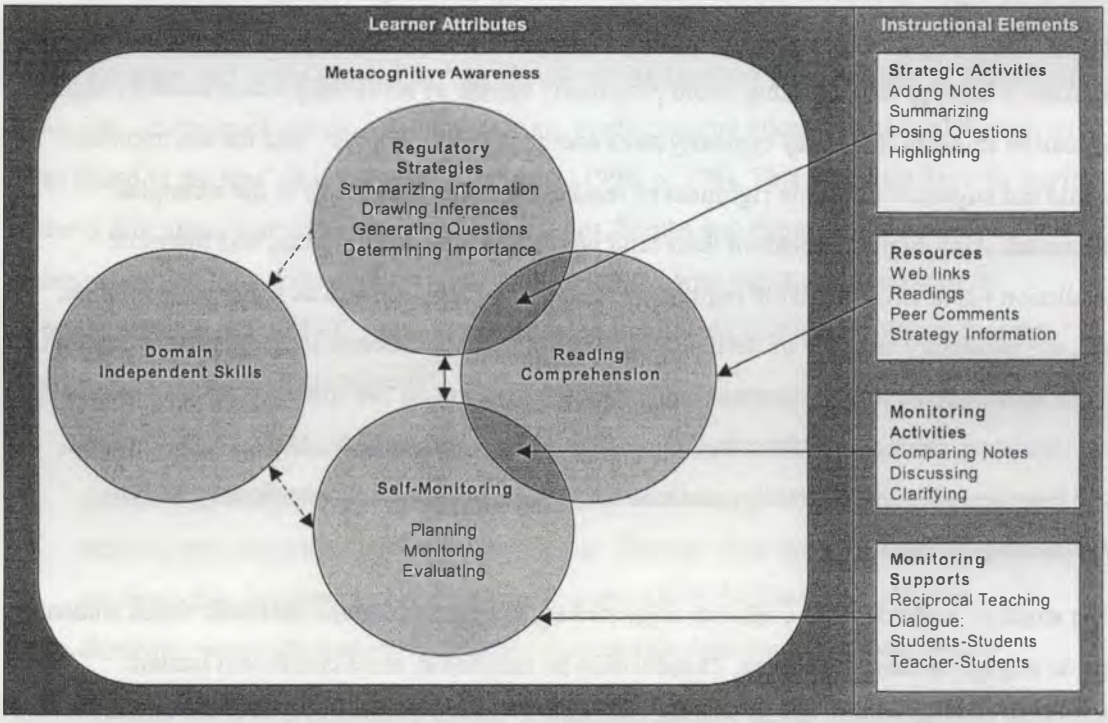


Figure 2.6: The Instructional Model for Metacognitive Development applied to reading comprehension

This model describes a set of teaching and learning processes associated with metacognition. It can be imagined in practice by considering a student who is required to read an academic article to support a learning topic. The student develops understanding of the reading content by engaging in the regulatory strategies of drawing inference, generating questions, rephrasing ideas in his or her own words, as well as working out what are the most important features of the reading. The activities that are required to do this include writing summaries, asking questions about the text, making notes on the sheet and so on. To assist in this process, the student may use other resources, such as Web links, which offer alternative points of view.

These resources also have a role in assisting the student to monitor his or her understanding. The student plans, monitors and evaluates learning by comparing his or her notes on the text with those of others, for example. The student may also seek clarification about an idea from a resource or from the teacher or other students. The processes of modelling, negotiation, and development of consensus inherent in these activities provide the reciprocal teaching support that assists in the monitoring, which in turn enables the metacognitive reconfiguration of strategy use.

2.4 Summary and Conclusions

This chapter has explored the research literature dealing with the concept of self-regulation. This exploration has argued for a focus on cognitive self-regulation and particularly on metacognition as the executive control for students' abilities to regulate their thinking. A model for the development of metacognitive regulation has been proposed. This Instructional Model for Metacognitive Development articulates the development of metacognitive awareness through the development and application of cognitive strategies as well as the self-monitoring that learners conduct as they engage within a domain of learning, and through the instructional components of activities, supports and resources. This chapter has concluded by contextualizing the model within the domain of reading comprehension, where students are required to develop regulatory skills such as questioning, summarizing and drawing inference, and where the use of these skills is monitored through activities such as comparing notes, discussing, and clarifying, all taking place within a reciprocal dialogue.

The next stage of the thesis involved the development of a learning environment supported by an on-line system that could provide the structure, organisation and implementation of the model in a teaching setting, so that the theories described could be tested with a group of learners.

The next chapter describes the development of the tool and articulates how the Instructional Model for Metacognitive Development was applied in its design and planned development.

3 Design and Development of Mark-UP

Mark-UP was designed as an instantiation of Instructional Model for Metacognitive Development (IMMD) in the form of a Web-based learning environment to assist in the development of metacognitive self-regulation for reading comprehension. It was designed to provide the opportunity for subjects to engage in the regulatory strategies inherent in the task through activities such as annotating, information seeking, summarising and so on as well as the underpinning metacognitive processes in these. These activities were to be framed around resources in the forms of reading content (articles in graphical form), Web links, peer comments and expository material provided by the teacher about effective reading strategies. The setting was designed to enable annotation of readings in the ways mentioned above, which were then stored in a database form which could be later accessed. To assist in the self-monitoring required, reflective activities were planned to be embedded in the tool. Users could, for example, compare their own annotations, summaries, etc. with others. They would also be able to seek clarification through discussion facilities and offer alternative points of view to those expressed. Support for this approach was to be found in the scaffolding inherent in reciprocal teaching, where appropriate strategies are initially modelled by an expert, and where students themselves provide guidance for each other, and in a way where such supports are eventually faded to a point where learners are able to engage in these processes in a self-directed way.

To build upon the understandings developed from the readings, a further level of activity was designed that would involve the application of understandings to a problem which had practical design implications. This was designed to promote and demonstrated the metacognitive use of understandings through transformation beyond the domain of reading comprehension. The reading formed the basis of activity within the environment, and provided a visual context for the learning that took place.

This chapter describes the overall process of building Mark-UP in terms of the workflow inherent in the design of the product as well as the process that went into the development of the Mark-UP. Each of the elements within Mark-UP is discussed in terms of its design as well as its potential to support the processes inherent in metacognitive self-monitoring.

3.1 Top-level design of Mark-UP

As has been mentioned, readings were used to form the basis of subjects' workflow within the product. It was designed so that each week a reading would be assigned, which provided an access point to the product. On selecting a reading, users would be presented with a visual representation of that reading. While viewing this, users may then access the tools within the product. Figure 3.1 demonstrates a top level flowchart of Mark-UP's structure.

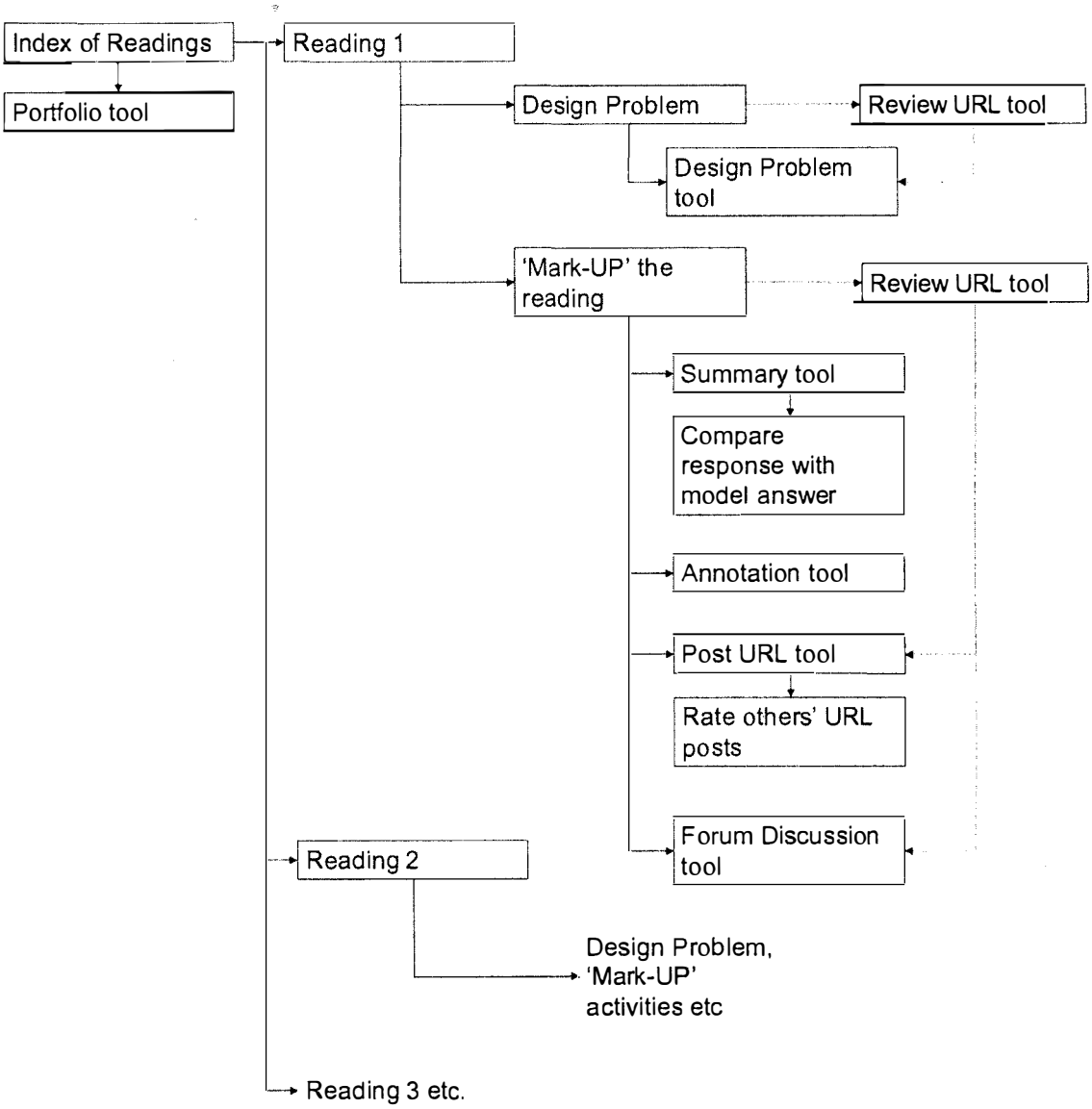


Figure 3.1: Top level design of Mark-UP from users' perspective

As can be seen, each reading was designed to enable activities to be attached to it, whether they would have consisted of design problems or would be more grounded in the process of developing understandings of the readings. As will be shown, the product was designed to make attaching activities and tools to each reading flexible enough to support multiple

instructional approaches. The workflow represented in Figure 3.1, however, demonstrates the typical pattern of activity for learners while using the product during this study. In order to respond to the design problem set for that week, students were to 'mark up' the reading using one or more of the Summary, Annotation, Post URL, and Forum Discussion tools, which are described later in the chapter

The next section describes the development of Mark-UP with regard to the technology selected and design considerations made.

3.2 Development of Mark-UP

The design of Mark-UP provided a structure for an environment that could have been implemented in a number of ways and through a variety of technological platforms. The potential of Mark-UP for flexible instructional design has been discussed. The purpose of this section of the chapter dealing with the design and development of the product is to document the development processes and the decisions made within it that lead to the final product.

Development was funded from a university teaching and learning grant and was done by Andrew Dunbar from the university. The initial challenge for the development of Mark-UP was to identify technologies that could manage the delivery of readings, while at the same time provide a flexible work environment for the collaborative negotiation inherent in the reciprocal teaching model for reading comprehension.

Table 3.1 shows a sample of the technologies assessed in the order in which they were investigated. The initial explorations focused on the Portable Document Format (PDF) as the document delivery method, rather than the conversion of the individual pages into image files.

Table 3.1: Development technologies investigated for Mark-UP

Product	Experimentation summary
Macromedia Director 8.0, deployed as a Shockwave movie, using PDF xtra (Integration New Media).	Although the PDF xtra provided adequate support for PDF documents within the shockwave environment, including auto-downloading of the xtra, it only provided limited support for Macintosh OS 9 clients, and no Mac OS X support. As the final needed to be accessible on a Mac OS X environment this solution was excluded.
Macromedia Director 8.0 deployed as a Shockwave movie, using html member.	This model used HTML pages that were imported into a Macromedia Shockwave movie for display. This model was excluded, as the documents would have to be converted into HTML format, and the HTML support with Director 8.0 was limited to the HTML 3.2 standard.

Macromedia Flash 5.0 using XML objects.	This model required that all the documents would have to be converted into an XML format.
Adobe Acrobat 5.0 Review and Commenting tools.	Acrobat's webDAV-enabled review and commenting feature facilitated all the necessary interactions required by a user when reviewing a document but did not allow for the authored comments to be transferred into a database system. This restricted the usefulness of the comments, as they could not be used outside of Acrobat and therefore not able to be collated into a portfolio. The review and commenting feature was only available in the full version of Adobe Acrobat, which meant subjects would have needed to purchase software
Adobe Acrobat 5.0 using embedded forms submitted to FileMaker Pro 5 and MySQL 3 databases.	This model pre-defined regions on each page within the PDF document. The regions were hidden form elements that the user clicked on which called a JavaScript function. The function then submitted the form data, including the user information, to a backend database. This model worked in practice but did not facilitate any method for bringing in the comments back into the PDF document. This meant that subjects could not view their annotations in their proper context.
PHP enabled Web based system using MySQL Database.	PHP enabled Web pages that use a combination of DHTML, XML, and Flash. This model gave the highest flexibility in design and uses large format, 8bit graphics of the document pages.

The final system design incorporated many of today's leading technologies, including Macromedia Flash, XML (eXtensible Markup Language), LDAP (Lightweight Directory Access Protocol for controlling user authentication), Dynamic HTML to control the regions for annotations and a combination of PHP and MySQL (open source technologies to maintain the database that sat behind Mark-UP).

MySQL was chosen as the database back-end having proven itself with an estimated 4,000,000 customers worldwide (MySQL, 2003). As an open source technology it provides a huge support base of developers and in this situation, 100% uptime.

PHP was another open source technology that offered developers a large number of programming tools for deployment of the Web. A recent survey found 12,000,000 domains using PHP-enabled websites since January 1999 (PHP, 2003). PHP enabled Mark-UP to be a truly dynamic application, with support enabled for MySQL and PostgreSQL databases, PDF generation, XML, XSLT, and LDAP. A key component of the Mark-UP system was its flexible nature of its development, in both the database back-end, and the PHP-enabled front-end.

The flexibility of the back-end MySQL database system can be best described in outlining the main table relationships. Each table was designed with a parent – child relationship, meaning that each table (child) contained the unique identifier of its predecessor (parent). This

recursive design meant it is very easy to 'attach' new tools to the Mark-UP system (Figure 3.2).

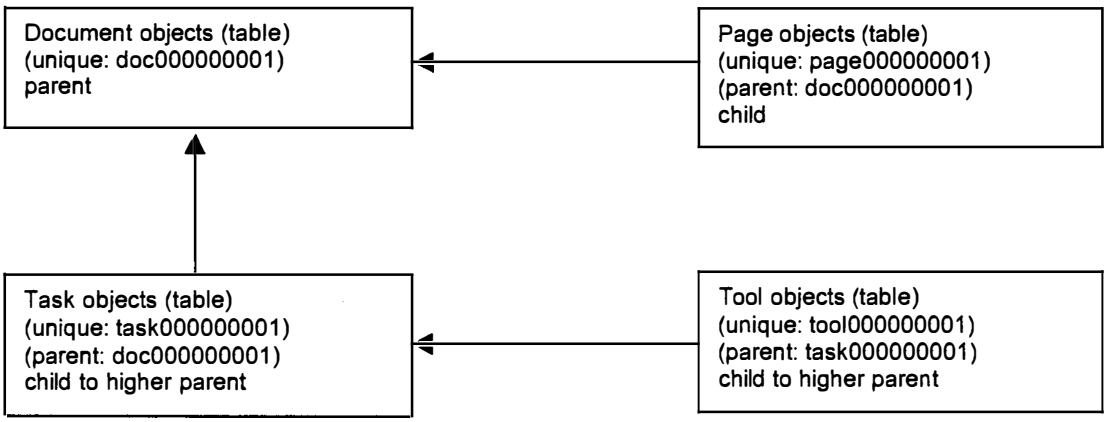


Figure 3.2: Database structure within Mark-UP

The above table relationship allowed new tool objects to be created easily and attached to existing documents, or document tasks without having to modify the existing data.

3.2.1 Design considerations

Once the underlying structure of Mark-UP had been confirmed, the next stage of development was to design an interface to the product that would support the activities defined in the previous chapter as efficiently as possible.

One of the guiding concepts of interface design is that of 'user-centred design' which Dix, Finlay, Abowd, & Beale (2004) describe in terms of 'task-centredness' which more accurately reflects the orientation of users as they use software tools:

> *Understanding the purpose and context of a system is the key to allocating functions between people and machines and to designing their interaction. It is only in deciding what a human-machine system should do and the constraints on this goal that the human and technical issues can be resolved. (Dix et al., 2004, p. xvii)*

As such, the design was informed by the user's need to access readings and maintain this visual access while engaging in activities relevant to those readings. Therefore multiple windows were used to allow this multi-modal approach to the task. This need to rapidly switch focus between the object (reading) and the function (annotation, summary etc) inevitably complicated the interface somewhat. Such complication is not desirable since one of the main goals of interface design is 'transparency', where 'users feel like they are reaching

right through the computer and directly manipulating the objects they are working with' (Mandel, 1997, p. 60). This transparency was sought through the information architecture of the system and through the design of individual screens.

3.2.1.1 Information architecture and interaction design

The main aim of the interface therefore was to maintain the utility and multimodality of the tasks while ensuring the simplest and most direct form of interaction with the system. In order to do this an approach needed to be developed that enabled the user to develop an effective mental model of the system. A mental model 'represents the relative position of a set of objects in an analogical manner that parallels the structure of the state of objects in the world' (Preece, 1994, p. 131). Such models can be functional, in that the model represents the procedures or processes the user engages in, or they can be structural in that the model represents an internalised concept of the structure of the system.

Mark-UP was designed with a view to supporting both structural and functional mental models of the system. This best demonstrated through Figure 3.1. The system needed to expose the hierarchy of readings, followed by activities; and the same time to enable the user to develop an understanding of how the workflow involved the completion of activities with the use of tools. To promote this functional model, a consistent approach to the organisation of activities was used. For example, a design problem was always presented as the main activity, with Mark-UP activities subordinate to these. While this maintained a level of flexibility necessary for a high level of user control, the emphasis on design problems also promoted a 'best case' approach to the use of the environment that became a familiar functional model for users.

Mark-UP was also designed to provide an effective means of navigating through the system. As a Web-based environment, the conventions of Web interaction were followed to ensure that interactions would be as intuitive as possible. These included the use of standardised 'widgets' such as the use of arrows to represent cascading menus, a consistent colour to identify hyperlinks (in this case a pale blue), standard use of aspects such as labelled form elements, and consistent use of functions such as 'submit' 'edit', 'delete' and so on.

When interacting with any system, responsiveness is an important factor in minimising user confusion and anxiety (Shneiderman & Plaisant, 2005). Mark-UP was therefore designed to provide an appropriate level of feedback to the user. This involved the following types:

- use of standard Web elements to indicate status (cursor changes, rollovers etc);

- feedback to minimise errors (form checking, pages acknowledging a successful post etc); and
- feedback to indicate process (intermediate screens indicating an action is in process, redirection after a few seconds etc).

The above were designed to give the user confidence in the security and functionality of the system and to reduce potential errors through, for example, multiple submissions of posts while minimising impatience in waiting for screens to load (interlaced graphics, for example, were used to enable pages to be seen as they gradually loaded).

3.2.1.2 Visual design

While visual design is fraught with issues relating to the subjective nature of taste and aesthetics, there are a number of guidelines available which are somewhat neutral in terms of the emotional associations with visuals, yet at the same time provide a useful heuristic for designing screens.

Marcus (1989), for example, describes visual design in terms of three imperatives:

- organize;
- economize; and
- communicate

Williams (1994) describes four principles to inform design:

- proximity;
- alignment;
- repetition; and
- contrast.

All of the above are broad guidelines to be applied to specific visual language elements such as layout, typography, colour and texture, imagery, animation, sequencing, sound, and visual identity (Marcus, 1989).

In fact there are many similarities between the two sets of guidelines. In discussing organization, for example, Marcus (1989) emphasises consistency as an approach that makes the organization of pages clear. Williams (1994) too emphasises consistency but within the guideline of repetition, where elements common to multiple pages use repeated design features to emphasise their similarity. The visual design of Mark-UP was informed partly by Marcus' principles of Organize, Economize, and Communicate (Marcus, 1989), but primarily by Williams' concepts of Proximity, Alignment, Repetition, and Contrast (Williams, 1994).

The discussion of the visual design of Mark-UP therefore addresses issues relating to the use of text, colour, imagery and so on within these four principles.

Proximity

Proximity refers to the relationship between screen elements. In practical terms this involves separating elements that are different and keeping elements that are similar close together. In the design of Mark-UP it was important to ensure a clear sense of which elements belonged where. For example, functions related to specific tools within the product were always kept close by the tool. Figure 3.3 demonstrates how the ability to create a new annotation was presented at the same level as the title to view existing annotations, while the link to respond to specific annotations was presented at the top of the section where the annotation begins.

Figure 3.3: functions provided in proximity to their related content

As well as organizing screens to keep related elements together (such as captions with images etc) another example of proximity is the use of white space to separate unrelated elements. Mark-UP was designed to make liberal use of white space to both distinguish between related and unrelated elements and to provide visual relief to prevent the screen from being overcrowded. The example in Figure 3.4 demonstrates how white space above and below the tools within Mark-UP provided relief from the 'business' of the reading page while distinguishing it as a discrete set of tools both separate from each other but related.

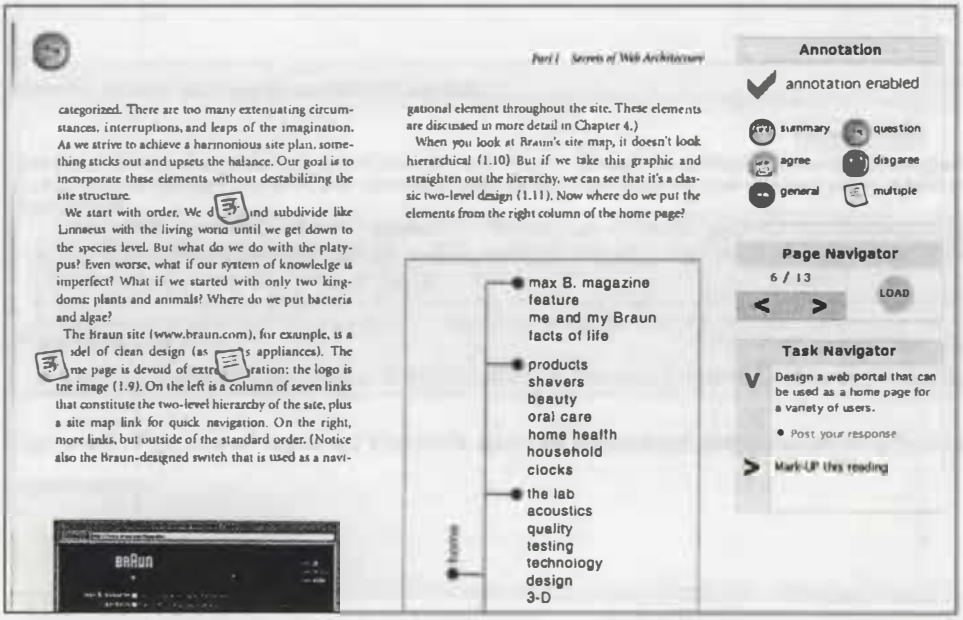


Figure 3.4: The design principle of proximity where related elements are grouped and where white space is used to differentiate between elements

Alignment

While the set of tools on the right of Figure 3.4 demonstrates how white space above and below were used to distinguish it from the reading, and how some limited space was used between the function of page navigation, annotation, and the task navigator to both distinguish and relate them, another important feature Figure 3.4 shows is the use of alignment. The screen is essentially broken into two columns with the reading page on the left and the functions on the right. The sizes of these columns were designed to be consistent throughout the page which broke it up into a grid-based system. This enabled easy visual scanning of the screen. It also enabled a hierarchy to be represented through indentation.

Figure 3.5 shows how multiple elements could be combined in ways that enabled clear distinction between them through the use of alignment.

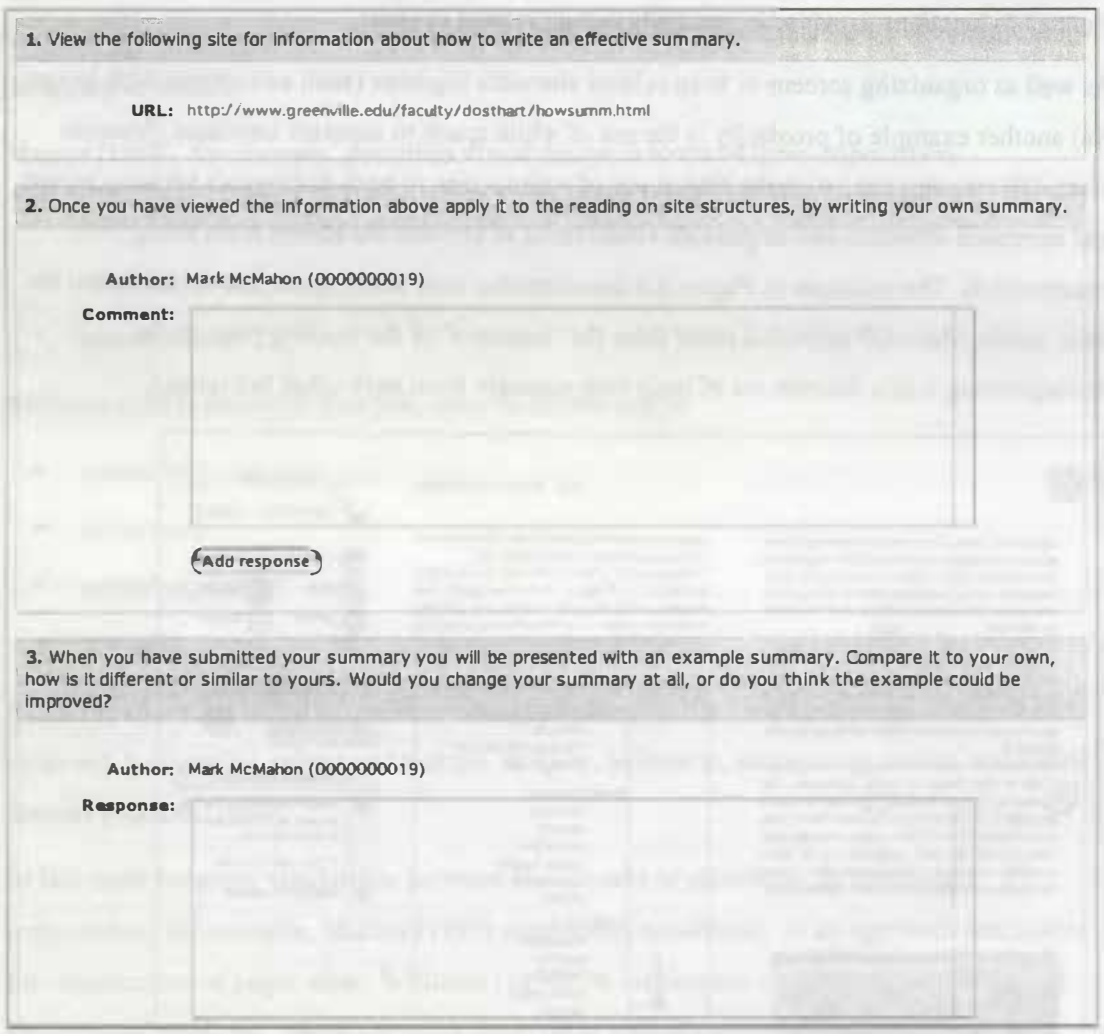


Figure 3.5: Alignment in Mark-UP

Each task consists of a box of a regular size. With these however, the text entry boxes are indented both on the left and right of the screen to demonstrate their role as subordinate to the main task descriptions. A clear relationship is maintained between elements where the name of the author is aligned with the text entry box, which in turn is aligned with the add response button. One can also observe the right text alignment of the author and response labels, which brings them in closer proximity to the elements they describe.

Repetition

Figure 3.5 also demonstrates a number of repeating elements. Heading sizes are consisted throughout the whole product. Each of the tools shown in Figure 3.5 is clearly distinguished by the consistent and repeated approach to the typography. For example, headings are bold text against a grey background, links are blue text, labels are bold right justified text and so on. This consistency was designed to assist in providing unity to the design and supporting immediate recognition of the types of information contained on the screen.

To assist this process, cascading style sheets were used to define the colours, weight and alignment of text elements. This ensured consistency between the various implementations of different heading levels and also allowed the style to be customised later.

Repetition was also used as a design feature to organise information. Lists of items, for example, were numbered or displayed as bullet points in a consistent manner to ensure their readability (Figure 3.6).

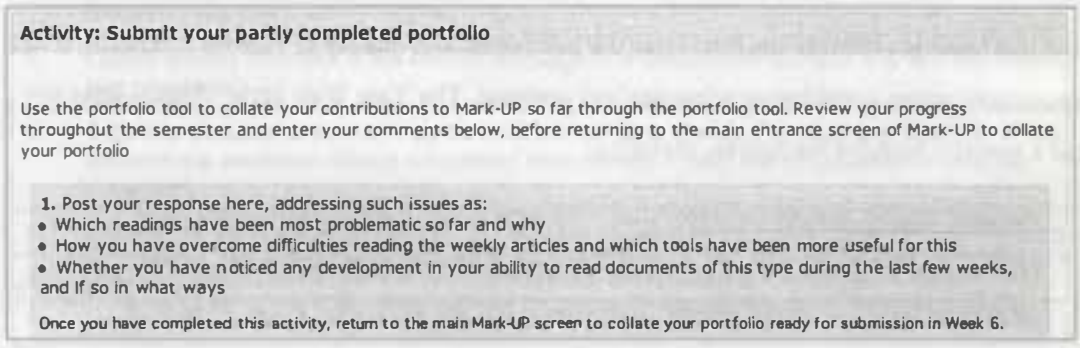


Figure 3.6: The use of repeated elements such as numbered and bulleted lists to assist organisation

Contrast

Contrast is to a certain extent the flipside of repetition. While repetition can emphasise the organisation of similar elements such as the use of consistent heading styles, and bullets for

ideas that have equal weighting, the use of contrast enables a hierarchy to be demonstrated within design. In Mark-UP all of the heading styles were designed to be quite different from each other in order to be clearly distinguished. As Figure 3.6 demonstrates, alternating background colours of white and grey were used to provide a clear separation of different screen elements and marked break-points in the text, such as different students' posts.

In order to clarify the types of annotations that students were to make in Mark-UP, the principle of contrast was also applied to the use of icons. Different colours and expressions of the annotation icons (Figure 3.4) were used to distinguish between questions, summaries, agreements, and disagreements. These icons also made use of contrast as a tool to provide visual interest (Williams, 1994).

Finally, legibility and readability issues relating to the text were addressed with this guideline. Adequate foreground and background contrast was provided for reading with a white or pale grey background combined with use of dark grey or black text. Typography is a significant issue when designing for the screen instead of for print:

> *Typographic design for the computer screen is difficult because of the relatively low resolution of personal computer displays. The low-contrast of reflected light LCD screens now used on many types of portable computers also severely limited type legibility in all but the best lighting circumstances. These compromises in the resolution and visual contrast of screen typography result in reduced reading speed and comprehension, but proper typographic design can do a great deal to relieve the difficulties of text in computer documents (Lynch, 1994)*

While this issue is certainly improving as the resolution and quality of screens increases, it has repercussions when considering adequate text contrast. The Yale Web Style Manual does not argue a specific font for the screen, claiming:

> *Various studies purport to show that serif type is more legible than sans serif type and vice versa. You can truly judge type legibility only within the context of the situation — on the screen — as users will see your Web page' (Lynch & Horton, 2002)*

However, to ensure the resolution of the viewing device did not impact negatively on the legibility of fonts, fonts were chosen that were either designed specifically for the Web or were sans-serif on the assumption that legibility would be best served by clean simple lines, while the decoration of serifs had the potential to impact negatively on the legibility of text by excessively complicating the type styles. Where it was not possible to use a sans-serif font

(for example in some of the graphical readings which were scanned bitmap images) fonts were presented at a larger size.

For that reason, the font list embedded in the style for the pages within Mark-UP was 'Arial, Helvetica, MS Sans-serif, and Verdana' at 10-12 point. Times or Times New Roman were used only for larger headings.

3.2.1.3 Accessibility

As has already been discussed, the technology used by Mark-UP was designed to promote the most flexible use of the product without the need for expensive client software or proprietary solutions. The server-based processing of PHP/MySQL enabled most machines with recent Web browsers and a connection to the Internet to use the product without extra plug-ins or other forms of software.

As well as the underlying technology of the product, Mark-UP's accessibility was ensured by applying the level 1 priority guidelines defined by the W3C as shown in Table 3.2 (World Wide Web Consortium, 1999).

Table 3.2: W3C Accessibility guidelines informing the design of Mark-UP

No	Guidelines
1.	Provide a text equivalent for every non-text element (e.g., via "alt", "longdesc", or in element content). This includes: images, graphical representations of text (including symbols), image map regions, animations (e.g., animated GIFs), applets and programmatic objects, ascii art, frames, scripts, images used as list bullets, spacers, graphical buttons, sounds (played with or without user interaction), stand-alone audio files, audio tracks of video, and video.
2.	Ensure that all information conveyed with color is also available without color, for example from context or markup.
3.	Clearly identify changes in the natural language of a document's text and any text equivalents (e.g., captions).
4.	Organize documents so they may be read without style sheets. For example, when an HTML document is rendered without associated style sheets, it must still be possible to read the document.
5.	Ensure that equivalents for dynamic content are updated when the dynamic content changes.
6.	Until user agents allow users to control flickering, avoid causing the screen to flicker.
7.	Use the clearest and simplest language appropriate for a site's content.
8.	Provide redundant text links for each active region of a server-side image map.
9.	Provide client-side image maps instead of server-side image maps except where the regions cannot be defined with an available geometric shape.
10.	For data tables, identify row and column headers.
11.	For data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells.
12.	Title each frame to facilitate frame identification and navigation.
13.	Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative

accessible page.

14. Until user agents can automatically read aloud the text equivalent of a visual track, provide an auditory description of the important information of the visual track of a multimedia presentation.
15. For any time-based multimedia presentation (e.g., a movie or animation), synchronize equivalent alternatives (e.g., captions or auditory descriptions of the visual track) with the presentation.
16. If, after best efforts, you cannot create an accessible page, provide a link to an alternative page that uses W3C technologies, is accessible, has equivalent information (or functionality), and is updated as often as the inaccessible (original) page.

This issue of accessibility is one that has practical as well as political ramifications. On one hand it is in the designer's best interest to make a product as accessible as possible; on the other, a number of legal cases have emphasised the importance of accessibility. In one of these examples, a visually impaired Web user successfully sued the Sydney Organising Committee for the Olympic Games because of inaccessible features of the 2000 Olympic Games website (McLellan, 2003).

While not all of the above guidelines were relevant to the product (for example, Mark-UP did not contain any time-based multimedia or frames) and some extra elements were incorporated into design (for example, text contrast is defined within the W3C's level 2 priority guidelines), the application of all of the relevant priority 1 guidelines into the design of Mark-UP ensured the majority of users could access the product effectively and enabled the product to claim level A conformance to W3C accessibility standards.

As well as general accessibility, Mark-UP was also tested in current versions of Netscape, MS Internet Explorer, and Apple Safari browsers both on Mac and PC platforms to ensure the broadest level of useability across multiple platforms and softwares.

3.2.2 Design explorations and prototype

Carol and Rosson (1985) characterise design in the following way:

- It is a process – it is not a state and it cannot be adequately represented statically;
- The design process is non-hierarchical; it is neither strictly bottom-up nor strictly top-down;
- The process is radically transformational; it involves the development of partial and interim solutions that may ultimately play no role in the final design; and
- Design intrinsically involves the discovery of new goals. (Carroll & Rosson, 1985).

The above principles formed the basis for the design process that was undertaken during the development of Mark-UP. Firstly, it was an evolutionary process that took place over a period of time where different technologies were tested. Secondly, this process of trying out new

technologies and approaches lead to a non-hierarchical approach to refinement redesign. Thirdly, the design and development of Mark-UP produced issues as well as unanticipated opportunities. One of the issues for example was the ability of PHP to parse non-standard characters such as '&' '%' without interfering with the actual syntax of PHP, which made use of some of these characters to form text strings and so-on. An interim solution was created where all potentially conflicting characters would be automatically stripped from users' posts. Finally, the discovery of new goals as a component of the design process meant that extra features could be built into the product once the potential of the environment was proven. An example of this was the ability to rate other users' URL posts, which was not incorporated into the earliest iteration of the product.

The process of prototyping the product involved expert review of design, as well as more formal aspects of evaluation such as desk-checking of code for logical and syntax errors. Beyond this abstract level of testing, the designer used the software from both an administrator and user's point of view to check for errors in the product.

Figure 3.7 shows an early prototype of Mark-UP. This prototype was used to assess the effectiveness and efficiency of the system with regard to the annotation tool, which incorporated much of the technology that was built into the other tools (such as text submission) as well as the more complex aspects of creating screen regions for annotations. The early prototype did not contain a full administrative system, nor did it allow for multiple tasks to be created or the attachment of other tools to these tasks. As will be shown, the design differed significantly from the later prototype.

Figure 3.7: Early prototype of Mark-UP

Once it was ascertained that the underlying technology worked effectively as a proof of concept, a more complex prototype was created. This second iteration was a fully functional working model of the product, which acted as a testing environment for both the technical stability and interface design of the product. An example screen of the revised prototype is shown in Figure 3.8.

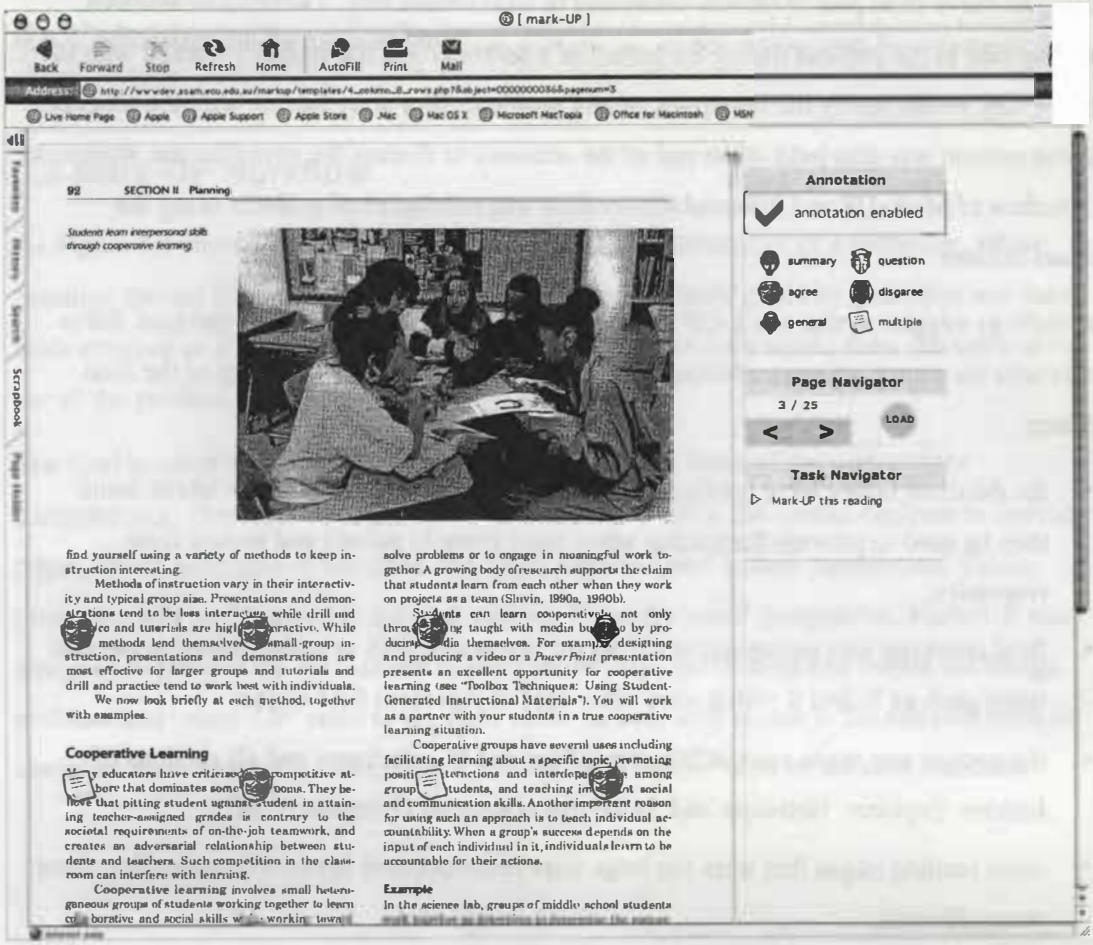


Figure 3.8: Sample Mark-UP prototype screen

As well as incorporating the full range of tools within the product, this prototype also contained some interface refinements. These consisted of:

- the creation of a Task Navigator, which allowed multiple tasks to be assigned to a reading;
- the inclusion of a Page Navigator. While the early prototype had an automatically generated 'tab' system for page navigation (Figure 3.7), this proved impractical when readings consisted of lots of pages. The task navigator was designed to allow the user to select a page then load it;
- multiple annotation types represented as different icons on the page – designed to provide users with the ability to instantly recognise the type of annotation before viewing it as well as to see where there were multiple annotations; and
- a restyling of the text and hyperlink colours to make it consistent with the learning management system into which Mark-UP was integrated.

Testing of the revised prototype was conducted in an informal way. Twenty-five students were exposed to the product during the period of a semester. As the students worked with the product they would notify the researcher of any problems they were having with the product. A focus session was also held at the end of the semester to discuss the strengths and weakness of interface of Mark-UP and informal observation was conducted of students using the product in class.

The findings suggested that Mark-UP was on the whole a useable and stable product. Some issues with the prototype were addressed to ensure the efficiency and stability of the final product:

- the database tables were configured to allow them to store HTML tags which could then be used to provide formatting when users came to submit and review their responses;
- field checking was incorporated to trap for characters such as smart quotes or unusual items such as % and $ which were often used to represent field codes;
- the system was made compatible across Mac and PC platforms and all versions of Internet Explorer, Netscape, and Safari that supported Dynamic HTML;
- some reading pages that were too large were recompressed to make downloading them more efficient;
- the 'tribal' style icons were replaced with more friendly faces as they were perceived to be somewhat aggressive by a number of students;
- the product was more smoothly integrated into the learning management system, incorporating the ability to carry over Active Directory Server details to prevent users from having to log in a second time; and
- some pages the text was considered too small to read so were recreated at a larger size.

3.2.3 Summary and conclusions about the development of Mark-UP

This section has described the top-level design of Mark-UP as well as the technology employed and the approach taken to the design, prototyping and development of the product. The overall design and development process of Mark-UP took a period of 8 months. This involved initial explorations of technologies and the development of design criteria followed by the six month trial of the revised prototype of Mark-UP and its continuous refinement over that time. This led to a final version that was created for the purposes of exploring the aims of this research. The next section describes this final version to explain the functionality within

the Mark-UP product as well as the workflow involved from both the user's perspective and that of administering the environment.

3.3 Mark-UP workflow

As Figure 3.1 shows, Mark-UP was designed from the perspective of a hierarchy, where readings formed the basis of the environment and where tasks could be generated and then tools attached to allow the tasks to be completed. This structure would form the basis of the use of the product.

The final product consisted of two separate perspectives; those of the user and the administrator. The administration mode was created to allow the course designer to upload pages, create problems or activities and apply tools to assist in their completion. These processes will be discussed in the next section. From the users' perspective, Mark-UP was designed to provide the mechanism to navigate through the reading and access the design problem and 'Mark-UP' tasks to the right of the screen, with access to the relevant tools to complete them below the tasks. Figure 3.9 shows this users' view of the user interface.

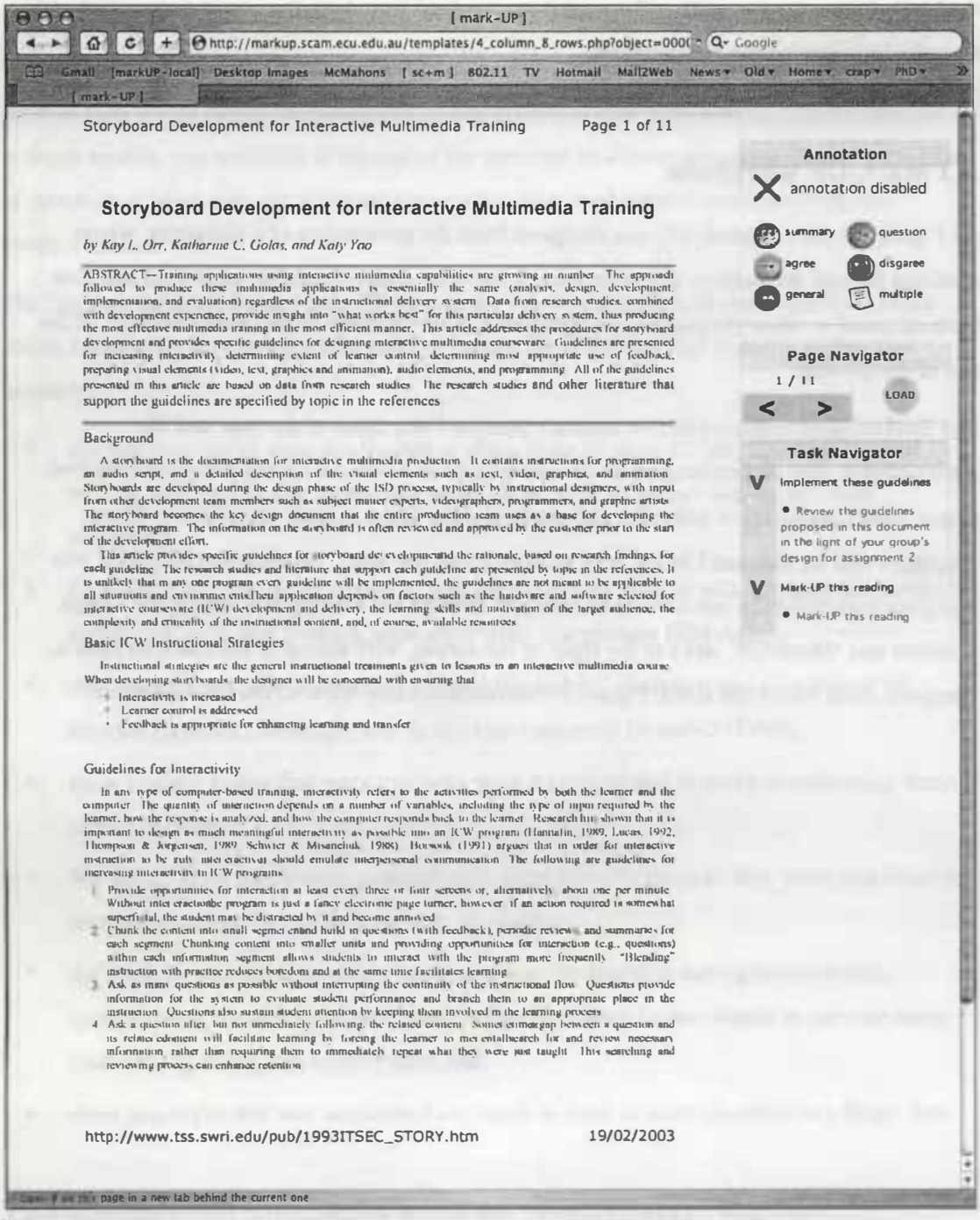


Figure 3.9: Page and task navigation view of Mark-UP

Selecting a task (in the case of Figure 3.9, either to complete the design problem implementing design guidelines to a specific context, or to 'mark up' the reading) would give access to the tools available within the product. A description of each tool and its rationale in terms of how it could be used to promote subjects' self-regulation is listed in Table 3.3.

Table 3.3: a detailed description of the tools available in Mark-UP and the reasoning behind them

Tool	Description	Rationale
Design Problem	This tool enabled the course designer to pose questions and provide a text box for users to complete. Questions could take many forms, for example prompts about a reading, or instructions for the end user to provide concrete examples.	This was a generic tool that allows handling of information types not supported by links and annotations. As well as responding to design problems it provided an opportunity for users to evaluate their progression over a period of time and review previous work to identify their conceptual growth. This was the tool for example that was used by subjects to identify plans and evaluate them later in the semester.
Summary	This tool was designed to allow subjects to summarise a whole reading. As the discussion of the administration of Mark-UP later in this chapter shows, the tool was essentially the same as the Design Problem tool, using a text-box response, but was used in this case for a different purpose. The tool also allowed the course designer to provide a model answer, which subjects could review after having submitted their original summary.	This tool enabled subjects to engage in the strategy of summarising that was identified in Chapter 2 as one integral to strategic reading. Subjects could be required to summarise a whole reading, or identify key ideas within it. The implementation of a second level of activity by having subjects review and compare their response to a model answer enabled a further level of reflection and monitoring.
Post URL	Subjects could add a link to an external website, including a title and comment. Once completed, they then had an option to review the URLs posted by others and rate them according to a star value (0-5) as well as add comments.	This tool was used to have students reflect on their interpretation of a specific reading and engage in information seeking by finding a website that covers a similar topic, and then discuss the similarities and differences in points of view. The ability to rate other students' links, and compare perspectives, also provided the reciprocal teaching for the self-monitoring processes in which learners engaged.
Annotation	Users clicked on a part of the reading to add an annotation to it, which then appeared as an icon on the screen at the point where they annotated. Annotations took the forms of: • Summary • Questions • Agree • Disagree • General Each type of annotation was represented by a different icon. Learners could view each other's annotations and add to them.	This tool was used to have students engage in the regulatory strategies for reading comprehension as proposed by Dole et al. (1991). Support for self-monitoring was provided by the discussion with peers.
Forum Discussion	This provided a direct link to an on-line discussion board. Subjects could start general discussion threads or respond to existing discussions	The Forum Discussion tool is one common to many on-line learning environments. In this case, it accommodated discussion that was not tied to a specific section of a reading but could be more general in nature. It enabled peer collaboration about a range of issues that were prompted by the reading

Portfolio	Portfolios consisted of a summary of all the subjects' work organised by reading. Students generated their portfolio which they could review and amend before submission.	The value of journaling as a means to enhance self-awareness has been well documented (Brooks, 1997). The Portfolio tool's role was for summative assessment, but most of all it provided an information base for further reflection. Students were required at times to review their understandings as articulated within the portfolio to describe how these had developed.
Review URL	This was an adjunct tool rather than a tool in its own right since it did not require any response from the subject per se, but could be integrated into the above tools, such as having subjects review an URL before finding one which complemented the example provided.	This tool operated as a prompt and enabled the course designer to integrate other sources of information into a Design Problem. Since it was a discrete tool within the project it is mentioned here although it did not actually involve any response from the user, and was not explored as part of this research.

The next section describes each tool individually, demonstrating how subjects were intended to use them during the implementation of Mark-UP.

3.3.1 Design Problem tool.

The Design Problem tool was essentially a text box submission form. Once a problem had been designed, the tool was to be attached by the course designer to enable subjects to respond to the problem. Figure 3.10 demonstrates how the tool was designed to appear to the user.

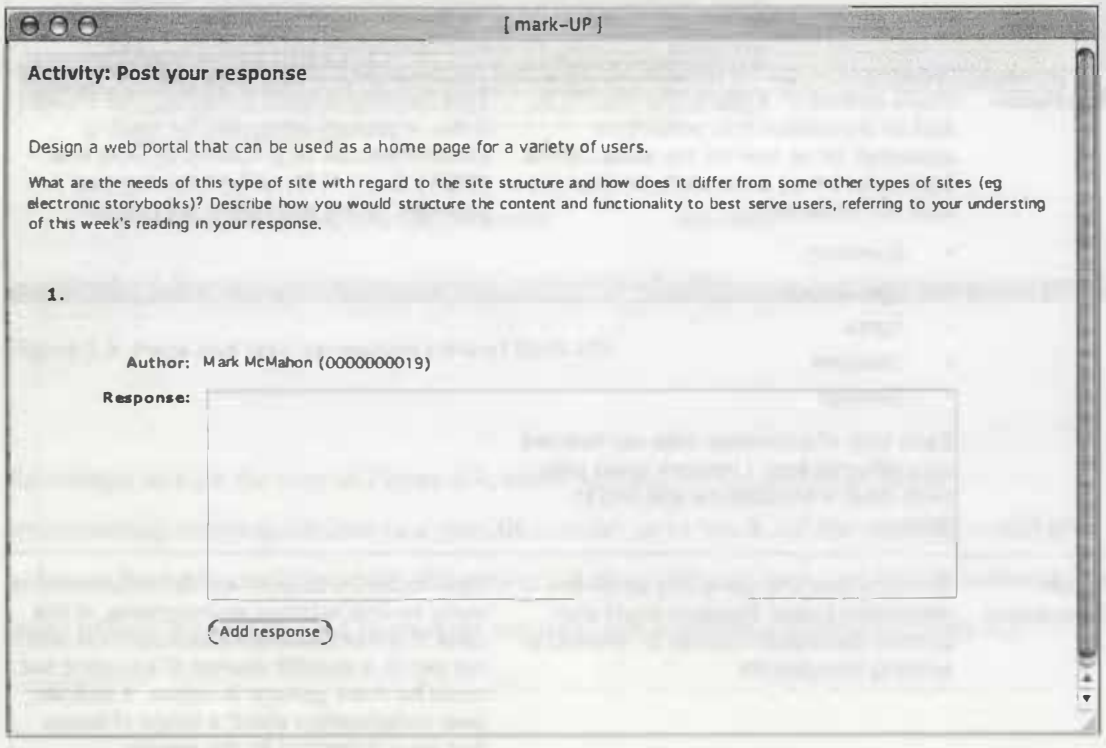


Figure 3.10: The Design Problem tool

Like all of the response tools within Mark-UP, the Design Problem tool would allow users to submit their response and then view or edit it later. The text box allowed subjects to format their responses using HTML tags for paragraph spacing, text formatting, creating bullet points and so on.

3.3.2 Summary tool

This was essentially the same tool as the Design Problem tool. It used a standard text box form as shown in Figure 3.11.

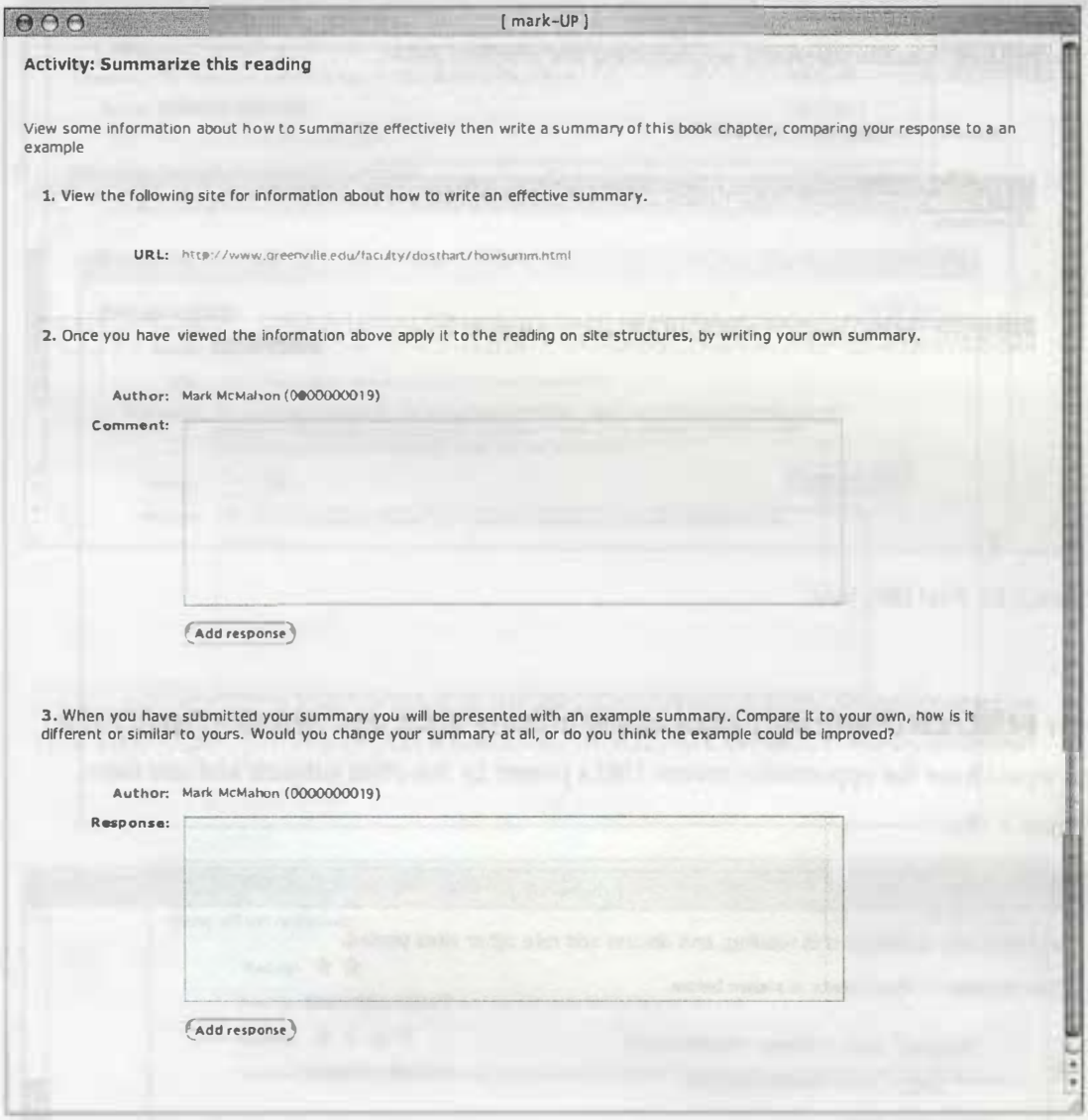


Figure 3.11: The Summary tool using in combination with the Review URL tool and with the option of comparison with a model answer

Figure 3.11 also shows how the ancillary tools of Review URL and the addition of a model answer for comparison could be attached to a single activity. In this instance, subjects would be required to review a website that discussed strategies for summarising, before writing their

own summary. Once submitted, the product would allow users to review a model answer and then using the same standard text box, identify similarities and differences between the model answer and their own response.

3.3.3 Post URL tool

The Post URL tool was designed to enable users to provide a Web address and comment on it as in Figure 3.12:

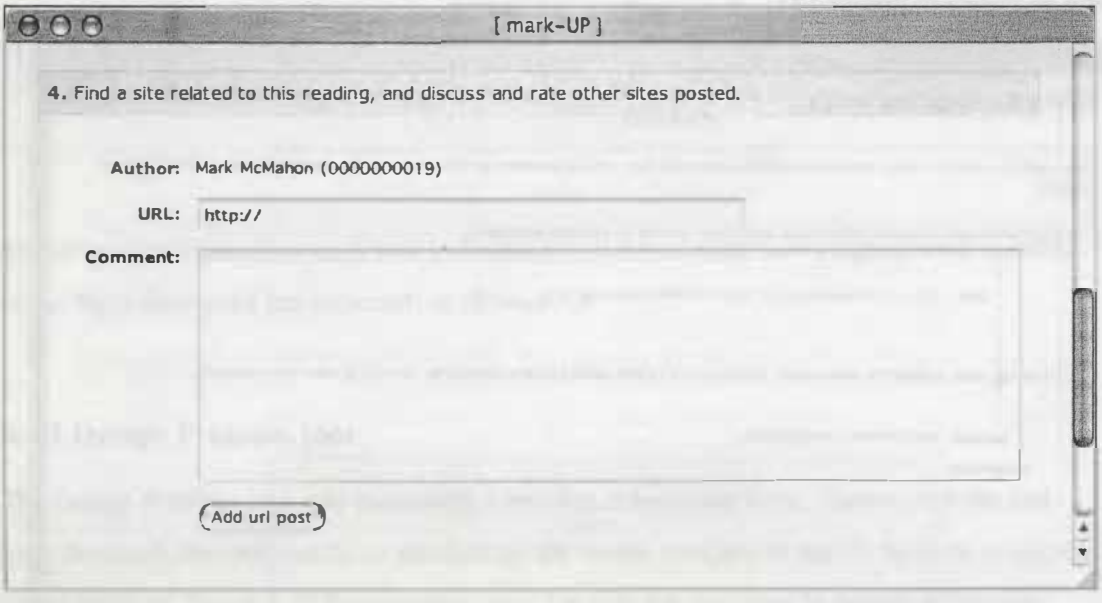


Figure 3.12: Post URL tool

Once a URL was posted, users would be able to edit or delete their response (Figure 3.13), and would have the opportunity review URLs posted by the other subjects and rate them (Figure 3.14):

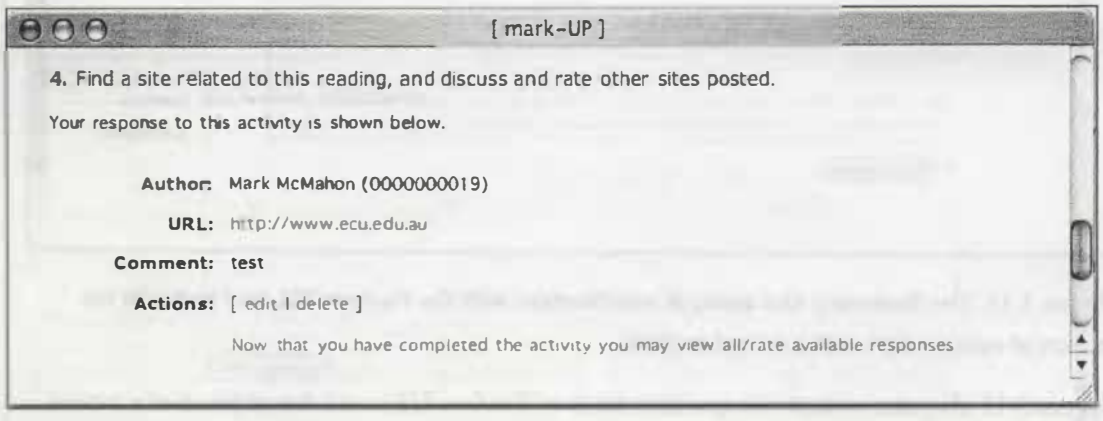


Figure 3.13: Editing URL posts

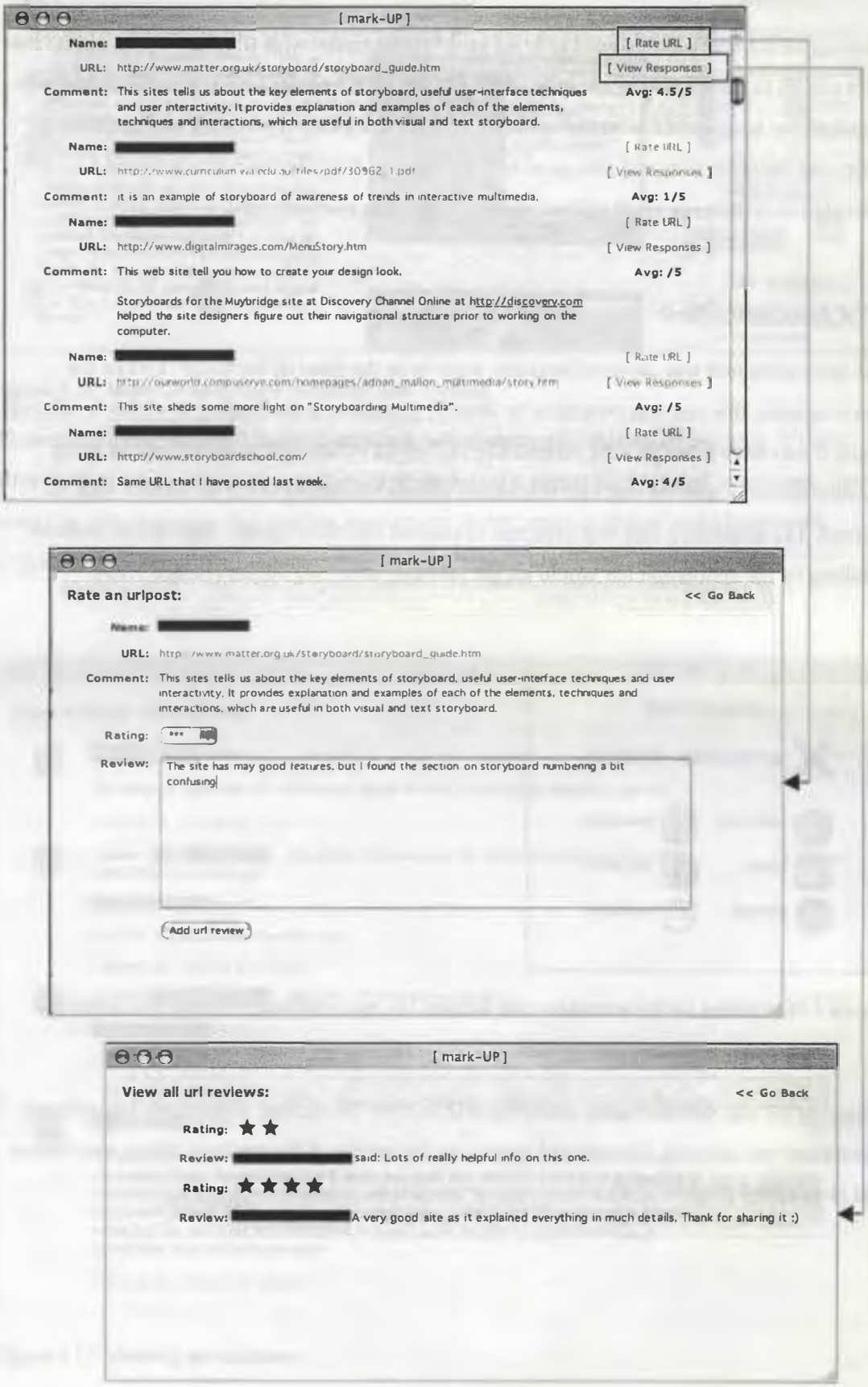


Figure 3.14: Reviewing and rating posted URLs

Clicking on the link was designed to bring up a further screen with all of the URLs posted that were related to the reading in question. The ratings would be done on a scale of 0 to 5. It was intended that users would have the option of either adding their own rating and comment or reviewing the comments and ratings of others (Figure 3.14). The main rating would be presented as an average of all of the ratings made on the particular site.

3.3.4 Annotation tool

The annotation tool was designed in many ways to be the heart of Mark-UP. Unlike the previous tools, this one was created to be directly grounded in the reading to which it referred. While it was envisioned that the Annotation tool could be attached to an activity as in the example above, it was the one tool that would always available even if an activity was not defined. The annotation tool was designed to support two main modes: disabled or enabled. Clicking on the annotation bar would toggle between these two modes (Figure 3.15).

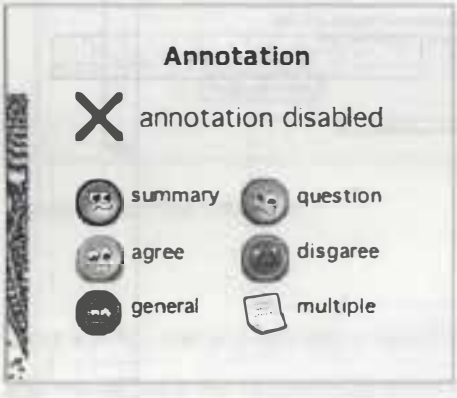


Figure 3.15: Clicking on the annotation bar toggled the mode between enabled and disabled

If annotation was disabled users would be able to view the reading without any impediment. If annotation was enabled, icons would appear on the section of the readings where annotations had been added (Figure 3.16).

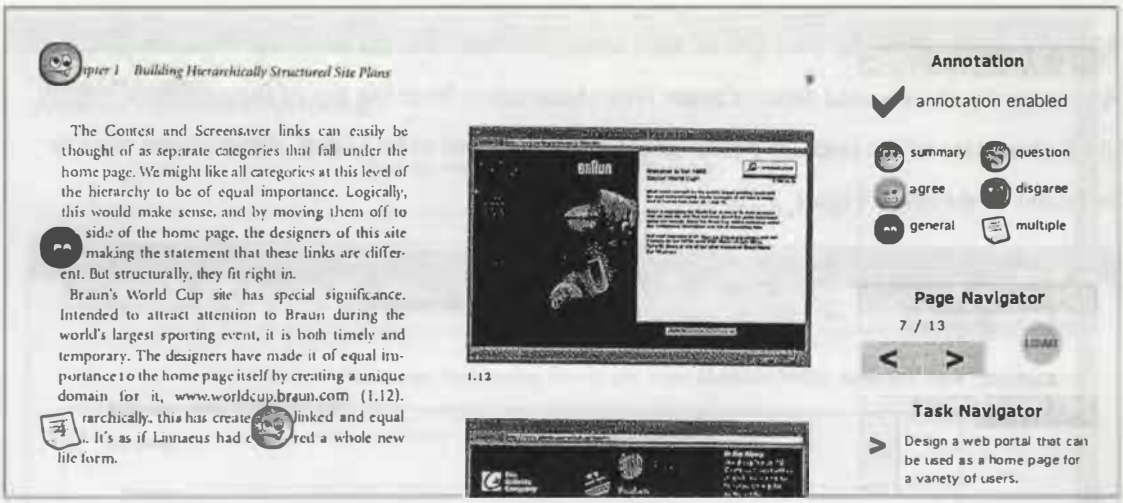


Figure 3.16: Mark-UP with the Annotation tool enabled

These icons were designed to represent the types of comments that could be made. If users were to click on an existing annotation or an area on the screen they wanted to annotate, they would be able to review the existing annotations at that point or choose to add their own (Figure 3.17).

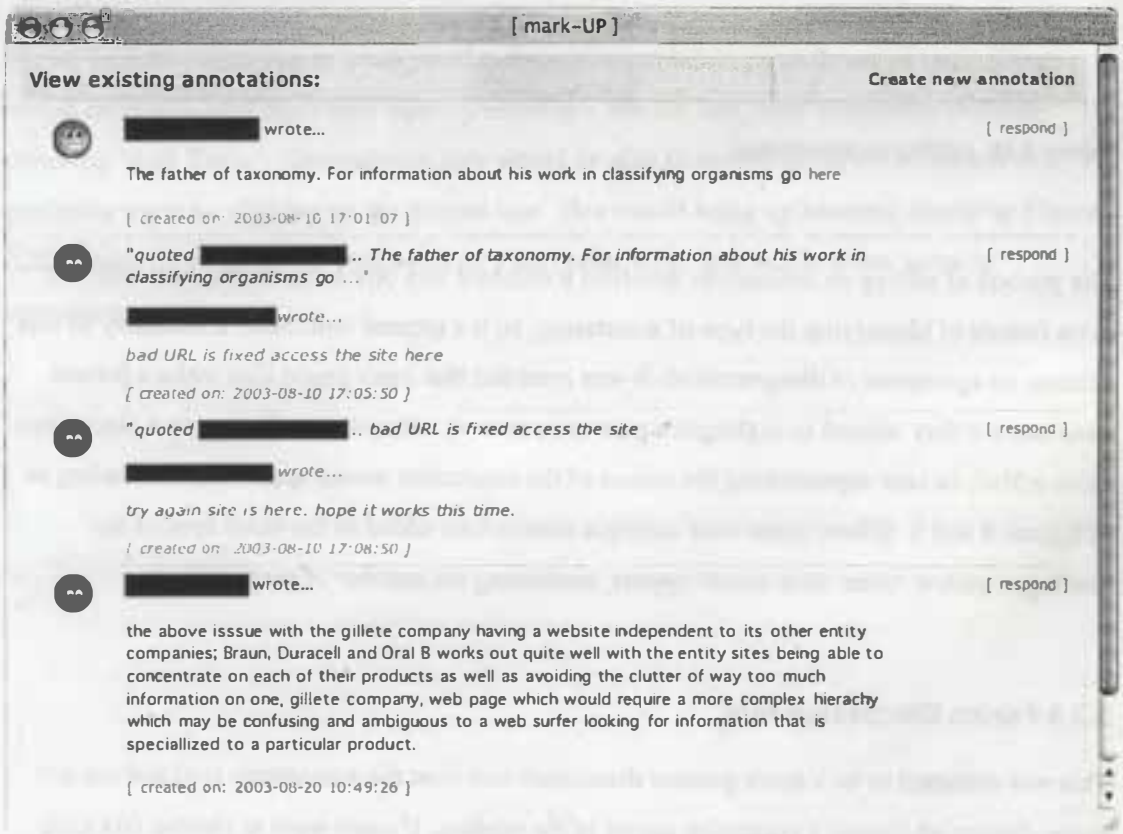


Figure 3.17: Viewing annotations

As Figure 3.17 shows, to the right of each annotation there would be an option to respond. Alternatively users would select Create New Annotation from the top of the screen or simply click on an area of the reading where annotations were yet to be added. Annotations were to be added as shown in Figure 3.18.

Figure 3.18: Adding an annotation

The process of adding an annotation involved a standard text box submission form with the extra feature of identifying the type of annotation, be it a general comment, a summary of that section, an agreement or disagreement. It was intended that users could also make a private annotation if they wished to highlight a particular section without contributing to a discussion. Once added, an icon representing the nature of the annotation would appear on the reading as in figures 8 and 9. Where there were multiple annotations added to the same area of the reading, a yellow 'note' icon would appear, containing the number of responses.

3.3.5 Forum Discussion tool

This was designed to be a more general discussion tool than the Annotation tool and did not frame discussion around a particular aspect of the reading. If users were to choose this tool, they would engage in a threaded discussion as shown in Figure 3.19:

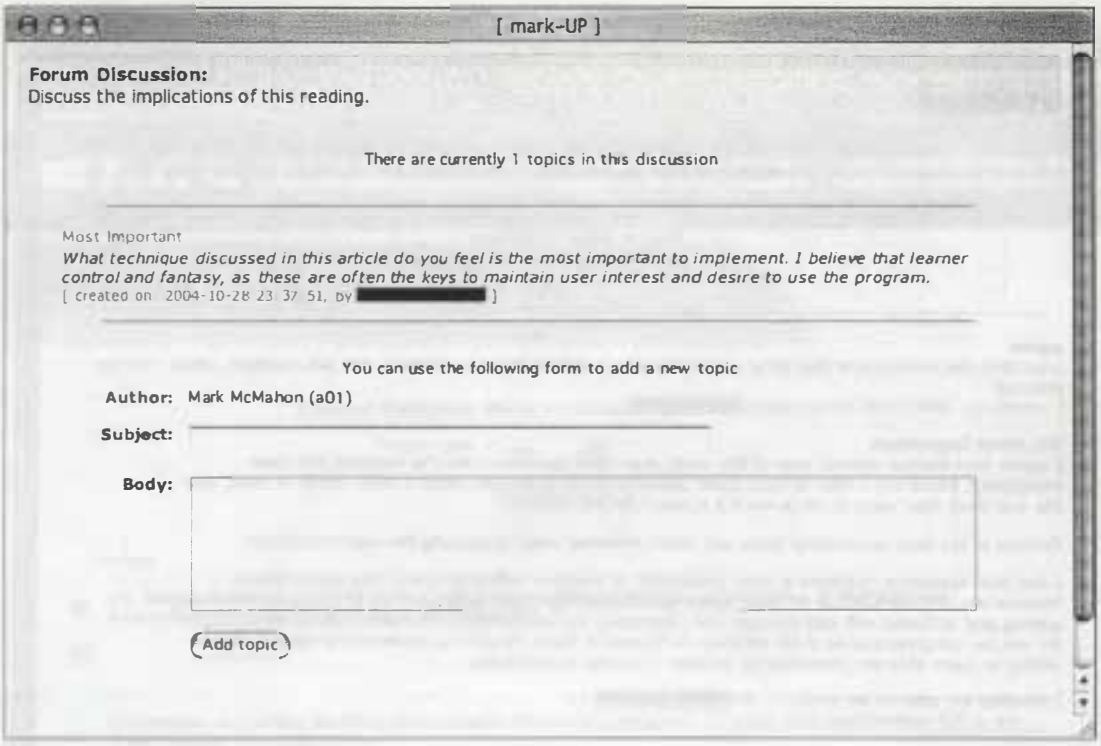


Figure 3.19: Forum Discussion tool

Figure 3.19 demonstrates an example of a discussion containing one thread or topic. Users would be able to start their own topic by entering a subject line, their comments and then choosing 'Add Topic'. Alternatively they would be able to review all of the responses to a particular topic by clicking on the subject line. This would bring up contents similar to Figure 3.20, which listed all of the comments on a particular topic and would allow users to contribute to that topic.

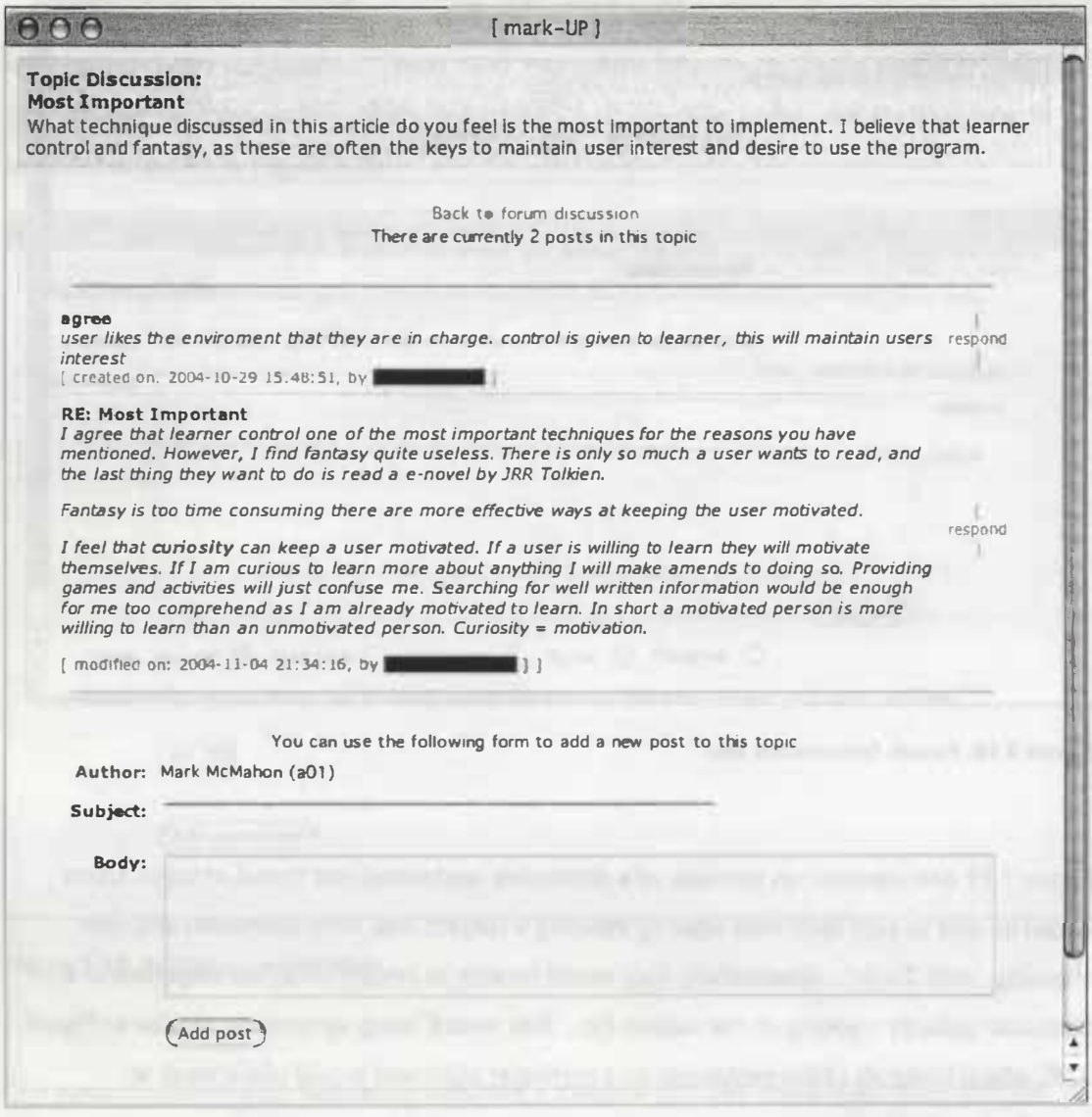


Figure 3.20: Responding to a topic in the Forum Discussion tool

3.3.6 Portfolio tool

The Portfolio tool was designed to have two roles. One practical role would be to allow users to collate their work and print it out for assignment submission. Its role as a tool for supporting metacognitive self-monitoring, however, was situated in its ability to organise users' work into a single cohesive body which could be used as a prompt for users to reflect on their performance. Since it was not planned to be tied to a specific reading, the tool would be available from the main page which indexed all of the readings. Figure 3.21 shows how users would be able to select to display their portfolio as either plain text or HTML, the latter preserving and displaying any HTML formatting that they may have entered into their responses. The Portfolio tool was also designed to allow users to see those readings for which

they had not completed an activity, as only readings with responses would appear highlighted when they entered the tool.

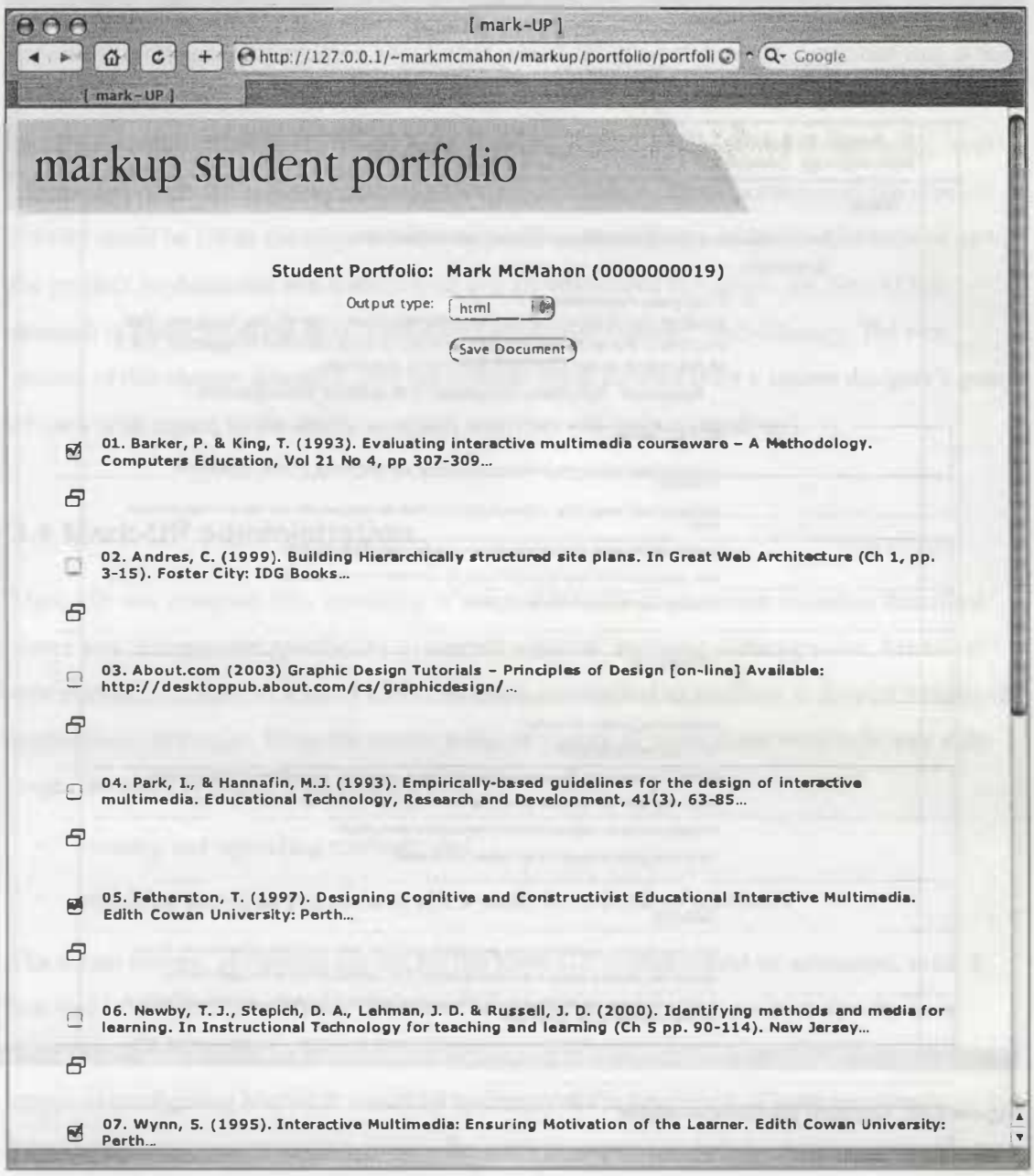


Figure 3.21: Portfolio tool

If users were to select 'save document' the collated portfolio would appear in the browser window either as plain text or HTML depending on their choice. The portfolio was intended to contain design problem solutions as well as all of the other responses to the Mark-UP tools collated by reading (Figure 3.22). The document could then be saved or printed out.

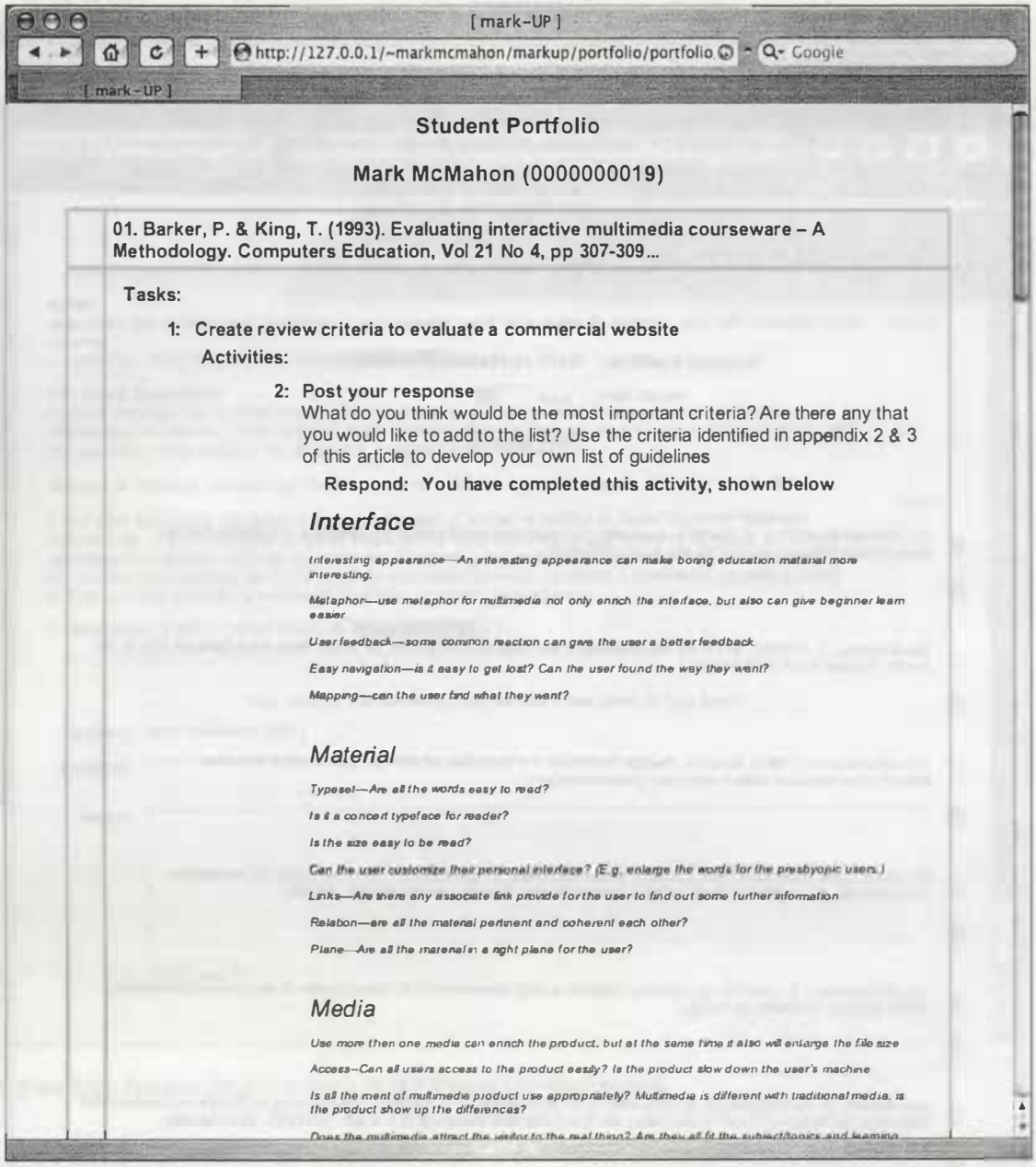


Figure 3.22: Collated portfolio example

3.3.7 Summary of tools within Mark-UP

As can be seen above, it was not just the tools themselves that were intended to provide the support for the development of metacognitive regulation. The selection of resources, activities, and supports, would be integral to the implementation in order for activities to be completed in a manner that would consciously engage users in planning, monitoring, and evaluating their work. Ideas would be evaluated and revised, and the use of regulatory strategies was to be internalised through the reciprocal dialogue that took place in the environment.

These dialogues would be framed within a process of scaffolding and fading. While the types of activity within the tool may at first be highly formalised, with specific instructions about what types of comments to make, combined with just-in-time support for the various regulatory strategies (information about what makes for good comments, questions etc), it was envisioned that the level of prescriptiveness and specific support provided by the course designer would be faded over time. While subjects could still be required to maintain a level of activity within the environment (in this case it did form a part of assessment), the types of activity could be left to the subjects' discretion. The actual design of the tool in terms of how the product implemented and instructional design formulated to achieve the aims of this research is described in the next chapter concerning the research methodology. The next section of this chapter describes how the product could be used from a course designer's point of view with regard to the ability to attach activities and tools to readings.

3.4 Mark-UP administration

Mark-UP was designed with flexibility in mind. While the instructional sequence described above was incorporated specifically to support subjects' evolving metacognition, Mark-UP was planned primarily as a set of tools that could be attached to readings to support a range of instructional strategies. From the course designer's point of view, there were to be two main stages involved in configuring Mark-UP:

- creating and uploading readings; and
- attaching activities and tools to allow users to respond to activities.

The actual process of creating log-ins for the Mark-UP system would be automatic, since it was tied to subjects' enrolments in units of study. By accessing the product directly from within course materials for the unit, further logging in would not be required. However the stages of configuring Mark-UP would be necessary at the beginning of each semester to populate the environment with activities for users to respond to and the readings themselves upon which the activities would based. Each of these stages is discussed in turn.

3.4.1 Creating and uploading readings

The first step of the Mark-UP administration process is to define a template upon which the readings are going to be based. The templates shown in Figure 3.23 demonstrate the grid can be applied over each reading page to define the active areas. The course designer is able to select from a template that already exists or to create a new template. The more rows and columns selected, then the more accurate the placement of annotations on the reading can be

and the likelihood of multiple annotations about different topics on the same area can be reduced. There is expected to be a small loss in the responsiveness of the system as the number of cells in a grid was increased. For most situations, a template of four columns by eight rows would be the most efficient.

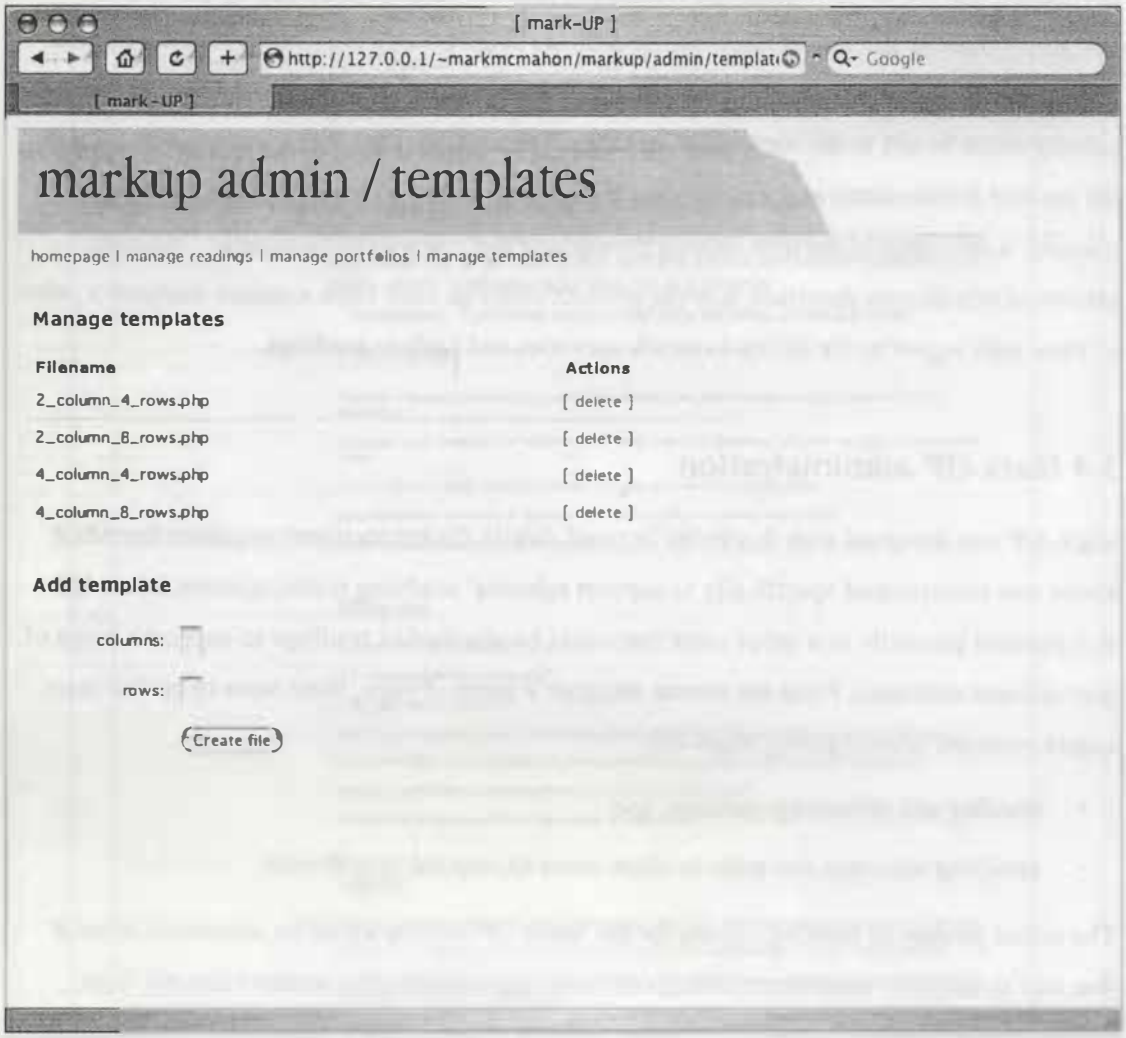


Figure 3.23: Templates to define the active areas on a reading

Once templates are defined, the course designer can create readings and attach pages to them. This is designed to be done by selecting 'manage readings' as shown at the top of Figure 3.23. This section displays all of the readings that have been created within the Mark-UP system. Each reading has the following options:

- Preview;
- Edit reading;
- Edit tasks/activities; and
- Edit Pages (Figure 3.24).

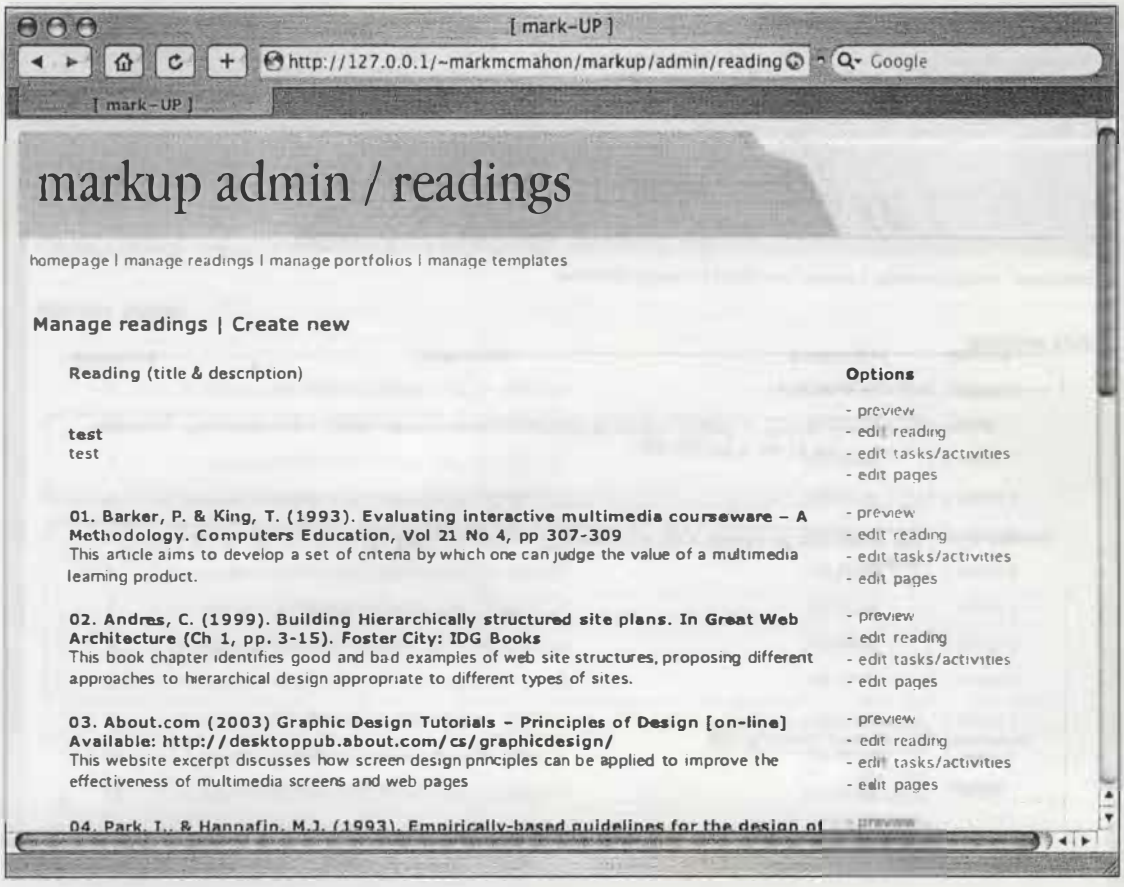


Figure 3.24: Managing readings in Mark-UP

Before a reading can be edited, however, it would need to be created in the system first. Selecting 'Create New' brings up a form that allows the course designer to add a reading title and description, as well as set properties for the readings. These properties are the template that can be used as an annotation grid, and the option to make the reading active (visible to users). Once the reading has been created, this form is able to be accessed from the 'Manage Readings' screen by selecting 'Edit Reading' which then allows the course designer to modify the properties of the reading (Figure 3.25).

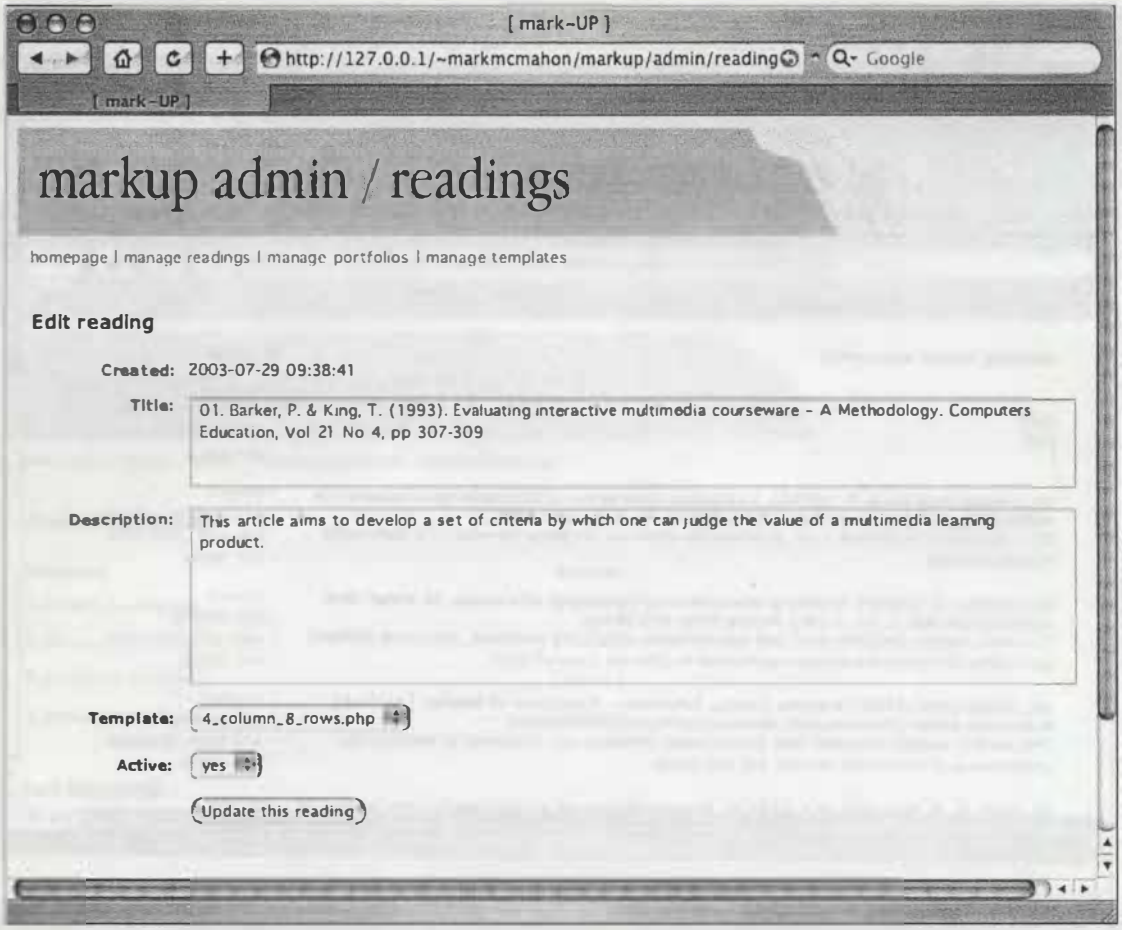


Figure 3.25: Creating or editing a reading

The next step is to add pages to the reading. These take the form of Web graphics (in this case each of the pages was a 4 bit .gif image automatically generated from a scanned Adobe Acrobat 'PDF' version of the reading). Selecting 'Edit Pages' from the 'Manage Readings' screen allows the course designer to upload the individual graphics as well as to delete and sequence them in order to create a series of pages which users can navigate through (Figure 3.26).

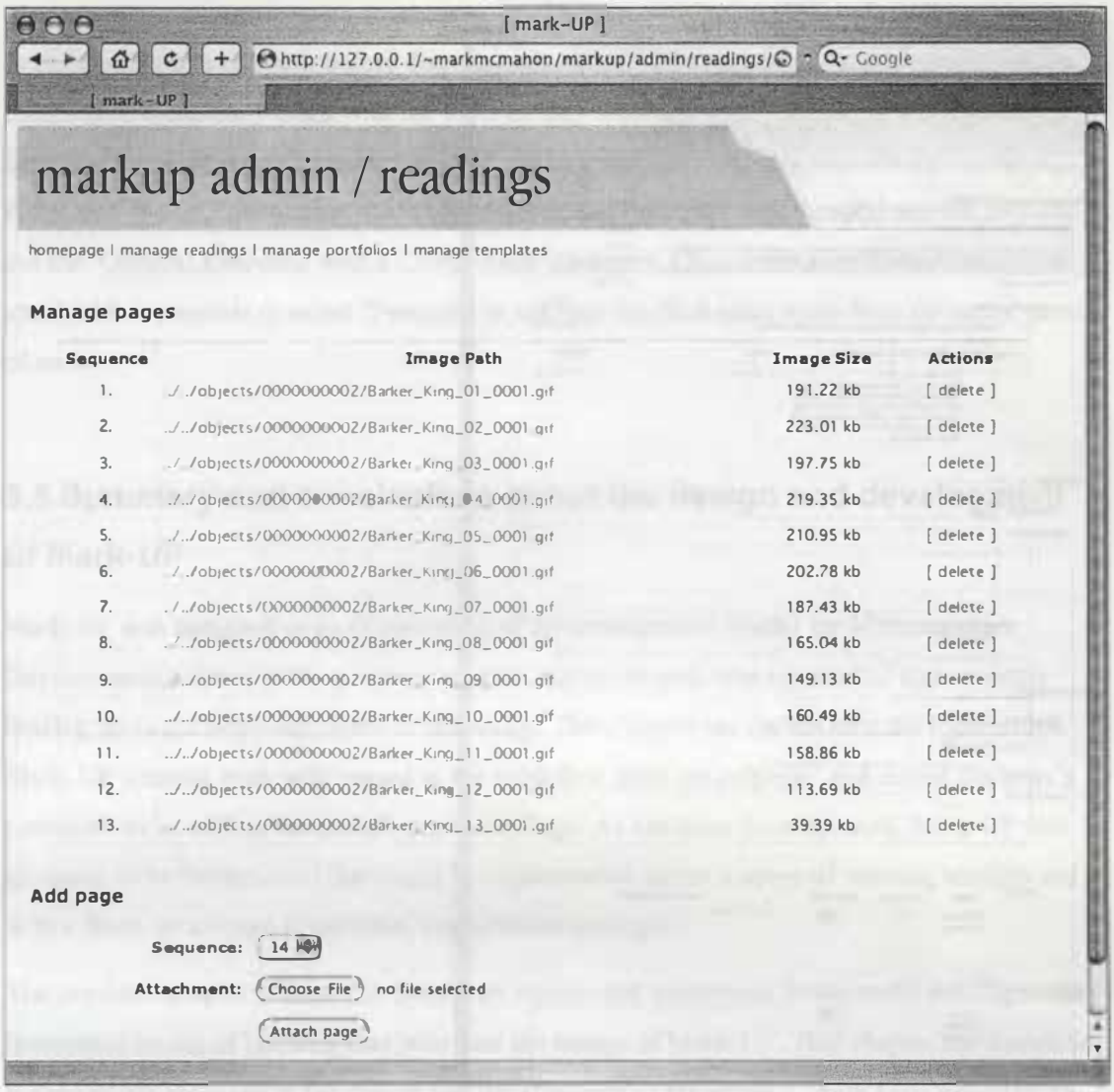


Figure 3.26: Adding reading pages to Mark-UP

3.4.2 Attaching activities and tools to Mark-UP readings

When a reading is in place, activities, and a set of tools to complete those can be added to the reading itself.

This was planned through the 'Edit Tasks/Activities' screen, accessible from the 'Manage Readings' screen. This rather lengthy screen best demonstrates the flexible way in which activities can be created. This tool was designed to be hierarchical in nature. A task is an overall definition of a job or problem. Activities can then be defined which engage users in the particular stages of a task. These stages may involve a response to a problem, a summary, posting an URL and so on. Then the relevant tool or tools are attached to the activity, to provide a response form for users.

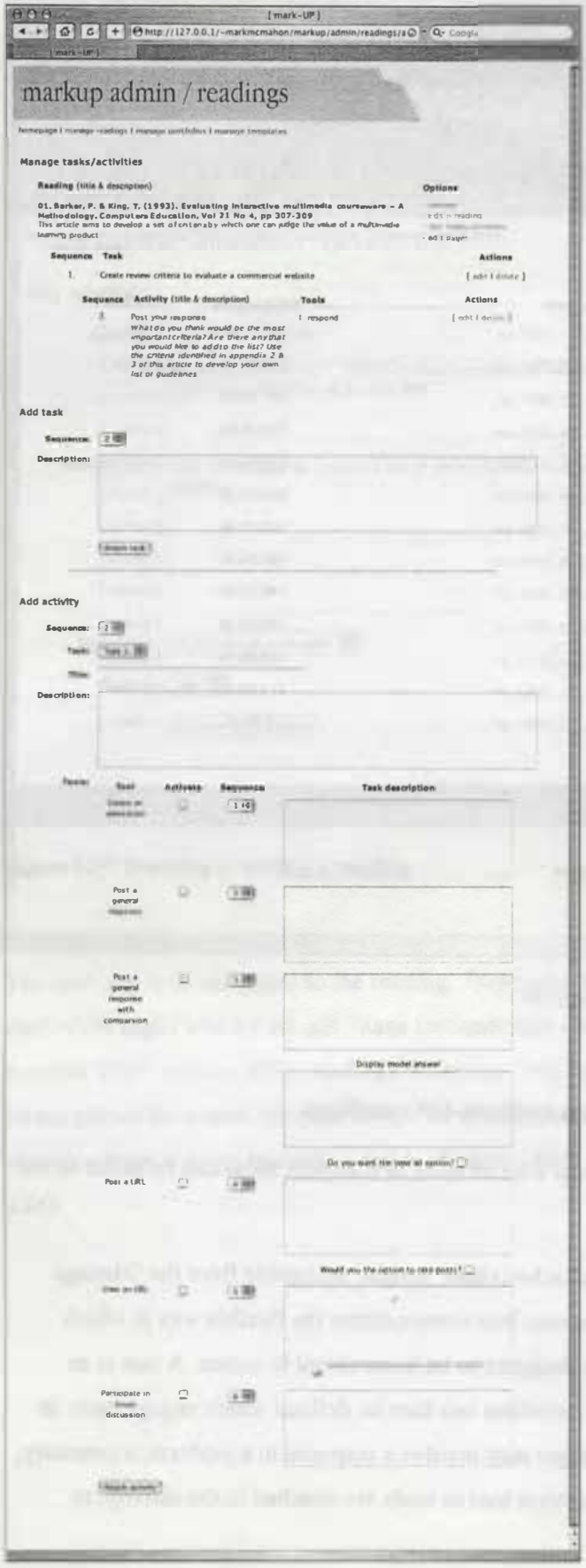


Figure 3.27: Adding activities and attaching tools in Mark-UP

These tools are designed to be combined: for example, visiting an URL before discussing it, or responding to a problem before discussing it. Also the functional tools in Mark-UP are not intended to completely align with the tools as they would be implemented in the Instructional Design. For example both the Design Problem tool and the Summary tool use the 'General Response' type of interaction, or if they required a comparison with a model answer they can use the 'General Response with a Comparison' tool type. Once these activities and tools are attached it is possible to select 'Preview' to see how the final tasks work from the users' point of view.

3.5 Summary and conclusions about the design and development of Mark-UP

Mark-UP was designed as an instantiation of the Instructional Model for Metacognitive Development defined in the previous chapter and developed over a period of eight months leading up to the implementation of this study. This chapter has shown how the tools within Mark-UP worked, both with regard to the workflow from the subjects' and course designer's perspectives as well as the underlying technology. As has been demonstrated, Mark-UP was designed to be flexible tool that could be implemented across a range of learning settings and with a focus on a range of potential instructional strategies.

The previous chapter (Chapter 2: Literature review and conceptual framework) developed the theoretical model of learning that informed the design of Mark-UP. This chapter has described the processes involved in the design and development of the product. Both have provided the foundations for the inquiry into the following two research aims:

1. Explore how students use an on-line learning environment designed as an instantiation of a model for facilitating cognitive self-regulation of reading comprehension; and
2. Explore the forms of self-monitoring that take place when students use this as an environment to support cognitive self-regulation

The next chapter describes the methodology used to conduct the inquiry. The chapter identifies sub-questions to support the aims. It also describes aspects of the product related to its implementation and the methodology applied to defining the research setting, as well as the approach to data gathering and analysis necessary to explore the role of the product as an environment to support subjects' evolving metacognitive regulation.

4 Methodology

So far, this thesis has described self-regulation and proposed a model for the development of students' metacognitive regulation of learning through a series of instructional supports, activities and resources relevant to the regulatory strategies inherent in the domain of reading comprehension. The previous chapter described the design and development of Mark-UP as a learning environment able to support the self-monitoring necessary for the development of metacognitive regulation, and defined two research aims as the focus of the study. The first aim relates to discovering the utility of the product in terms of how the product was designed and implemented. The second aim explores the value of the product in supporting the self-monitoring that is aligned to metacognitive activity.

This chapter describes aspects relating to the implementation of Mark-UP, and the approach to data collection and analysis that was used to address these research aims. The chapter is organised around four aspects of the methodology:

- a description and rationale of the research approach;
- a description of the research setting regarding the instructional design of Mark-UP and the subject group;
- a description of the data collection instruments and how they were developed; and
- a rationale for the approach to analysis and a description of how each of the questions that underpinned the aims of the research were explored.

Each of these aspects of the research is described in turn.

4.1 Research approach

The nature of research has long been a battleground for academic debate, particularly in the area of social sciences; a term which itself can be interpreted as something of an oxymoron. With traditional notions of empirical research yielding ground to more qualitative approaches, the question of how to conduct research is still a pressing one. This is particularly true of learning technologies. Russell's 'No Significant Difference Phenomenon' (1999) is a cogent reminder about the failure of quantitative science to show any demonstrable advantage for

using technology over traditional forms of learning. If comparative experimental approaches fail to elucidate, the issue, then, is what types of research need to be conducted in educational technology, and even, what are the correct questions we should be asking? It is the belief of this researcher that formalistic and prescriptive approaches to research are often reductive in nature and fail to fully describe the quality of learners' experiences. With this in mind, therefore, the next section describes the rationale for an approach to research that could best meet the needs of this study with regard its design as an exploration of metacognitive self-monitoring, with a focus both on the monitoring processes and investigation of Mark-UP as a tool to support them.

4.1.1 Relevant research methods

Given the somewhat 'hidden' nature of metacognitive processes, and the difficulties in attempting to compare one form of learning with another in terms of educational outcome, it was planned that the study would not test whether learners are more metacognitive after using Mark-UP than before. Instead, the research would require a more open-ended approach. It is also important to acknowledge the fact that the implementation of Mark-UP would necessarily be grounded within a specific context. Students were to engage in specific readings within a specified domain, and complete tasks designed with a deliberate focus on the application of content within the readings. While traditional experimental design seeks to eliminate variables in a quest for objectivity (Neumann, 2003) these would not be so easily managed in this case, and indeed would need to be accommodated within the selected methodology.

Therefore, an approach was needed that could embrace the context of the research and examine the impact of these in qualitative terms. As Solomon (2000, cited by Roblyer & Knezak, 2003, p. 68) claimed, 'critical analysis methods must join "scientific" ones to help us understand what works, when it works, and why'. With that in mind each aim was expanded on through a series of questions that would seek to elucidate and interpret the dynamic that underpinned the practical use of Mark-UP:

The first aim sought to explore how students use an on-line learning environment designed as an instantiation of a model for facilitating cognitive self-regulation of reading comprehension. This was to be investigated using three research questions to focus the exploration:

1. What factors inherent in the design and implementation of the environment affect its use?
2. What factors inherent in users' backgrounds affect the use of the environment?

3. What are the external environmental factors that affect the use of the learning environment?

The second aim was intended to focus more on the nature of the product in terms of its value as an environment to promote metacognitive regulation, exploring the forms of self-monitoring that would take place when students used Mark-UP. This aim was underpinned by a further four questions:

4. What are learners' prior experiences of learning metacognitively?
5. How did Mark-UP support subjects' planning as a component of metacognitive self-monitoring?
6. How did Mark-UP support subjects' evaluation as a component of metacognitive self-monitoring?
7. How did Mark-UP support subjects' monitoring as a component of metacognitive self-monitoring?

The exploratory nature of these questions involves an inherently interpretive position, and a plethora of qualitative methodologies exist to examine and interpret learner activity within specific contexts. Grounded research, ethnography, and action research all allow for a deep interpretive approach to research that supports the subjective nature of the project, as well as acknowledging the contextual nature of its implementation.

First proposed by Glaser and Strauss (1967), *grounded theory* is an approach to research that seeks to understand social phenomena through data collected from real world situations, with a view to the development of theories and theoretical propositions. With its emphasis on real world phenomena, and the concept of propositional rather than hypothetical constructions (a hypothesis is necessarily amenable to testing), it is an approach that has salience in research of this kind. However, one of its defining characteristics is its focus on an inductive approach to understanding phenomena, rather than the exploration of a priori theory (Pandit, 1996). In this case, however, the aims of Mark-UP, and a proposed model to describe learning processes, were to be clearly stated up-front.

In some respects, it is possible to define this study as ethnographic in nature. It has been said that educators are paralysed in their efforts to effectively educate individuals in their care if they lack knowledge of the communities in which students live (Gordon, 2000). *Ethnography* can literally be defined as a portrait of people, the product being a written description of a particular culture collected through fieldwork (Fetterman, 1998). One of its distinguishing features, promoted by Goetz (1973), is an approach to analysis that involves 'thick description'. In order to get a valid interpretation of the community being studied, the richness

of the dataset needs to be fully explicated. It is an approach that has direct relevance to this research, where the nature of the learning situation impacts on the effective use of the tool and where many of the subordinate research questions are an attempt to characterise the learners themselves. However, the concept of describing a culture only fulfils a part of the role of this research. Ethnography is an inherently passive approach. While it does not necessarily seek to objectively analyse the culture, indeed an 'emic' perspective and participant/observation are common approaches within it (Eisenhart, 2001), ethnography's focus on the culture rather than on a product designed to have an impact within it, make it too limited a paradigm for the aims of this research. While ethnographic approaches are evolving to more explicitly identify an ideological position and create an agenda for social change in a range of fields, even accounting (Dey, 2002), this 'Critical Ethnography' (Anderson, 1989), is still bound by a post-modern paradigm of argument rather than action.

This study, therefore, appeared to best fit within the paradigm of *action research* because of its focus on the application of a tool to activate metacognitive processing. Action research is in fact a term that describes a broad approach rather than a specific methodology, having 'expanded to include a broad array of action inquiry technologies, making it difficult to provide a simple definition.' (Ziegler, 2001, p. 3) As the name suggests, however, the focus is on achieving two sets of outcomes at the same time: action AND research, with one informing the other (Dick, 1999). The breadth of this approach can be witnessed in the philosophically diverse paradigms in which it can find itself, from positivist through interpretivist, to critical science perspectives (McCutcheon & Jurg, 1990). While there are some features that are common to all types of action research, for example it is participatory, practical, focuses on change, has academic rigor, and involves a reflective feedback loop (Denscombe, 1998), action research in the natural sciences obviously takes a different form to research taking place within a critical paradigm. As has been shown, this study appeared most relevant to an interpretivist approach to exploring the design and implementation of a specific learning product within a theoretical framework. As such it was decided to develop a methodology informed by *design-based research*, as a design experiment - an approach that has been allied with action research (Hoadley, 2002) but has some distinctive features.

4.1.2 Mark-UP as a focus for design-based research

Design experiments are often referred to as design or design-based research to avoid a 'mistaken' identification with traditional experimental methodologies (The Design-based Research Collective, 2003). While analytic approaches to experimentation strive for objectivity and testing of single hypotheses, design-based research aims to develop a profile

of a learning situation. It acknowledges the context-laden nature of instructional settings, and the multiple variables inherent in these. Instead of controlling variables and using fixed procedures in social isolation, the aim is to characterise the situation, and allow flexible design revision and social interaction. Ultimately the researcher is a co-participant in design and analysis rather than an experimenter. (Collins, 1999). It is 'pragmatic as well as theoretical in orientation in that the study of function - both of the design and of the resulting ecology of learning – is at the heart of the methodology' (Cobb, Confrey, DiSessa, Lehrer, & Schauble, 2003, p. 9). This combination of both practical and theoretical components is underscored by Cobb et al. (2003) who identified five distinct features:

- a focus on developing a class of theories about the process of learning *and* the means that are designed to support it;
- an interventionist approach, acting as a test bed for innovation;
- building on the first two features, an aim of creating conditions for developing theories, but placing these theories in harm's way;
- an iterative approach to design – the intended outcome being an explanatory framework that specifies expectations that become the focus of investigation during the next cycle of inquiry; and
- the theory generated must do real work – rather than developing a generic theory that may be difficult to put into practice, design experiments speak directly to the types of problems that practitioners address in the course of their work.

These criteria therefore make design-based research a highly appropriate methodology for a study of this nature, which was planned to explore a theoretical model within the context of an innovative product design rather than test a theoretical hypothesis. Due to the heavily contextual and grounded nature of this form of research, prescriptive approaches to conducting design-based research are unavailable. Bannan-Ritland (2003) however, proposes an 'integrative learning design framework' to guide the process. This is a four-stage model:

1. informed exploration;
2. enactment;
3. evaluation: local impact; and
4. evaluation: broader impact.

In this study, the first stage was implemented through a literature review, and synthesis into a proposed design model, engaging in 'the essential research steps of problem identification, literature survey, and problem definition' (Bannan-Ritland, 2003, p. 22). The enactment phase consisted of the development and implementation of Mark-UP within a setting. These aspects

of the research are covered in Chapters 2 and 3. The evaluation phase attempts to assess both the value of the product as well as its wider potential to inform the further development of theoretical and practical applications. The evaluation of local impact is conducted through the exploration of how subjects used Mark-UP in Chapter 5, while the evaluation of broader impact is conducted through the exploration of how this use was indicative of the planning, monitoring and evaluation inherent in metacognitive self-monitoring. This is explored in Chapters 6 to 8.

4.2 Research setting

Mark-UP was implemented in the second semester of 2003 among a group of students in the unit IMM2125: Interface and Information Design. This was a second year undergraduate unit in an Australian university. The unit concerned principles relating to the design of Interactive Multimedia for information and learning with a focus on students developing skills in interface, screen and interaction design as well as the theory and practice of designing for e-learning, including practical techniques such as storyboarding. The unit was part of a major in Interactive Multimedia in the university's Bachelor of Communications. It was also a recommended unit in the Bachelor of Science Software Engineering and Bachelor of Science Internet Computing degrees.

This varied audience provided a subject group with a range of prior skills and experiences when they undertook the unit. However, the vast majority of subjects were enrolled in a degree with some focus on technology, whether this was multimedia design and development or more traditional computer science. Being a second year undergraduate unit, it was also possible to assume that subjects had more limited experiences in cognitive self-regulation than, say, a class of graduate students. It is also one of the first multimedia units in the Bachelor of Communications that involved the synthesis of academic texts.

In all, 126 students participated as subjects in the research. The unit was taught on campus and consisted of three contact hours per week with a one-hour lecture and two-hour laboratory session. Of these 126 subjects 12 volunteered to be interviewed formally, which formed another of the main forms of data for this study.

The unit consisted of 12 weeks of contact over a period of four months, with Mark-UP being used in activities in each of the contact weeks. Subjects completed the majority of the Mark-UP activities in their own time outside of the regular class.

4.2.1 Implementation of Mark-UP and data collection schedule

Each week of the semester, subjects were presented with a reading and a design problem that was to make use of the reading concepts. In addition to that, subjects engaged in 'marking up' their readings and completing activities that foregrounded the metacognitive processes of self-monitoring in a manner that was scaffolded and faded over the period of the implementation. Table 4.1 provides a summary of how Mark-UP was implemented over this period with regard to the overall research design and approach to data collection. A fully detailed outline of each week's activities including the readings, and design problems and the explicit directions given to students is available in Appendix 1.

Table 4.1: Summary of weekly learning activities and their role in the research plan

Week	Learning and research characteristics	Data collection
1	**Questionnaire** Subjects completed a survey to gather information about their perceived abilities as self-regulated learners and other demographic information such as their experiences with technology	✓
2	**Strategy instruction** Subjects reviewed a site that discussed how to summarise effectively **Mark-UP activities** Subjects used the advice from the review to summarise the week's reading before comparing their response to a model answer.	✓
3	**Strategy instruction** Subjects reviewed a site that provides information about how to annotate texts effectively **Mark-UP activities** Subjects reflected on their understandings by using the annotation tool to summarise, highlight, question, or gave opinions about sections of the week's reading	
4	**Reflective activity** Subjects reflected on their experience of Mark-UP over the first few weeks and provided feedback in their portfolios that was used to explore Research Aim 1 **Mark-UP activities** Subjects continued to practice annotation with structured guidance as to the types of comments to make	✓
5	**Reflective activity** Subjects reflected on their portfolio to date identifying difficulties in using the product and how their approach to learning has evolved – data used to explore research aim 2, with particular emphasis on the role of Mark-UP in supporting metacognitive evaluation **Strategy instruction and Mark-UP activities** Subjects were introduced to the Post URL tool with information to help scaffold its strategic use	✓
6	**Mark-UP Activities** Support was now being faded. Subjects had access to all of the tools available in Mark-UP. Suggestions were made as to how to use them. However, subjects had the choice over which ones they perceive as most personally relevant	

7	**Mark-UP activities** Further fading of initial scaffolds, with fewer suggestions as to possible regulatory strategies	
8	**Reflective activity** Subjects were required to reflect on the feedback they received from the tutor about their partly completed portfolio and identify plans for improvement – used to inform exploration of Research Aim 2, specifically with regard to planning and evaluation	✓
	Mark-UP activities Subjects used Mark-UP in independent ways with no learning support beyond the self-monitoring inherent in the use of the tools	
10-13	**Mark-UP activities** As for the previous week, no learning support beyond the self-monitoring inherent in the use of Mark-UP's tools	
14	**Reflective activity** Subjects engaged in self-analysis to describe how their approach to learning and reading had evolved over the semester. Prompts for this activity were less prescriptive than the reflective activity in line with subjects' developing cognitive self-regulation.	✓
	Portfolio submission Specific responses from subjects' portfolios were used to explore subjects' self-monitoring in their use of the tools beyond the specific data collection points already outlined.	✓
	Subject Interviews 12 subjects were interviewed shortly after submission of their final portfolios.	✓
	Final Survey A final survey was conducted in week 13. This survey covered similar aspects to the original survey but also asked specific questions about Mark-UP to explore subjects' experiences with the product and how these influenced their perceived cognitive regulation.	✓

4.3 Data collection

With this study's combination of both narrow and broad research aims, it was important that focus was not lost on the wider implications of the research:

> *Although as a practical matter, a design experiment is conducted in a limited number of settings, it is apparent from the concern for theory that the intent is not merely to investigate the process of supporting new forms of learning in those specific settings. Instead the research team frames selected aspects of the envisioned learning and of the means of supporting it as paradigm cases of a broader class of phenomena. (Cobb et al., 2003, p. 10)*

In order to achieve these aims, a range of qualitative data types was gathered from the sample group. Design-based research 'respond[s] to emergent features of the setting' (The Design-based Research Collective, 2003, p. 5). A practical setting such as the one in this study is

inherently 'messy' and this is not such a bad thing since the clinical control inherent in traditional research settings may in fact distort our understanding of the situations that characterise real life learning (Collins, 1999). It does however add complexity to the nature of activity which takes place within the setting. A range of data, therefore, that accommodated the multiple dependent variables of real-life settings were gathered for this study:

- portfolios generated by the system evidencing the work produced within Mark-UP;
- questionnaires, applied both at the beginning and end of semester; and
- interviews with selected students both at the beginning and end of semester.

By incorporating questionnaire data, there were opportunities for formal and summative data to ascertain general trends among the whole group using descriptive statistics. In interpretative methodologies, both interview and document analysis, as in the use of portfolios, have been found to provide rich forms of data that enable deep analysis (Schuh & Upcraft, 2001). In this case, the interviews enabled causality to be drawn from the descriptive statistics provided by the questionnaire results, while the portfolios allowed an exploration of how subjects demonstrated the types of processing inherent in the metacognitive focus of the study beyond their own assertions in interview and questionnaire. Chapter 3 has explained how the Portfolio tool within Mark-UP operated as a tool to gather data for analysis. The next sections of this chapter describe the rationale for the tools chosen and the process involved in the creation of the questionnaire instruments and interview questions.

4.3.1 Portfolios

The concept of an electronic portfolio is not new. In this study one obvious role was its utility as a medium to promote metacognitive monitoring, as described in the following stages:

- collection – save artefacts that represent the day-to-day results of teaching and learning;
- selection – review and evaluate the artefacts saved and identify those that demonstrate achievement of specific standards or goals;
- reflection – reflect on the significance of the artefacts chosen for the portfolio in relationship to specific learning goals;
- projection (or direction) – compare the reflections to the standards/goals and performance indicators, and set learning goals for the future; and
- presentation – share the portfolio and receive feedback. (Danielson & Abrutyn, 1997)

The instructional strategy described in section 4.2 of this chapter has demonstrated how the above processes were implemented in this study, although it must be acknowledged that there

was no process of selection as the portfolio was a document of all work rather than a curated artefact.

Beyond their role as a learning tool however, portfolios provide a means for gathering evidence for research that 'gives meaningful insight into behavior and related change. Because portfolio assessment emphasizes the process of change or growth, at multiple points in time, it may be easier to see patterns' beyond a specific point of data collection (Sewell, Marczak, & Horn, 2000). However, the actual analysis of portfolios is still subject to many of the issues of qualitative research methodologies (Patton, 1990).

4.3.2 Questionnaires

Questionnaires have the potential not to be subject to the same ambiguity in terms of interpretation and therefore have value as a means of triangulating some of the more qualitative aspects of the other research methods selected. Some of their advantages include that they:

- can be completed anonymously;
- are often inexpensive to administer;
- are usually easy to compare and analyse;
- can be administered to many people; and
- can provide lots of data (McNamara, 1999).

McNamara (1999) also contends. however, that questionnaires don't always give the 'full story' in terms of the research conducted. Hence their role to supplement the other forms of data collection. The questionnaires conducted at the beginning and end of the semester had two main purposes for this research. The first was to provide the data necessary for an analysis of subjects' perceived levels of self-regulation. This involved general statements about metacognition as well as planning, monitoring and evaluation, and how these manifested themselves a strategy use. It was also necessary to explore the affective dimensions of self-regulation to see how these impacted on subjects' experiences with the product.

The second purpose of the questionnaires was to specifically document subjects' backgrounds with regard to their experiences with technology, and in the latter questionnaire their attitudes towards Mark-UP after having used the product.

The focus of the questionnaires therefore was on the following dimensions of the study:

1. Subjects' perceptions of their:

a. Metacognition
b. Self-monitoring
c. Cognitive strategy use
d. Self-concept
e. Motivation
f. Volitional strategy use

2. Subjects' access to technology
3. Subjects' experience with technology
4. External social and personal factors impacting on their study habits
5. Subjects' perceptions of the value and utility of Mark-UP

Dimensions 1 to 4 were integrated into the initial implementation of the questionnaire and were identified as 'questions relating to my study habits', while the final questionnaire re-iterated these while also containing questions identifying the fifth dimension relating to subjects' experiences with the product.

The questionnaires took the form of a five-point Likert scale addressing the extent to which subjects disagreed or agreed with statements identifying aspects of each dimension. In the end of semester questionnaire, four open ended questions were also asked to provide more prescriptive feedback about dimension 5, relating to the actual product.

The process of developing the questionnaires was fairly straightforward for the second to fifth dimensions, as the concepts themselves were clearly delineated and statements could be developed for them that were somewhat self-evident. The development of statements addressing each of the components of self-regulation however, was more problematic. The statements needed to be phrased in such a way as to be understood easily by the subjects, and at the same time they needed to clearly address aspects of a concept that is somewhat nebulous and open to misinterpretation. For that reason, a process of expert validation was undertaken to ensure the statements regarding self-regulation correctly identified the six underpinning processes.

4.3.2.1 Development and expert validation of questionnaires

The researcher developed statements designed to address various aspects of self-regulation. The types of questions that can be used in surveys vary depending on the nature of the instrument. Descriptive surveys seek to, 'estimate as precisely as possible the nature of existing conditions or the attributes of a population' while explanatory surveys seek to

'establish cause and effect relationships but without experimental manipulation' (Burns, 1994, p. 344). While this questionnaire was to be predominantly descriptive in nature, since it sought to identify existing perceptions of subjects' self-regulation, there were a number of assumptions made with regard to the relationships between constructs to be tested and their role as indicators of self-regulatory processes. This added complexity to the process of instrument development. Howard (1990) argues that there are many methodological issues when trying to assess self-regulation in the classroom, many of which are confounded by the interplay of cognitive, motivational, socio-behaviour, task and context variables.

Most attempts to measure self-regulation therefore have relied heavily on subjective self-assessments on the part of subjects themselves (Boekaerts, 1992). Some examples of instruments to measure perceptions of self-regulation include Lidner & Harris' (1992) Self-regulated Learning Inventory (cited by Ertmer, Newby, & McDougal, 1996), which breaks the concept down into measure of metacognition, learning strategies, motivation, contextual sensitivity, and environment control. The LASSI (learning and study style inventory) instrument (Loomis, 2000), on the other hand, consists of 10 dimensions of study and learning strategies and methods, many of which can be associated with self-regulated learning such as attitude, motivation, time management, anxiety, concentration, information processing, selecting main ideas, study aids (developing & using), self testing, and test strategies (ability to prepare effectively for exam and reason through exam questions).

Some studies have made use of Bandura's (1989) Multidimensional Scales of Perceived Self Efficacy which incorporates criteria to assess self-regulation (Miller, 2000). However, all of these instruments approach the construct of self-regulation from different perspectives. For example, the LASSI tool makes the implicit assumption that self-regulation is a generalisable skill, while the Motivational Strategies for Learning Questionnaire proposed by Pintrich, Smith, Garcia and McKeatchie (1993) consists of seven motivational scales and 10 learning scales that treat self-regulated learning as a context specific activity which differs from subject to subject (McManus, 1996).

For the purposes of this study therefore, elements gathered by exploring standardised instruments were combined with concepts about how self-regulation could be manifested and reported from literature with a view to creating statements that addressed each criterion of the model of self-regulation proposed in Chapter 2 to assess subjects' perceptions of their metacognition, self-monitoring, cognitive strategy use, self-concept, volitional control, and motivation.

Because of difficulty in defining self-regulatory constructs and the originality of the items created for this study, the credibility of the instrument required attention. In terms of

reliability, the need for the instrument to be consistent across multiple contexts and times was not a major issue since this study was to be grounded in a specific context. Nevertheless acknowledgement must be made that the instrument may not have reliability across multiple contexts. Also, the use of modified established scales meant that there was no statistically developed validity to the questionnaire. Instead, expert validity was sought in a heuristic manner to enhance the credibility of the questionnaire. In difficult cases such as these, 'ultimately social researchers should look to both colleagues and subjects as sources of agreement on the must useful meanings and measurements of the concepts they study' (Babbie, 2002). To enhance the credibility of the instrument therefore, expert validity was sought to provide an independent appraisal of the questionnaire items.

Before finalising the survey a focus group was formed that consisted of five university lecturers, all of whom were working at either Edith Cowan University or the University of New South Wales, and were actively researching into educational technology.

The group had the six elements of metacognition, self-monitoring, cognitive strategy use, self-concept, motivation, and volitional strategy use defined. The items were differentiated by their cognitive or affective bases, and by their description as: a state of awareness (metacognition & self-concept), underpinning processes (self-monitoring, and motivation), and their practical manifestation as strategies.

The group was then asked to complete the questionnaire by ticking the most appropriate response and providing a percentage split (eg 70/30) where they thought an item was applicable across more than one concept. All of the participants did so except for one, who used a different number of ticks to identify their preference (eg two ticks in one concept, one in the other indicating a preference for the concept with two ticks).

The items were then discussed, with the participants explaining their rationale for the choices. Where there was an obvious misinterpretation the participant had the option of changing his or her response.

The responses are indicated in Figure 4.1. A mark on 10 was allocated for each item and for each participant, based upon the percentage split between each concept. Therefore a full mark of 10 was allocated where a participant ticked only one box, marks of 7 and 3, where a participant indicated a 70/30 split and so on. Where two ticks were allocated as opposed to one, marks of 6.5 and 3.5 were allocated. The researcher's own initial interpretations are indicated in large bold text.

Name:_____

Please put a 'x' in the boxes for the concept which you think best represents each statement below. Where you think there are more than one concept covered, give a percentage score to represent the relevance of each (eg 70% motivation, 30% self-concept)

	Metacognition	Self-Monitoring	Cognitive Strategy Use	Self-Concept	Motivation	Volitional Strategy Use
I find it helpful to compare my ideas with other students to make sure I am on the right track		**250**		50		
It is important for me to find ways of applying what I am studying to real settings	**30**		150		120	
I find relating information to my own experiences valuable	**130**		50		20	100
Making notes helps me understand what I am studying	50		**250**			
I usually find study personally satisfying				**50**	150	100
When I sit down to study I have difficulty working out where to begin	33	33	**133**		100	
Making notes in my textbook helps me to make sense of what I am reading	50		**200**			50
I tend to blame myself when I receive negative feedback on assignments				**230**	70	
Giving an opinion in class is a nerve-wracking experience				**230**	70	
I am more comfortable when I have read through my notes before I go into the next class		**100**	120		30	50
It find it hard to concentrate when studying on my own					**170**	130
I feel it is important for me to stay up to date with all of my course requirements		50	**0**	50	30	170
It is important for me to work my way through course readings even when they are uninteresting		100	50		100	**50**
I understand concepts better when I imagine them in practice	230		**50**		20	
Giving myself rewards is a useful way of maintaining effort when I study					230	**70**
I tend to give up when study is difficult		50			**120**	130
I am easily tempted away from study					170	**130**
I work best when I set myself specific lengths of time to study and stick with them		150			30	**120**
I plan my study ahead of time whenever possible		**100**	100		30	70
I worry about failing my units				**200**	100	
I find it difficult to study subjects I don't enjoy					**200**	100
I learn best when I link what I'm studying with what I already know	**300**					
Summarizing passages helps me to understand the content to be learned	50		**250**			
I know what I am good at as well as the things I have difficulty with	**130**	50		120		
It is hard for me to find the motivation to begin studying	50				**150**	100
Translating course materials into my own words improves my learning	100	**30**	170			

Figure 4.1: Validity results for questionnaire items

As Figure 4.1 shows, there was a general agreement on most items, though many of them were seen as being relevant in part to more than one concept. Where there was a clear preference for a concept, the question was left unchanged. Where there was a significant split or confusion identified in the discussion following the initial allocation process, the question was changed. A description of the discussion around questions and amendments is detailed in Table 4.2.

Table 4.2: Amendments to questionnaires as a result of expert validation

Original Statement	Changes	Rationale
I find it helpful to compare my ideas with other students to make sure I am on the right track	Unchanged	There was a general consensus that comparing with other students was a process of self-monitoring, though several of the members also thought it indicated a conscious strategy.
It is important for me to find ways of applying what I am studying to real settings	Unchanged	It was decided that this was predominantly an indicator of metacognition though it could be perceived as a strategy, and also implicitly involved self-monitoring. One participant believed that it involved the regulation of effort.
I find relating information to my own experiences valuable	Unchanged	There was a strong consensus that this indicated metacognition, though could manifest itself as a conscious cognitive strategy.
Making notes helps me understand what I am studying	Unchanged	There was a strong consensus that making notes was an explicit cognitive strategy.
I usually find study personally satisfying	Studying makes me feel good about myself	Three of the participants identified this as a motivational process, in that it defines an intrinsic orientation towards study. The statement has been reworded to provide a clearer indication of self-concept.
When I sit down to study I have difficulty working out where to begin	Unchanged	While it was acknowledged that poorly motivated learners, and those without volitional strategies may feel this sense of disorientation, consensus was achieved that this primarily defines a lack of strategy to regulate cognition.
Making notes in my textbook helps me to make sense of what I am reading	Unchanged	This was considered predominantly to be an indication of cognitive strategy use.
I tend to blame myself when I receive negative feedback on assignments	Unchanged	It was decided that blaming oneself may indicate a low cognitive awareness; however this was primarily an indication of low self-esteem.
Giving an opinion in class is a nerve-wracking experience	Unchanged	There was a clear belief that this was a measure of poor self-concept.
I am more comfortable when I have read through my notes before	It is useful for me to think about my studies before I go	There was a belief among participants that the term 'comfort' had affective qualities and note reading may be interpreted as a strategy.

I go into the next class	to class	Therefore the statement was reworded to be a perception of utility rather than comfort and to broaden out the sentence towards general thinking.
I find it hard to concentrate when studying on my own	Unchanged	While poor self-reliance may be an indicator of low self-concept, it was determined that this was primarily a measure of poor motivation.
I feel it is important for me to stay up to date with all of my course requirements	Discarded	While staying up to date with readings implied cognitive strategy, the lack of any specific strategy combined with the term 'feel' led the participants to perceive this item as a description of an emotional process.
It is important for me to work my way through course readings even when they are uninteresting	Unchanged	There was consensus that the description of a lack of interest made this a statement of volitional control.
I understand concepts better when I imagine them in practice	Unchanged	While initially interpreted as an indicator of cognitive strategy, the strong sense of the participants that it represented a more general cognitive awareness has led to this item being reclassified.
Giving myself rewards is a useful way of maintaining effort when I study	Unchanged	There was a strong belief that this was an effective measure, with rewards being perceived by most participants as an explicit volitional strategy.
I tend to give up when study is difficult	Unchanged	It was decided that this was a measure of motivation although somewhat indicative also of poor self-concept.
I am easily tempted away from study	I avoid other activities when I need to study	Rather than being a lack of volitional strategies, the participants identified this item as representing poor motivation. The question was reworded to be more positive and to be more explicit in its description of strategy.
I work best when I set myself specific lengths of time to study and stick with them	Unchanged	One participant felt confused by this question, although all of the others were confident that this was a clear indication of volitional strategy use.
I plan my study ahead of time whenever possible	I find it useful to set myself goals for learning	This element of 'planning' caused some participants to see this as a volitional strategy. The question was reworded to make it affectively neutral through an expression of utility and to identify the self-monitoring process of goal setting rather than planning.
I worry about failing my units	Unchanged	The participants believed this was an indicator of poor self-concept, although it was also acknowledged that metacognition and motivation may be contributing factors to this sense of worry about failure.
I find it difficult to study subjects I don't enjoy	Unchanged	While the statement indicates some level of metacognitive awareness, this was seen by the participants as a clear measure of poor motivation.

I learn best when I link what I'm studying with what I already know	I know what I learn best	This was viewed overwhelmingly as cognitive rather than affective. However, the processes and implicit strategy use caused some confusion. The question was reworded to be a statement of awareness without any underpinning process.
Summarizing passages helps me to understand the content to be learned	Unchanged	This was unanimously identified as a cognitive strategy.
I know what I am good at as well as the things I have difficulty with	Unchanged	This was overwhelmingly identified as a measure of metacognition although two participants felt that it was hard to separate from the underpinning self-monitoring process.
It is hard for me to find the motivation to begin studying	Unchanged	This item was interpreted as a statement of motivation, though it was accepted that it also indicated a lack of volitional strategy.
Translating course materials into my own words improves my learning	Unchanged	The participants unanimously identified this as a measure of cognitive strategy use.
None	I compare what I achieved in learning with what I planned to achieve	This statement was added as a third indicator of self-monitoring. The process only validated two measures, and this item will provide another item to triangulate the reliability of the Self-Monitoring statements.

The amendments in Table 4.2 provided greater validity of the instruments that were delivered at the beginning and end of the semester. When discussing properties of the whole group with regard to their assertions regarding their study, conclusions could then be drawn about the extent to which subjects perceived themselves to be self-regulating against each of the previously defined dimensions.

The final end of semester survey is shown in Appendix 2. The questionnaire contains all of the questions modified as a result of the validation process as well as extra questions designed specifically to assess the subjects' perceptions of Mark-UP after having used the product. Since it was not the intention of this study to prove developments in subjects' metacognitive awareness and because the two implementations failed to demonstrate any significant difference between the two implementations with regard to perceived metacognition only the first survey's results regarding this phenomenon are discussed.

4.3.3 Interview questions

In order to explore the relationship between subjects' work as evidenced in their portfolios and the descriptive data provided for the whole group by the questionnaires at the beginning and end of the semester, 12 subjects were interviewed. This enabled data from other sources to be corroborated (Eisner, 1991) but most importantly enabled the researcher to explore

aspects of the learning situation and the subjects themselves that may otherwise have been unobservable. According to Patton (1990), self-reporting and the analysis of the artefacts of research fail to provide information about more hidden attributes such as feelings and the meanings applied to experiences. Nor can we observe experiences that the subjects may have had prior to the study. Instead, 'we have to ask questions about these things' (Patton, 1990, p. 278).

Denzin (1989) identifies several types of interview based upon the level of structure, ranging from schedule standardised to non-standardised. Since the nature of the research questions required a level of openness to accommodate potentially unforseen but valuable information, while ensuring focus on specific aspects of subjects backgrounds, their value of the product and the monitoring they engaged in while using Mark-UP, a semi-structured approach, described by Denzin (1989) as a 'non-schedule standardized interview', was adopted. This enabled the researcher to ask specific questions about subjects' backgrounds, their experiences with Mark-UP and the work in their portfolios and also suited the approach to research where one researcher conducted all interviews, ameliorating a need for a more standardised objective approach.

Subjects were asked to volunteer to participate in a 45 minute interview that was recorded and transcribed for analysis. They were awarded a movie ticket for participating. This selection process, therefore, was not predicated against any previously defined attributes. The 12 subjects provided a large enough sample to exhibit a range of learning experiences, preferences, and perceived levels of existing metacognitive awareness. However there were no other guiding criteria for selection than their availability and willingness to be involved. The interviews were conducted at the end of the semester following their use of Mark-UP.

Generally, questions were asked to ascertain subjects' experiences, understandings and values with regard to the following broad question types:

1. what factors inherent in the design and implementation of the environment affect its use?
2. what factors inherent in students' backgrounds affect the use of the environment?
3. what are the external environmental factors that affect the use of the learning environment?
4. what are learners' prior experiences of learning metacognitively?
5. what forms of self-monitoring take place when students annotate and transform text-based problems to solve problems?
6. in what way do students apply the processes of metacognitive regulation when scaffolding has been removed?

a. I notice the amount of work increased/declined over the semester. What was the reason for this?

b. Your marks improved/worsened between the part submission and the final submission of your portfolio. What was the reason for this?

41. If you had the opportunity to repeat this unit, is there anything you would do differently?
42. Did you prefer the more structured activities in the first few weeks to the less structured approach of the final weeks?
43. Would you use Mark-UP again? Eg If it could be a replacement for an exam? Why?
44. Have you used it since you submitted your portfolio? (eg exam prep) or do you intend to?
45. Overall, do you think it helped you to learn?

4.3.4. Summary of data gathering approaches

The above forms of data were selected for their ability to provide 'thick descriptive datasets' (The Design-based Research Collective, 2003, p. 7). Collins (1999), for example, specifically mentions electronic journals and on-line discussions as innovative approaches to data collection that can do much to explain the nature of activity within real settings. The portfolios provide a detailed journal of all the work that students completed within the environment from the beginning of semester to the end. The questionnaires provided more general information regarding subjects' responses to the product and the nature of the activities and processes within it. The interviews allowed for greater flexibility than that provided by the questionnaire, enabling deeper exploration of responses and the possibility of unanticipated responses. Since self-regulation is developed individually and through a lengthy process beyond the scope of this study, a detailed exploration of selected individuals' experiences through the semester was beneficial. Therefore, a range of individual students was followed through the semester with supplementary data gathered through interviews and assignments submitted, as well as in the portfolios generated in Mark-UP. The final section of this chapter describes the approach taken in the analysis of the data to develop findings about the research aims and their subordinate questions.

4.5 Ethical considerations

Since the research required the use of human subjects, ethical clearance was obtained through the university's Research Ethics Committee. This involved adhering to the requirements of informed consent, confidential data management, and the management of risk to participants.

4.5.1 Informed Consent

Subjects in the study were informed as the purpose of the study and were advised on the voluntary nature of their participation. All subjects who participated signed a form acknowledging their role in the study and willingness to participate. Two separate types of information sheets and consent form were used. The first was for all students who participated in the questionnaires at the beginning and end of the semester, while the second specifically sought consent from interview subjects to allow their interview transcripts and portfolios to be used as part of the study. No payment was made to any of the subjects although those who participated in the interview were provided with a movie ticket as acknowledgement of their participation.

4.5.2 Confidential data management

Students' informed consent was based on the affirmation by the researcher that all of the data gathered for the study would be confidential in nature. No identifying information was contained in the questionnaires. Also, interview subjects were not mentioned by name during the process of the interview and no identifying information was kept within proximity of the audio tape recordings or transcriptions. This meant that nobody other than the researcher was aware of the identity of the interview subjects. All data was stored in a locked filing cabinet in the researcher's office. Following the completion of all reporting and the passing of this thesis, data is to be disposed of by shredding in the case of paper-based materials, or by erasure in the case of audio tape recordings.

During the reporting of the findings of this study aliases are used to ensure the anonymity of subjects.

4.5.3 Management of potential risks to participants

Some of the data was personal in nature but otherwise non-intrusive. Therefore risk to the subjects was minimal. Subjects could withdraw at any time or choose not to respond to a question. To ensure that the research did not impact in any way on the assessment of the unit in which subjects were enrolled, interview subjects were identified that were not familiar to the researcher and did not belong to any of the classes that were taught by the researcher. Therefore the researcher was not responsible for the academic assessment of any of the interview subjects during the duration of the study.

4.6 Approach to analysis

The design-based research conducted as part of this research afforded the opportunity to collect a broad range of data. Such 'multiple sources of data ensure that retrospective analyses conducted when the experiment has been completed will result in rigorous, empirically grounded claims and assertions' (Cobb et al., 2003, p. 11). Reliability comes through triangulation of such multiple data sets and iterative analyses, while validity is maintained through the groundedness of the research. Rather than trying to answer a single question, the exploratory nature of this research allowed for paradigm shifts and design revisions that may be required as a result of the inquiry (The Design-based Research Collective, 2003).

To conduct effective analysis in design-based research one needs to 'work systematically through the extensive, longitudinal data sets generated in the course of a design experiment so that the resulting claims are trustworthy' (Cobb et al., 2003, p. 13). Through a process of interpretation of multiple forms of data, patterns could be identified that supported or described phenomena demonstrated in the questions inherent in the research aims.

This approach to analysing the data collected throughout this study can best be defined as an immersive one. Once the data was collected, the researcher spent time to familiarise himself with the various forms of data before engaging in a more formal approach to analysing and categorising the findings, and drawing conclusions from them.

Support for this grounded approach to data analysis can be found in an approach to analysis known as constant comparison. Glaser and Strauss (cited in Lincoln & Gruba, 1985, p. 339) described the constant comparison method as following four distinct stages:

1. comparing incidents applicable to each category,
2. integrating categories and their properties,
3. delimiting the theory, and
4. writing the theory.

In this case, the data was explored to identify common conceptual threads that emerged in response to the defined research questions. These were organised and categorised, and then the various forms of data were compared to provide legitimate basis for the generation of findings about each of the questions. According to Goetz and LeCompte (1981) this method 'combines inductive category coding with a simultaneous comparison of all social incidents observed' (p. 58). As social phenomena are recorded and classified, they are also compared across categories. Thus, hypothesis generation (relationship discovery) begins with the analysis of initial observations. This process undergoes continuous refinement throughout the

data collection and analysis process, continuously feeding back into the process of category coding. 'As events are constantly compared with previous events, new topological dimension, as well as new relationships, may be discovered' (Goetz & LeCompte, p. 58).

4.7 Summary and conclusions about the research methodology

Tables 4.4 and 4.5 summarise the research questions applied to each of the aims of this study, as well as the approaches taken to the gathering and analysis of the data:

Table 4.4: Research questions and approaches to data collection and analysis for Aim 1

Research Aim 1: Explore how students use an on-line learning environment designed as an instantiation of a model for facilitating cognitive self-regulation of reading comprehension		
Question	**Data Gathering Method**	**Approach to Analysis**
1. What factors inherent in the design and implementation of the environment affect its use?	• User logs of subjects' activity within Mark-UP • Portfolios of selected subjects' work generated by the tool • Questionnaires applied at the beginning and ends of semester • Interviews with selected students	Identify the aspects of the product that students used and didn't use. Identify elements of the design that assisted or inhibited its use (interface & information design, stability, accessibility). Explore patterns in subjects' attitudes to the product. Explore patterns in the impact of the design of activities within Mark-UP and the choice of the readings on subjects' experience with the product.
2. What factors inherent in users' backgrounds affect the use of the environment?	• Questionnaires applied at the beginning and end of the semester • Interviews with selected	Identify demographic factors relating to prior experience with technology as well as subjects' perceptions of themselves with

	students	regard to the affective aspects of self-regulation to explore how these influence their level of comfort with, and use of, the product.
3. What are the external environmental factors that affect the use of the learning environment?	• Questionnaire applied at the beginning and end of the semester • Interviews with selected students	Identify factors external to the product and the students that affect patterns of use of the product: • Quality of home internet connections & computers • Amount of time available to students to use the product • Quality of time available to students to use the product (time of day, other distractions, environmental factors – warmth, cold, noise etc.).

Table 4.5: Research questions and approaches to data collection and analysis for Aim 2

Research Aim 2: Explore the forms of self-monitoring that take place when students use Mark-UP as an environment to support cognitive self-regulation		
Question	**Data Gathering Method**	**Approach to Analysis**
4. What are learners' prior experiences of learning metacognitively?	• Questionnaires applied at the beginning of the semester • Interviews with selected students towards the end of semester	Look for patterns that identify aspects of a subjects' backgrounds that indicates an ability to self-regulate, such as their interpreted levels of metacognition, reading and technology skills based upon aspects such as their prior experience in learning independently, level of responsibility that they have assumed in previous work or study, and the extent to which these have involved higher order processing such as strategy development.
5. How did Mark-UP support subjects' planning as a component of metacognitive self-monitoring?	• Portfolios of students' work generated by the tool • Interviews with selected students at the end of semester	Explore specific instances where subjects were required to plan in Mark-UP as well as interview and questionnaire data where subjects explain their approach to planning to characterise the relationship between metacognitive planning and goal orientation, and how Mark-UP supported these.
6. How did Mark-UP support subjects' evaluation as a component of metacognitive self-monitoring?	• Portfolios of students' work generated by the tool • Interviews with selected students	Explore specific instances where subjects were required to evaluate in Mark-UP as well as interview and questionnaire data where subjects explain their

		approach to evaluation to describe the different evaluations subjects engaged in, the extent to which they demonstrated metacognitive processing, and how Mark-UP supported these.
7. How did Mark-UP support subjects' monitoring as a component of metacognitive self-monitoring?	• Portfolios of students' work generated by the tool • Interviews with selected students	Analyse examples of students' use of the Mark-UP tools to identify the forms of monitoring that each supported and the extent to which they demonstrated metacognitive processing. Explore Mark-UP's value as an environment to support monitoring by analysing the ways that interview subjects used the product in the light of their previously interpreted backgrounds.

Exploration of each of these questions involved analysis of at least two forms of data to ensure a rigorous approach to developing findings. Not all of the data gathered was necessarily qualitative in nature. Descriptive statistics drawn from the questionnaires provided a firm basis for exploring trends for the whole group, which contributed to exploring the questions relating directly to the utility of Mark-UP. However, the broader goals of this research were to explore the psychological dynamics that occurred when subjects used the tools within Mark-UP when engaging with course readings. These dynamics required rich datasets and a constant comparative approach to analysis. The ultimate aim was not to prove that Mark-UP made students better learners. Indeed the goals of design-based research are to:

> *Surpass the ubiquitous but ultimately futile media comparison studies, to overcome the sterility of most qualitative studies, and to ... present a way forward towards more significant and socially responsible research (Reeves, Herrington, & Oliver, 2005, p. 15)*

This study supported these goals by defining research aims that were both broad and narrow, and involved detailed explorations of phenomena through a combination of data gathering methods that were both qualitative and quantitative in nature and enabled a deep immersion to develop findings that had use both to theory building and product development.

The remainder of this thesis discusses the findings of this research. These findings are organised according to the research aims and the questions that underpinned them. Accordingly, the findings are organised around four chapters:

- Chapter 5 discusses Research Aim 1, which explored the research questions relating to the product itself, and how subjects used it;
- Chapter 6 focuses on the first two questions of Research Aim 2, in particular subject's backgrounds with regard to their interpreted levels of metacognition and how these manifested themselves in Mark-UP through planning and goal setting;
- Chapter 7 explores evaluation as a component of metacognitive self-monitoring to examine how Mark-UP supported subjects' explicit evaluation; and
- Chapter 8 focuses on the final research question which explored the monitoring component of self-monitoring to see how the tools within Mark-UP supported monitoring processes.

5 Use of Mark-UP to Annotate Readings and Solve Problems

The first aim of this inquiry was to explore how students would use Mark-UP, with the purpose of identifying the features relating to the design and implementation of Mark-UP as well as the demographic aspects of the student population that impacted on its use. The aim was to identify those features of Mark-UP that worked and those that did not, providing evidence that could then be used to suggest design improvements for the product.

To achieve the aim, this chapter is organised around the following three research questions:

1. what factors inherent in the design and implementation of Mark-UP affect its use?
2. what factors inherent in users' background affect their use of Mark-UP? and
3. what external environmental factors affect the use of Mark-UP?

The focus in this chapter is on the product itself, rather than how the use of the product necessarily supported learners' ability to regulate their cognition.

Data was sourced in the form of surveys that were conducted near the beginning of the semester (Week 2) and again towards the end (Week 12). The first survey consisted of questions relating to users' perceived level of self-regulation as well as demographic questions designed to identify extraneous factors that may impact on their use of the tool such as access to technology, previous experiences learning independently, and so on. The second survey consisted of the same set of questions regarding self-regulation, as well as a series of questions focusing specifically on the subjects' use of Mark-UP. This second survey also allowed subjects to provide information in their own words about how they found the product, what the strengths and weaknesses of it were, whether they would recommend it to a friend, and whether any factors affected (assisted or inhibited) their use of the product throughout the semester. The first survey was administered to 90 students, the second to 107 – the difference was attributable to the level of attendance in workshops for Weeks 2 and 12. A total of 81 students took both surveys.

Patterns of use within the product were also explored through analysis of the database posting produced within Mark-UP. Mark-UP was organised around weekly readings. These were sourced from journal articles, books and websites and scanned into the system. For each reading, students would be required to conduct activity around the reading using an array of

tools such as a Summary tool, Annotation tool, Post URL tool and so on. They would also be required to use their understanding of the reading to respond to a design problem. All of the responses within Mark-UP took the form of postings to a database, which enabled the creation of summative usage logs. For each reading it was possible to ascertain the number of students who used the various features of Mark-UP. It was also possible to identify the number of total annotations for each reading.

The content of responses was also used. In Week 4 of the semester, the design problem required subjects to identify what they perceived to be problems with the design Mark-UP and then respond using the forum discussion tool. These proved useful in analysing design-based factors within the system.

5.1 Research Question One: What factors inherent in the design and implementation of Mark-UP affect its use?

The question sought to investigate the design features of Mark-UP with regard to the overall utility of the system. This was, in effect, a product evaluation, that had two main aims: to identify issues relating to the design of the product in order to lead to improvement; and to provide a context for user activity within the environment with a view to the next chapter's exploration of the product as a means for facilitating the processes inherent in the proposed model for cognitive self-regulation. Before addressing the product's value as a learning environment, its effectiveness in terms of its interface, visual design, and overall useability needed to be ascertained. To do this, Mark-UP was examined in relation to four aspects of its implementation:

1. a review of the activity within Mark-UP to identify which features were used, and which ones were not;
2. an exploration of students' attitudes to the tools that were available within Mark-UP;
3. an evaluation of the end-user interface, with the purpose of identifying the design features that were problematic for subjects as well as the product's strengths; and
4. an examination of the course design to explore how the nature and sequencing of activities and readings within Mark-UP impacted on its use.

These elements enabled conclusions about the useability of Mark-UP to be made, and issues for the instructional design of courses using Mark-UP to be identified.

5.1.1 A Review of the activity within Mark-UP to identify which features were used and which ones were not

As has previously been mentioned, all student activity within Mark-UP was stored in a central database. Following the implementation of the product, this activity was explored to identify which features were used and when. Table 5.1 provides a summary of this. The first five sets of figures indicate the number of students responding, while the column 'total annotations depicts the number of responses. Annotations per student is calculated from the number of annotations divided by the number of students. In all, there were 12 readings in the unit corresponding to each week of the semester, except for Week 8, where there were no readings to be completed. All readings had a design problem that could be completed with the assistance of the reading material. The use of various cognitive strategies for reading was scaffolded through the introduction of the Summary, Post URL, Forum Discussion and Annotation tools within the system.

Initially the use of these tools was prescribed. For example, Week 2's reading activity had no data for the Post URL tool, Forum Discussion tool or Annotation tool as subjects were required to do a summary for that week. From Week 6 subjects were provided with a choice of tools to assist their learning.

On the whole, the level of activity within Mark-UP was high, with an average of 106 students completing the design problem assigned to each week's reading (Table 5.1). Of these, nearly all students completed some form of activity based upon the reading, with many students using multiple tools to assist them in their reading comprehension. For the first week, there was no specified activity based around the reading beyond the design problem. However the Annotation tool had been demonstrated in class along with the overall interface of Mark-UP, and was always available as an activity within Mark-UP regardless of whether it was prescribed or not. One can see therefore that there are a significant number of annotations each week even in the first two weeks where it was not tied to a prescribed activity (Table 5.1). Over time, the reading tools of summarising, annotation, forum discussion and URL posting were added. In the first five weeks students were expected to use only one of the tools per reading, as specified within the system. By the sixth week, the range of tools was made generally available and the Post URL tool was introduced. From the seventh week, users were instructed to merely 'Mark-UP' their readings in a way that best suited their learning. As well as having to complete the design problem, the tools were made available with no prescription beyond the expectation that subjects should demonstrate some activity based on each reading.

Table 5.1: Summary of responses in Mark-UP

Weekly Resadings	Tasks	Number of Students				Responses			
Reading	Description	Task Responses	Summaries	URL posts	Forum Posts	Annotat-ions	Total Annotations	Number of annotations per student	Notes
01 Barker, P & King, T. (1993). Evaluating interactive multimedia courseware – A Methodology Computers Education, Vol 21 No 4, pp 307-309	Create review criteria to evaluate a commercial website	112	n/a	n/a	n/a	n/a	239	n/a	Annotation tool always available but unspecified in the first two weeks
02. Andres, C (1999). Building Hierarchically structured site plans In Great Web Architecture (Ch 1, pp. 3-15). Foster City IDG Books	Design a web portal that can be used as a home page for a variety of users.	109	104	n/a	n/a	n/a	257	n/a	Completion of summary presented a model answer and students were asked further to compare theirs with the model - 113 responses received
03. About.com (2003) Graphic Design Tutorials – Principles of Design [on-line] Available: http://desktoppub.about.com/cs/graphicdesign/	Propose a new look and feel for a site	114	n/a	n/a	n/a	107	703	6.57	Students were explicitly asked to annotate
04. Park, I., & Hannafin, M.J. (1993). Empirically-based guidelines for the design of interactive multimedia Educational Technology, Research and Development, 41(3), 63-85	Contribute to a better Mark-UP	110	n/a	n/a	n/a	102	761	7.46	Task completed as a forum activity
05. Fetherston, T (1997) Designing Cognitive and Constructivist Educational Interactive Multimedia. Edith Cowan University. Perth	Submit your partly completed portfolio and reflect on performance so far	102	n/a	n/a	n/a	n/a	245	n/a	Annotation still available but not specified
06. Newby, T. J., Stepich, D. A., Lehman, J. D. & Russell, J. D. (2000). Identifying methods and media for learning In Instructional Technology for teaching and learning (Ch 5 pp. 90-114) New Jersey: Prentice Hall.	Propose an approach to teaching how to design an energy efficient house	110	89	n/a	46	95	573	6.03	Students now given the choice of annotation, summary, or forum discussion
07 Wynn, S (1995). Interactive Multimedia Ensuring Motivation of the Learner Edith Cowan University: Perth	Enhance a business's on-line profile	109	82	68	50	93	373	4.01	Task completed as a URL post with comment (introduction of Post URL tool)
09. Dix, A. Finlay, J., Abowd, G. & Beale, R. (1993) Interaction Styles. In Human-computer interaction (pp. 102-114) Hemel Hempstead: Prentice Hall	Design OS Z	107	86	65	54	91	444	4.88	Extra task added to reflect on feedback from partly submitted portfolio - 103 responses
10 Orr, K. L., Golas, K. C., & Yao, K (1994, Winter) Storyboard Development for Multimedia Training Journal of Interactive Instruction Development, 18-30	Review the guidelines proposed in this document in the light of your group's design for assignment 2	104	86	60	57	89	395	4.44	
11 McMahon, M (1995). A Textual Storyboard Example. Perth, WA: West-One	Horses for Courses -- propose an approach to storyboarding your design	104	73	58	56	87	255	2.93	
12 Nielsen, J. & Tahir, M. (2002) Homepage Useability. 50 Websites Deconstructed pp 1-27 New Riders	Letter to a webmaster - Improve a site's homepage	95	77	n/a	57	85	533	6.27	The task also required users to post the address of the site that needs improving - 102 students did so
13 Laurel, B (1990). Interface Agents Metaphors with Character. In B Laurel (Ed.) The Art of Human-Computer Interface Design (pp. 355-365). Reading:Addison Wesley Total Pages 523	Redesign the MS Office paperclip	100	73	58	47	85	323	3.80	As a final task, students were required to reflect on their experiences with Mark-UP and respond - 99 students completed this activity
	Averages	**106**	**84**	**62**	**52**	**93**	**425**		

In comparing the average use of the tools over the semester it can be seen that the Annotation tool was the one that most students applied to each reading. A summary of the average number of students responding to each tool is represented in Figure 5.1:

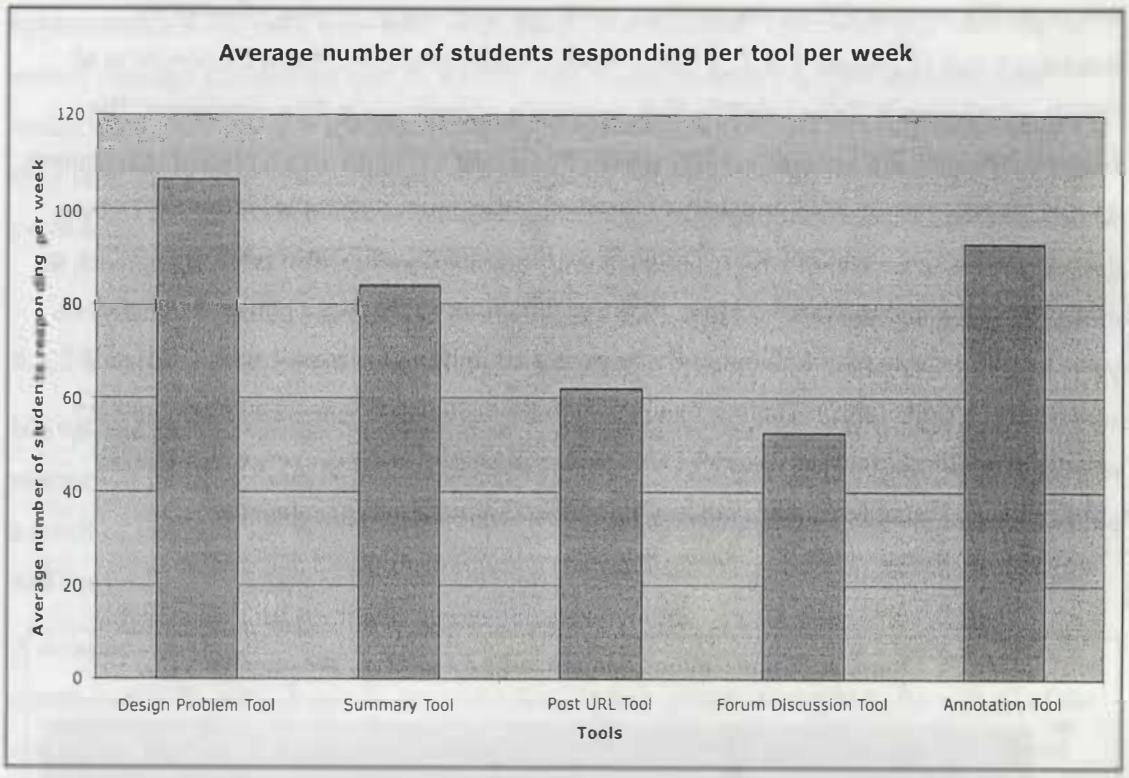


Figure 5.1: Average student responses per Mark-UP tool

This provided a mean result of 93 (Table 5.1), only 13 less than the average number of students who completed the compulsory design problem for each reading. The second most popular tool was the Summary tool, while significantly fewer students on average used the Post URL tool or the Forum Discussion tool. The popularity of annotation was not just because annotation may have been seen as less cognitively demanding for students. It was certainly true that the use of the Annotation tool was tied to a specific point in the reading, and therefore required less reflection or consideration than using the general Forum Discussion tool. It was also true that Annotations were frequently briefer. However, in exploring the total number of annotations, one can see that most students made several annotations per reading. Figure 5.2 provides a comparison chart between the number of students who make annotations each week with the number of total annotations for that week.

Since the use of the Annotation tool was not a prescribed activity for Readings 1, 2 and 5, no data was recorded in terms of the number of students who used it. However, it was still widely used. For example, in the fifth reading, 245 annotations were made to the system (Table 5.1). The actual number of students suffers a small but steady decline throughout the semester, due in part to the level of attrition experienced by most units throughout a semester, but also, as

will be shown when examining other questions related to the research aims, many students found the workload excessive towards the end of the semester. The results also show that some readings elicited far more responses than others. While in Weeks 3 and 4, annotation was explicitly requested from the students, there was also a large number of posts for Readings 6 and 12 (Weeks 6 & 13). These weeks required reading articles by Newby et al. (2000) and Nielsen & Tahir (2002) which were quite contentious in their comments. The former was a textbook chapter, which presented concepts without much rationale or argument, while the second consisted primarily of discrete 'bullet point' recommendations for website design, written by an author who is famous for his dogmatic and confrontational approach to design, claiming in interview, 'Many of the usability books that were published the last two years made a cheap play for popularity by giving up fighting for what's right. I will never surrender.' (Yank, 2002). Table 5.1 shows the ratio of students to posts was 6.03 and 6.27 respectively for these weeks. Week 11's reading (Reading 10), however, was much less polemical and recorded a more modest ratio of 2.93 annotations per student.

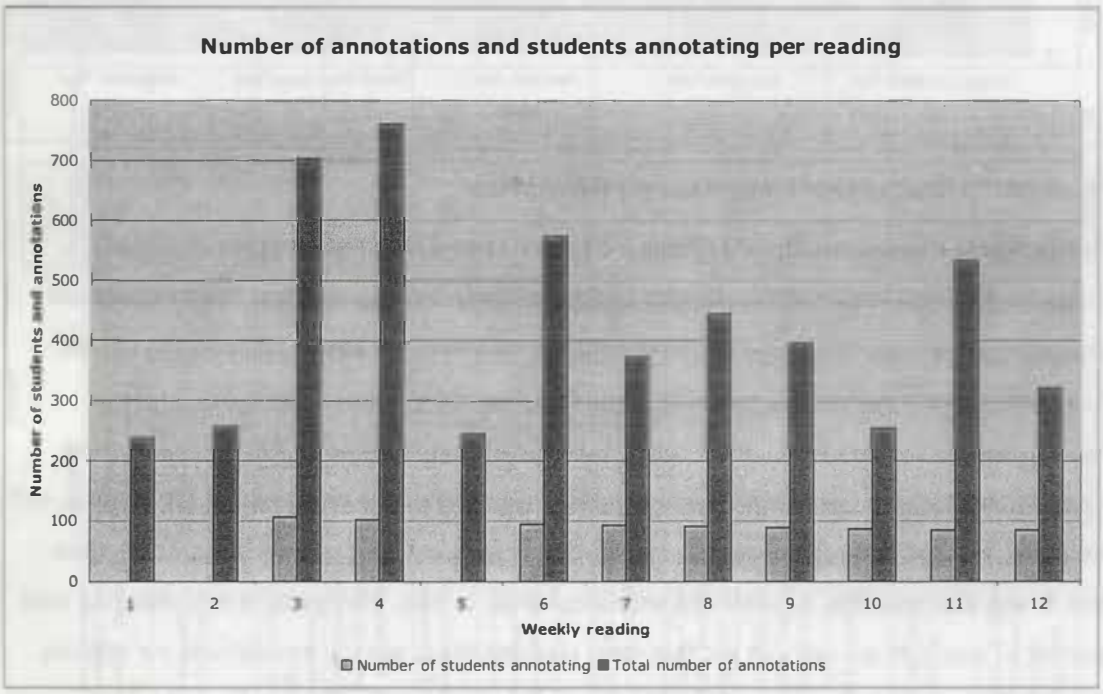


Figure 5.2: Number of annotations within Mark-UP mapped against the number of students posting

As well as the contentiousness of the reading being an influencing factor, the difficulty of the reading itself also appeared to impact on the number of responses. The greatest number of posts was achieved for Week 4's reading, one that as will be shown later was widely considered to be the hardest of the 12, which covered concepts relating to learning design – a

part of the course with which few students had any background. In this case students made on average 7.46 annotations each.

In conclusion, Mark-UP provided the means for a great deal of activity throughout its implementation. All tools were used, even when not prescribed. The nature and difficulty of certain readings affected the type of activity with which students engaged. In the readings which were contentious or addressed unfamiliar concepts, annotation was the most widely used tool. The next section explores the motivations behind subjects' use of specific tools in more detail.

5.1.2 Exploration of students' attitudes towards Mark-UP tools

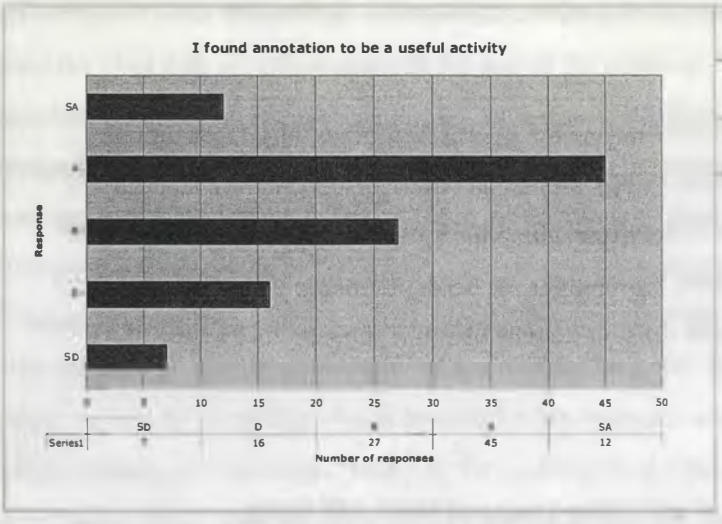
Beyond the extent to which the tools within Mark-UP were used, an even more important measure of their worth was the value that subjects themselves placed on them. Rather than as a result of its perceived utility, subjects may have used a tool because it was expected of them, and because as is the case here, grades were dependent upon their contributing to the system.

A detailed description of each of the tools can be found in Chapter 3. Students were questioned in the second survey about which tools they valued over others. As with all of the statistical results presented in this section, the survey instrument took the form of a 5 point Likert Scale ranging from Strongly Disagree (1) to Strongly Agree (5). As Table 5.2 demonstrates, students showed a range of responses to the tool.

Table 5.2: Average responses to the usefulness of Mark-UP tools

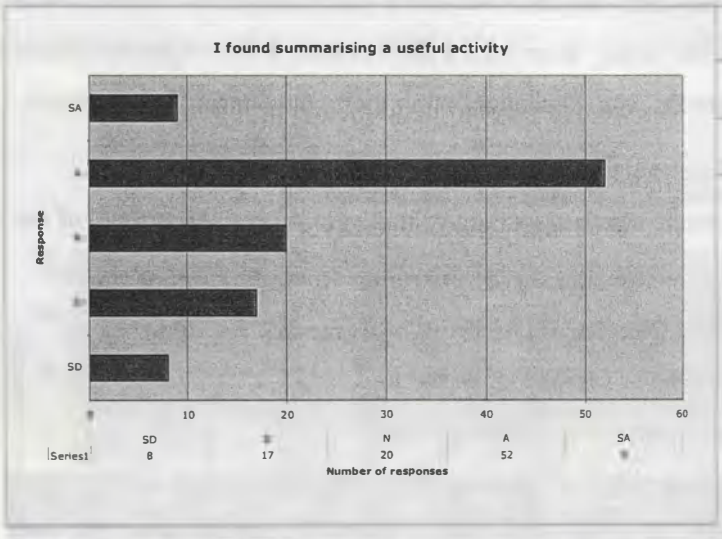
Questionnaire Statement	Mean Response	Number of Responses
I found annotation to be a useful activity	3.36	107
I found summarising a useful activity	3.35	106
I found posting URLs and reviewing others a useful activity	3.27	106
I found discussing issues on the bulletin board a useful activity	3.27	106
I found solving the weekly problems a useful activity	3.46	106
I found reviewing my portfolio a useful activity	3.44	107

The tools perceived to be most useful were the Design Problem tool (weekly problems) and the Portfolio tool. The Summary tool, and the Post URL tool were less valued by students (Table 5.2). Nevertheless, the breakdown of the distribution of responses for each item shown in figures 5.3 to 5.6 demonstrates remarkable consistency between the tools.



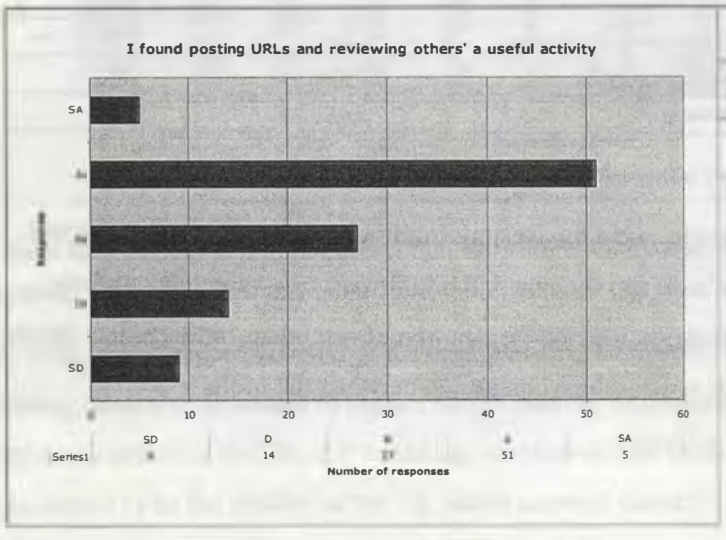
Agreement	57
Disagreement	23
Ratio of Agree/Disagree	2.48

Figure 5.3: Student impressions of the Annotation tool



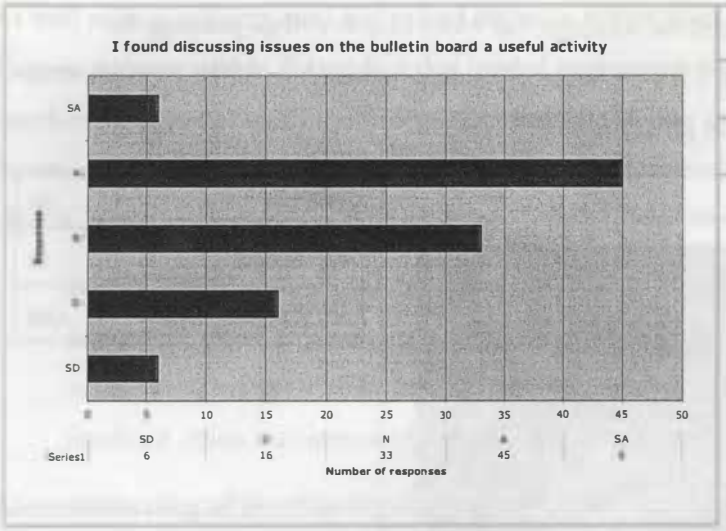
Agreement	61
Disagreement	25
Ratio of Agree/Disagree	2.44

Figure 5.4: Student impressions of the Summary tool



Agreement	56
Disagreement	23
Ratio of Agree/Disagree	2.43

Figure 5.5: Student impressions of the Post URL tool

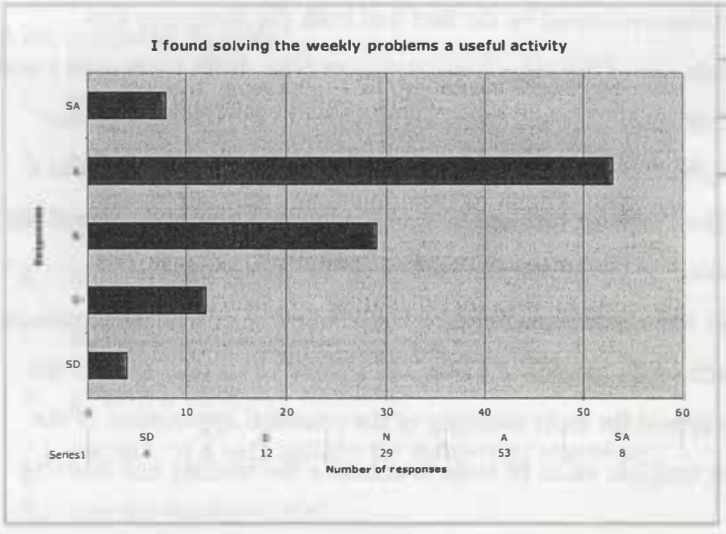


Agreement	51
Disagreement	22
Ratio of Agree/Disagree	2.32

Figure 5.6: Student impressions of the Forum Discussion tool

For all of the tools that are based around reading, the similar results demonstrate an overall positive bias. In discounting the number of neutral responses, it can be seen that the number of students who agreed ranged between 51 and 61. This difference was even less for the number that disagreed (25 to 22). In comparing the two, overall ratios between 2.32 and 2.48 highlighted this consistency (Figures 5.3 to 5.6).

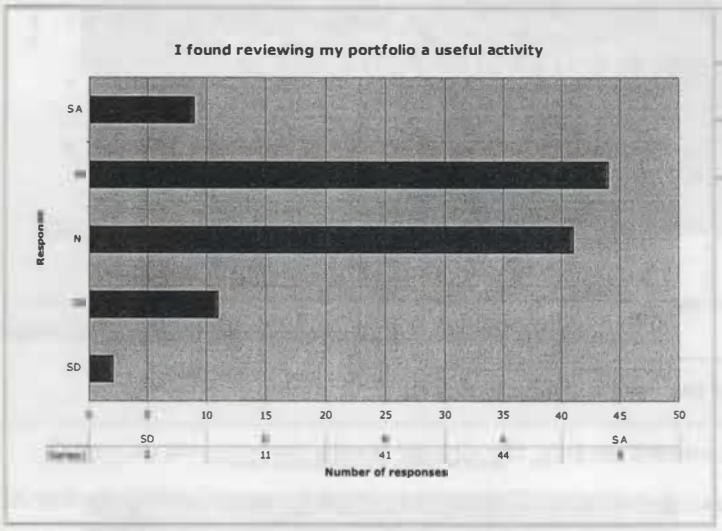
Subjects appeared to feel differently about the Design Problem tool, however. Being more grounded in the practical activity of design rather than reading, this tool was perceived to be far more useful. Figure 5.7 demonstrates a lower level of disagreement than was recorded against any of the tools applied specifically to reading, leading to ratio between positive and negative responses of 3.81; much higher than those recorded for the Summary, Annotation, Forum Discussion, and Post URL tools.



Agreement	61
Disagreement	16
Ratio of Agree/Disagree	3.81

Figure 5.7: Student impressions of the Design Problem tool.

The Portfolio tool was also perceived to be very useful. As with the Design Problem tool, the Portfolio tool was not based around the readings, but was a tool to collate postings for reflection and submission. Figure 5.8's depiction of student impressions of the Portfolio tool shows the lowest disagreement for all of the tools.



Agreement	53
Disagreement	13
Ratio of Agree/Disagree	4.08

Figure 5.8: Student impressions of the Portfolio tool

However the Portfolio tool also generated the most neutral responses of all of the items. Such guardedness is understandable given the fact that using the Portfolio tool for reflective learning is quite a different activity from using it as a means to collate posts for submission. Subjects were required to do both during the semester, so the response may represent this duality.

A clear pattern can be seen in the way subjects valued the tools within Mark-UP. Subjects perceived the tools that allowed them to apply their understandings in a practical way, such as the weekly design problems, to be more useful than those that were more process-oriented, such as the reading tools. This is also evidenced by the fact that both the Summary and weekly Design Problem tools made use of the same basic response type. Both tools used a text box in which users would type their responses and then submit them to the database. Since they were valued differently by subjects, the ease of use of the tool could be discounted as a contributing factor to its value. The Portfolio tool had a strong outcome focus and seemed the most preferred of the tools. However as the primary means of collating responses, its perceived value as a learning tool was diluted, leading to a larger number of neutral responses. Overall one can conclude that each tool's perceived value was related to its relevance to the course outcomes, with stronger support for tools assisting in the practical application of the unit concepts, rather than the less tangible value of tools to enhance the reading and learning process.

5.1.3 An evaluation of the end-user interface

As well as how subjects used and valued the tools within Mark-UP, the third aspect of the features inherent within the product that needed exploration was the quality of its end-user interface. The useability of the environment had the obvious potential to be a major issue with the use of Mark-UP for learning. In comparing computer interfaces to familiar real-world objects, Jenny Preece goes so far as to argue:

> *Just as the shape and position of the steering wheel and its effect when turned has an enormous impact on the driver, so will the design of the computer system have an effect on its user. The format of the input and the style of feedback affect the success with which any artefact is used (Preece, 1994, p. 5).*

An understanding of the affordances and limitations of the interface of Mark-UP was therefore essential before any judgement could be made of the value of it as a learning environment. Overall, subjects found Mark-UP quite easy to use.

In Week 4, students were asked to comment on their experiences of Mark-UP to date, and two of the open-ended questions asked at the end of the semester provided data to assess the useability of the product:

- what advice would you give to a student who is using Mark-UP for the first time?
- are there any factors that have influenced (hindered or helped) your use of Mark-UP during the semester?

These, as well as findings from the open ended questions from surveys one and two, provided data to inform the development nine specific design features that had affected subjects' experience with the environment. These were developed by finding consistent patterns in the data (for example where an issue is mentioned more than 3 times) and are discussed in detail in the following sections:

1. inconsistent use of arrow icons;
2. hidden tasks;
3. page navigation;
4. session time-outs;
5. insecure transactions;
6. graphical interface elements;
7. the lack of a help facility for formatting responses;
8. pop-up windows; and
9. bandwidth requirements.

5.1.3.1 Inconsistent use of arrow icons

Mark-UP was designed as a lean visual environment to help limit the cognitive load of the interface. Nevertheless, this economy caused a problem where an interface element was used in two situations which supported two separate functions.

Arrow head icons were used to assist page navigation (forward and backwards paging) but also played a role as markers for tasks. The issue is evident Figure 5.9.

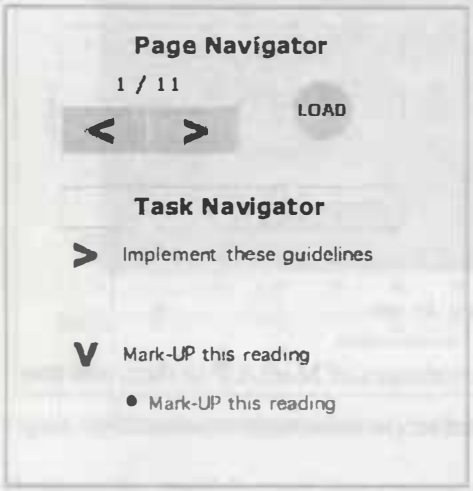


Figure 5.9: Page and task navigation

In his Week 4 response to the design of Mark-UP, one student correctly identified this as a problem, claiming, 'the arrows used for the task navigator and the page navigator look the same, yet one drops down. This clashes with my previous experiences of this style of arrow metaphor' (Subject 113, Portfolio Week 4). This response was echoed by several other posts. One student complained that 'the same arrows for both navigators is confusing' (Subject 32) while another argued, 'a lot of people would think the arrows do the same thing everywhere they are used and so it is misleading (sic) when they are used for the drop down links in the task navigator' (Subject 89). One student suggested the use of a plus (+) sign for the task navigator as 'a more recognisable symbol of expanding a directory' (Subject 56). One student in particular felt quite strongly about the issue:

> *The most confusing thing is the drop down arrows that enable the links. This is a stupid idea and whether it has been designed to show us what not to do when building an interface or just someone's idea of being funky, it really doesn't work (Subject 57).*

In fact, the task navigator itself did not actually need an expandable menu. While initially designed with the idea of attaching multiple stages within one task, this could easily be achieved at the level of attaching tools to a task. As one student noted, 'if the links just show for the reader, it is so clear and easy' (Subject 123).

Overall one can conclude that the use of arrowheads for two functions was a design flaw, though the level of responses about this suggest this multiple role was an irritant rather than a major problem in the system. Many subjects were able to identify and critique this aspect of the product and were able to adapt to the flaw. However, in a unit about interface and information design, it was the type of simple issue that, while easily fixed, cost Mark-UP some credibility.

5.1.3.2 Hidden tasks

To enable greater economy of screen 'real estate' the arrows in the task navigator served the purpose of allowing the menu to be expanded or contracted. This allowed for several tools to be attached to a task. Figure 5.9 shows two states of the menu. The expanded one enabling subjects to 'Mark-UP' their readings sits below the contracted menu item identifying the task of implementing design guidelines to a problem. Clicking on the arrows would reveal or hide the links that sat beneath the main task title. On initially scanning the task navigator an issue became apparent in that there is no obvious link to the task. This issue was allied with the dual use of the arrowhead icons. Those students who were not aware that the arrows in the task navigator were expandable had difficulty locating the link to the task itself. One student highlighted the importance of this issue: 'The hidden link. Why should it be hidden? And the link is also the place where the students will submit their work. If they don't know, how will they submit it?' (Subject 110). In fact, this proved to be the experience of one of the users:

> *When I first used the mark-up, I didn't even have any idea what activity I need to do and where to post the solution, all I knew was to read the article and that's it. It took me ten minutes to figure what I need to do and where to post the solution. You have to click the arrow icon before you see "annotate this reading". How do a first time user know that the arrow icon is a link displaying another link that displays the activity to do and to post the solution? (Subject 30).*

However for most students, hiding the task was a minor annoyance in that it 'introduces one more mouse click to the usage of the system' (Subject 64). Nevertheless having an extra level of hierarchy within the task navigator proved unnecessary in the end: 'they are better showed instead of hidden since making them hidden might cause students to miss them. The links don't consume much space to unhide them and don't ruin the screen design' (Subject 128). Again, this was an issue that was quickly overcome. Once the hidden links had been 'discovered' subjects would not make a similar mistake again. Nevertheless, it did increase

the initial cognitive load of the interface, as the link to the task to be completed was not immediately apparent.

5.1.3.3 Page navigation

Figure 5.9 shows how the page navigator made use of three interactive icons: page forward; page back; and load. The load function was added to enable quicker paging through the readings. If each time a student paged forward the system attempted to load the new page it could have caused a significant drop in performance both for the server and the client. This issue caused discomfort with some students however: 'I find the page navigator a bit annoying, because when you want to jump to the next page, or previous page, you have to click on the "load" button (Subject 42). Another student complained, 'I find it a little annoying to have to click on the next page and click load' while acknowledging, 'This may be ... useful if the reader wants to find a specific page of the readings' (Subject 94). Terms like 'a bit' and 'a little' annoying, suggest this is only a minor problem. However one student warned:

> *I agree with the load button being confusing. Luckily we are all intelligent uni students and after a little trial and error we worked it out. However, I think this is because our grades rely on this. If this was a "real world" situation maybe not so many of us would have bothered to work it out (Subject 110).*

One useability issue is the actual manner in which the page navigation was used. While the environment allowed users to jump to a specific page, 'how is that useful when the content of that page is unknown until you go there' (Subject 34). It would appear then that many students were using the page navigator as a reading system rather than simply as a means of accessing a page for annotation while referring to a printout of the reading. This mode of use, where a reader is most likely to be simply clicking forwards to read, is certainly inhibited by the act of having to click "load" after navigating to the page. One student responded positively to the page navigator, stating:

> *I don't see any problems with the page navigator, because if it did load every time we clicked on the arrows, each page will load individually. This way we can jump from the 1st page to the 23rd and not wait too long for the page to load. (Yes we are not used to seeing it, but in this case I think it is appropriate) (Subject 99).*

One solution would have been to simply offer a dual mode of navigation as proposed by two students, one of whom noted, 'it may be easier for students who read the reading on-line to have next and previous buttons installed along with the current page navigator' (Subject 128).

The page navigation was designed with an assumed mode of operation where subjects would navigate to a page in a non-linear fashion, having a printed copy of the reading beside them as a point of reference. This assumption proved erroneous. A number of students chose to read directly off the screen, and the page navigator, while not preventing these students from successfully completing their work, enforced a second click which interrupted the narrative flow for those students.

5.1.3.4 Session time-outs

The courseware management system from which Mark-UP was linked initiated a session 'time-out' after 15 minutes of inactivity (i.e. failure to submit a post or navigate to a different page). This feature was intended to prevent others from accessing materials where a student may have left a terminal without logging out. Session time-outs proved to be a major useability issue in Mark-UP, and one that needed to be fixed during the implementation of the software. Since the environment frequently required users to make considered and reflective comments before posting, many subjects had difficulty when they came to complete a post:

> *Every 15 minutes or so the session times out. This is annoying because it disrupts what you are doing, forcing you to have to close down all your windows, log back in, then reload all the pages. When a task may take an hour plus to complete, more than 4 timeout can occur. This is an example of where technology is controlling people, taking the power away from the user (Subject 34).*

Several other students posted similar comments in Week 4's review of Mark-UP. By Week 7, the session length was extended, and anecdotally it appears the issue was resolved. Nevertheless it was enough of a problem to be mentioned in responses to the second open-ended question of the post-semester survey. When asked what factors influenced (hindered or assisted) their use of Mark-UP, five of the 83 responses directly mentioned the time-out issue, one student claiming lost work as a result. None of the previous issues rated more than one or two mentions in the responses to this question.

One can conclude therefore that this feature had a severe impact on the useability of the system while it lasted but had repercussions beyond that. Laurel defines the interface as, a contact surface that 'reflects the physical properties of the interactors, the functions to be

performed, and the balance of power and control' (Laurel, 1990, p. xiii). This loss of control immediately diminishes the confidence the user has in the system. Control is also a requisite component of intrinsically motivating software (Malone, 1981). While the time-out was extended after the first few weeks, its initial impact engendered some negativity towards Mark-UP.

5.1.3.5 Insecure transactions

In the first week that Mark-UP was implemented, a coding error in the system meant that responses to the first activity were not stored properly in the system. In fact, each post would end up being stored in the same single field in the database. The experience for the end user was that the most recent post to a problem would overwrite all of the previous ones for that problem regardless of which student was posting. Understandably, subjects were shocked when revisiting a submission to see someone else's work where theirs should have been. This issue was fixed by the second day however it raises the important issue of the need for interactions within the system to be secure. While the number of students this affected was small, issues where work was actually disrupted or lost were understandably considered as major by students:

> *I think the biggest issue is student confidence in the system. Listening to people in the labs, the majority of concerns relate to lost data or the potential for loss. I know that my week 1 comments disappeared. It would be rather unwise not to have a back up of the work. I use a word document, but the problem there is remembering where comments should be placed within Mark-UP (Subject 64).*

Some initial loss of confidence in the system was obviously a factor in users' acceptance of Mark-UP. While the above comment suggests a practical strategy for overcoming this, regardless of the security of the system, the overheads for the student in preparing and maintaining back-up copies of work to ensure against time-out issues and bugs in the system would have hindered the acceptance of Mark-UP.

5.1.3.6 Graphical interface elements

Iconic faces were used within Mark-UP to identify the nature of each annotation; whether it was a summary, question, general comment, or a comment of agreement, or disagreement. Figure 5.10 shows how these appeared on the screen. There was a mixed reaction to the use of these 'emoticons'. While some students responded well to them ('I don't really mind the faces, they are pretty kewl, I like it' – Subject 1) some users found them quite confusing.

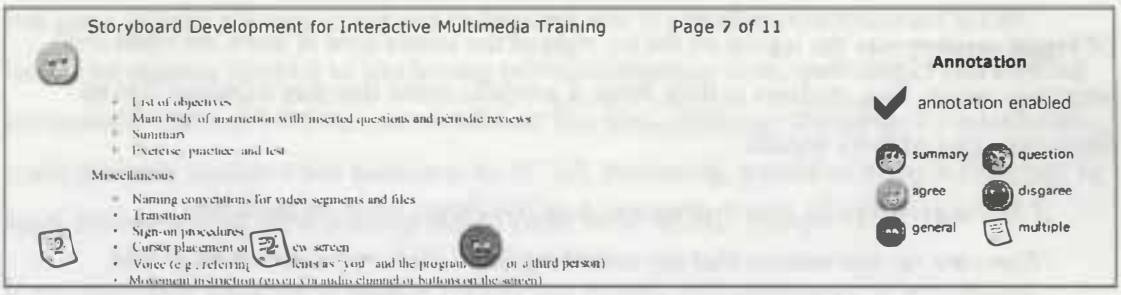


Figure 5.10: Icon use on Mark-UP's annotation screen

On the whole, these icons were seen as quite arbitrary in nature. According to one student:

> *The faces are a good idea so that people know what the sort of response will be, but they don't really convey what they are supposed to very well. The summary face looks like it's in disagreement and the questioning one looks a bit sick (Subject 89).*

This was not true for all students however. One noted, 'being a frequent user of MSN Messenger, I was easily able to guess the emoticons in the interface were for discussions when I first used Mark-UP,' though she did observe, 'the summary icon looks more like an unhappy face' (Subject 102). Part of the issue is that some students did not feel the full range of emoticons were needed, that 'having one or two symbolic "post" icons would be sufficient,' (Subject 39) and that, 'perhaps there are a few too many to choose from' (Subject 85). There were two comments relating to the location of the emoticons on the page. Locations of icons were set by dynamic HTML regions organised in a 4X8 matrix, and this led one user to comment on the limited way in which annotations could be placed on the page, arguing, 'making the location of the icons changeable would be another idea, and/or making placement more precise' (Subject 64). Another felt disappointed that the icons turned into "curled paper" images when there were more than one annotation, although the same student commended the design feature of being able to see how many annotations were made on a region.

Overall, the use of emoticons proved to be a somewhat subjective design element. On one hand the 'smilies bring the image of the page down somewhat, they might be good for primary school children' (Subject 87) while on the other they 'are added to make us loosen up a little bit, not too tense, a little bit funny things in some serious things are needed' (Subject 130). Only one comment about the emoticons was made when students were asked open ended questions about Mark-UP at the end of the semester, the user claiming that the icons did not look 'academic'.

Of bigger concern was the legend on the top right of the screen used to show the icons and what they meant. Two students in their Week 4 portfolio noted that they expected it to be interactive. One of them argued:

> *I first expected to be able to drag and drop [the faces] on to the document. There are no instructions that say something like "click on the document to add annotation". The cursor does change into a hand when you mouse over something that is clickable, providing a clue that you can click on it. (Subject 49)*

It is clear the use of emoticons was considered a positive feature overall. Some reworking would seem to be required to make the expressions more clearly represent the type of annotation made, as well as ensuring that users know to click on the page to add an annotation. While it did not prevent users from interacting with Mark-UP in an effective manner, the emotional response to graphical elements in the system made it a factor which had some impact.

5.1.3.7 The lack of a help facility for formatting responses

It was considered during the design of Mark-UP that its features were evident enough not to require a help facility. While it proved not to be a significant concern – only two of the 83 responses to the open ended question conducted at the end of the semester about improvements to the system suggested a help screen – it registered several times in users' Week 4 reflections on Mark-UP in their portfolios. The lack of help was not considered to be a major issue with the interface, and none of these responses mentioned it specifically in that context. Most simply responded in terms of it being a good idea to 'to create a response or help navigate the system' (Subject 23). A bigger issue was the need for help in formatting text in users' posts. The system was designed to be able to parse basic HTML tags to assist presentation of the portfolio. These included heading styles (<H1>, <H2> etc), paragraph formatting and creating bulleted as well as numbered lists, and so on. These were demonstrated to students at the beginning of semester, but several students requested an additional reference available within Mark-UP: 'There are no instructions to explain how the system works and no "help" section. It also assumes that users know basic HTML in order to format their responses. It should be easier to format text' (Subject 50).

One student suggested implementing a help system in a very basic form, arguing, 'the system doesn't have to be complex, maybe just one page explaining the features in Mark-UP and listing a few basic HTML tag' (Subject 128). Two students went so far as to suggest a formatting feature be integrated into the system. One posited, 'overall the Mark-UP system

was good, at least it's easy to use and understand. But it's troublesome to use the HTML format for system. Could it be like having editing/formatting tools, spell check? (am I asking too much?)' (Subject 118). Another reinforced this idea, claiming, 'the editor for submissions could probably include a few buttons to do HTML formatting, instead of doing HTML tags by hand. However most IMM students should know basic HTML' (Subject 70).

It was obviously incorrect to assume HTML was already well understood by all students. While there was nothing preventing students from simply entering 'plain' text which could easily be displayed without formatting, subjects understandably felt a need to format their comments in a way that assisted communication. This is a reasonable requirement, and although Mark-UP did not inhibit HTML formatting, facilitating the formatting process would have enhanced the value of the product as a tool for communication and learning.

5.1.3.8 Pop-up windows

The design of Mark-UP was such that it frequently opened items into a new window. The main Mark-UP window listed the readings available. When accessing a specific reading, a new window was spawned that contained the reading and the listed activities. When users attempted an activity (such as a post, or an annotation) this was done in a further pop-up window. It was possible therefore to have two pop-up windows from the main menu. While that in itself was not problematic, the integration of Mark-UP into the School of Communications and Multimedia Courseware Management System (SCAMSyte) caused some issues. To integrate with SCAMSyte it was decided that the courseware management system would act as a portal to Mark-UP. This had the advantage of being able to use the SCAMSyte log-in to access Mark-UP. However it was also necessary to treat Mark-UP as a separate system to preserve the integrity of the Courseware Management System.

This created another level of abstraction. Rather than embedding a reading and the Mark-UP system directly within the weekly schedule for the unit, a pop-up to Mark-UP and then a further pop-up to the actual reading and activities was required. This is demonstrated in Figure 5.11.

Several students found the overall effect problematic. One student stated, 'Organisation of content topics, readings and weekly activities are very well organised, however too many pop-up windows become annoying and confusing after a while' (Subject 56). Another student suggested using page-based navigation rather than pop-up windows: 'One thing that I feel a bit annoying is the windows. There are too many windows to get to our tasks. Instead of moving to the new window, I think the use of "back button" is better' (Subject 125).

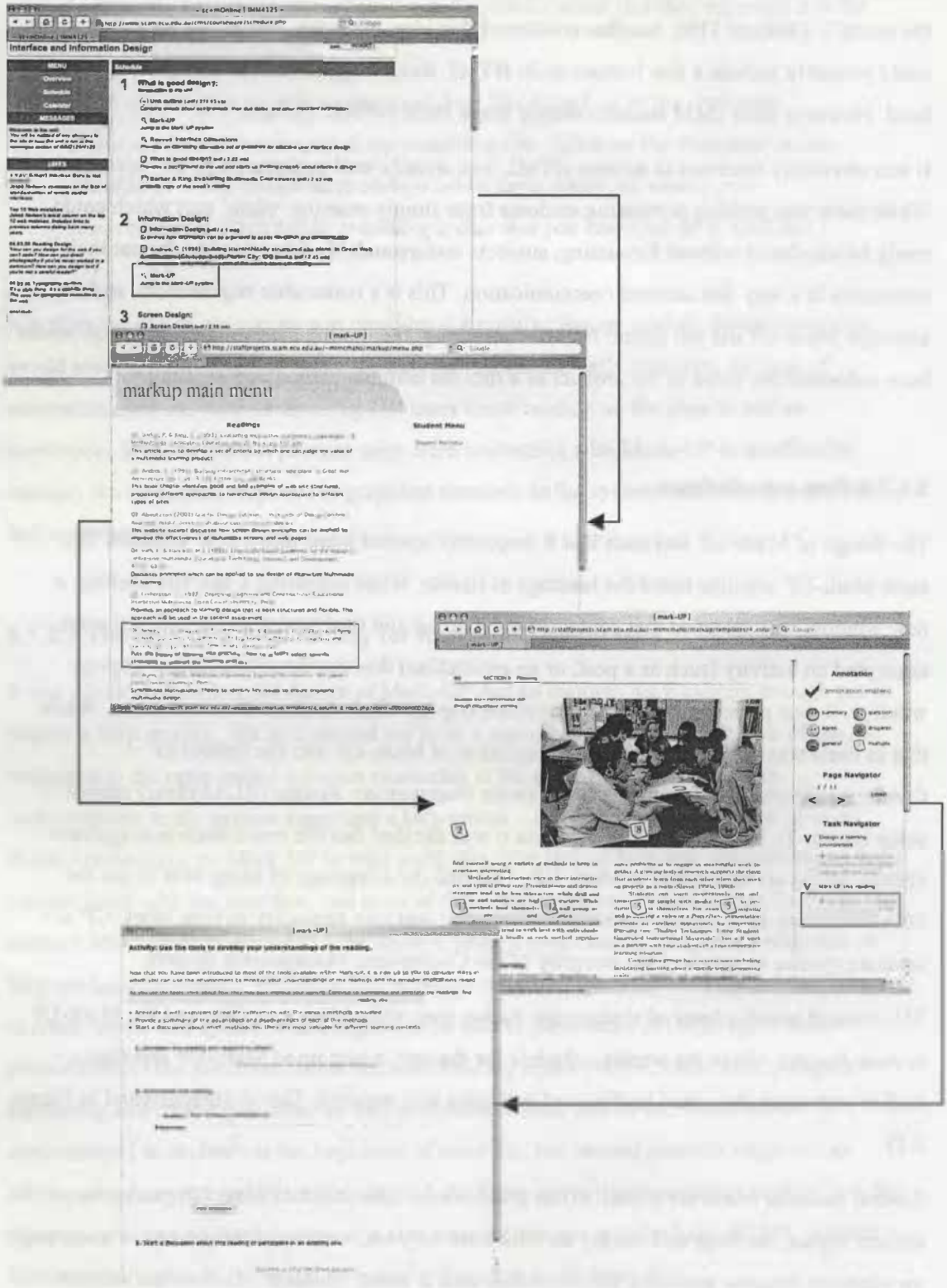


Figure 5.11: Pop-Up windows adding complexity to Mark-UP

The issue was further exacerbated when users needed to access other websites to complete an activity. One complained, 'while doing the activity with the Bold and the Beautiful website it had at least 6 different windows up at the same time' (Subject 129). While it could be argued that the implementation of Mark-UP within an existing courseware management system was the cause of many of these issues, it was certainly an annoyance for several students and was also a contributing factor to the final issue to be discussed.

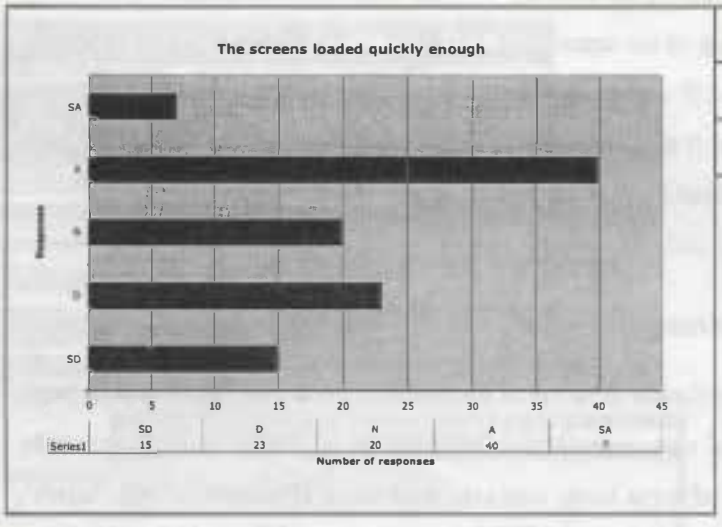
5.1.3.9 Bandwidth requirements

Mark-UP required significant overheads in terms of bandwidth. On accessing a reading page, users had to download a graphical representation of that page, as well as all of the icons to be placed on that page. The placing of these icons was achieved using Dynamic HTML 'layers', which required initial processing by the server, and added greatly to the size of the HTML file. The sheer number of comments on a region of a page also meant that the server had often to collate over 30 responses and then send a long page of all the annotations to the user. This created a significant impact in terms of the responsiveness of the system.

Given the tendency for Mark-UP to be disaggregated into multiple levels of pop-up windows, it is inevitable that there was some delay in students quickly accessing their materials. In addressing Mark-UP's propensity for pop-up windows, one student complained:

> *A major source of frustration is how many screens need to be opened to get to the desired screen in Mark-Up. To post a response you must first sign into the SCAM home page, choose the unit 4121, choose Mark-Up, and then click on an activity to go to another screen to post. Sometimes when you get to this screen there will be another link for pages related to the particular activity. Having so many windows open can be disorientating and messy on the desktop, as well as taking a long time to get to due to the deep structure. This is a problem for me as it is not very convenient to be at university outside of class hours and I would prefer to work at home but I have found that it takes so long with my slow dial-up connection to get to the page that I want to that I inevitably close before it has loaded, cursing Optus after waiting what seems like an intolerable period of time. (Subject 131)*

This demonstrates how the pop-up windows and the size of downloads both contributed to an overall sluggish performance. The dissatisfaction with this was borne out by the survey conducted at the end of semester. Figure 5.12 shows the results of the questionnaire statement about download time and demonstrates a noticeable level of disagreement that the screens loaded quickly enough.



Agreement	47
Disagreement	38
Ratio of Agree/Disagree	1.24

Figure 5.12: Student impressions of screen loading times

One can see that although there was general agreement to the statement, the number of students who disagreed outweighed the number who were neutral. Also there were far more students who strongly disagreed than strongly agreed, indicating that this was a pressing issue for many students.

The open-ended questions achieved similar results. 79 responses were received to the question "In general, what were the strengths and weaknesses of Mark-UP? How could it be improved?" 49 of these responses identified weaknesses. Of those, seven comments found issue with download times both of the individual pages of reading, as well as where there are were a large number of annotations being loaded or a lengthy forum discussion. This also became apparent through the question "Are there any factors that have influenced (hindered or helped) your use of Mark-UP during the semester?" 22 of the responses focused on access to the system from outside the university. The vast majority of these related to the download times, particularly through a modem. For some this was a strong issue, with one student stating, 'Not having access to Mark-UP at home severely hindered my use. The exercises should be available directly from the website i.e. you shouldn't have to log on to Mark-UP to find out the exercises for the week.' Another student argued as a result of the poor download times, 'I don't think it's an efficient/effective way of learning'. One student also complained of not being able to access the system from any other computer laboratories than the Apple multimedia labs, though this was not a common complaint.

Exploring this issue more closely it can be seen that some of the problems were related to the graphical nature of the readings: 'The quality of scanned article is not so good which makes eyes tired. If the readings are in text form not a graphic, it will reduce file size to reduce time when loading and will view clearly as well' (Subject 33). However, another student presented

an opposing point of view, stating, 'The actual loading time of the mark-up reading itself is good. I like how it is in gif format and not in pdf, and how the pages are broken up' (Subject 23). It appears therefore that the graphical pages for annotation were not the only issue relating to performance. In fact, one student commented on how some performance issues had been overcome, stating, 'the idea of having many pages for the article seems good for slow internet connection users, because it takes just a while for each page to load' (Subject 120).

The printable copies of readings were of higher resolution and available as pdf downloads. Since many were made up of scanned pages rather than text, the sizes varied between 180Kb and 3.7Mb, leading one user to comment 'the readings are stored as graphics, in a reading that is 23 pages or so it can take a long time to download, especially if on a low speed Internet connection' (Subject 34).

A final issue was related to the performance of the actual annotation and forum systems. With over 120 students using the system, annotations were made of many posts, which took some time to process and present on screen: 'When for example looking at the other users answers, everything is loaded into one window. This takes ages for my machine to display, so I'd suggest it splits up for example 5-10 responses per page to minimize download times' (Subject 69). Overall it can be seen that download speed proved to be a frustration for many users but was exacerbated by the issue of the session time-out. Several users mentioned both as a combination. There was therefore a range of factors that impacted on the speed of the product particularly on modem lines. While these were certainly an irritation, they were not insurmountable:

> *If users [connect] with high speed communication, - such as ISDN, T1, E1 lines – it will be good and no problems to navigate on there. However, if users have to use on lower communication lines, - such as 56k – still OK, but they need to wait. (Subject 35)*

Ultimately there is little that could be done about this feature of Mark-UP. Consideration was given early on in the design of the product to ways of minimising the bandwidth requirements. Readings were scanned at an appropriate resolution to be readable on screen while not of print quality. Hence an Adobe Acrobat printable version was provided as an alternative. The scanned images used for annotation were presented as 4 bit greyscale images, allowing 16 shades of grey to enable graphics to be readable, if not aesthetically pleasing. GIF compression was used to make the files as small as possible. Where there were very many annotations on a single region of the reading, download time was a factor. However little can be done about this, other than reducing the number of students enrolled in the system or interrupting the flow of discussion by breaking it into pages. The bandwidth requirements

were a necessary evil that, while producing a negative impact for home users, were manageable within a high bandwidth laboratory scenario.

5.1.3.10 Summary and conclusions

There are a number of design features that require attention to improve Mark-UP and these issues have had a minor impact on users' experiences with the product. Some, such as the use of graphical icons and approaches to the navigation system within Mark-UP, are easy to modify. Others, such as the bandwidth requirements of the system, are intractable, but will improve with advances in technology and the wider adoption of broadband Internet. None of these issues prevented students from using Mark-UP to read or transform texts, and it is important to acknowledge a number of Mark-UP's strengths with regard to overall ease of use. On the whole, students found the environment manageable, particularly once they had overcome any initial difficulties caused by the design features identified above.

In fact, one student went so far as to claim it has changed the way he does readings: 'Normally I wouldn't go home and do the readings and write comments about it but this Mark-UP is really simple to use' (Subject 79). This concept was reinforced by several other users. One stated, 'I feel it is easy to navigate and easy to understand what I'm doing and where I am in the site. The page is quite consistent and contrast well in relation to colours and design layout' (Subject 38). The simplicity of the product is commended by another subject who states, ' I don't see anything ... wrong with it because after all we are at uni and we are using this site to learn, so as long as it provides all the information and links we need, it doesn't have to be very "flashy"' (Subject 99). One student wrote about how he developed an effective way of working with it, arguing, 'you quickly work out a system of copying and pasting from a document to Mark-UP – or just entering your comments straight into the system. Anyway you do it, the workings of the system do not interfere with the learning process,' adding, 'It is an easy system to use and its functionality is self evident' (Subject 64). Overall it appears the product was quite intuitive for users: 'Once the concept of Mark-up is understood, the application itself is relatively easy to use. Its consistency every week makes it simple to read the readings and submit the responses' (Subject 9). In conclusion, the product proved to be useable for the most part although some problems with the interface did produce an initial negative attitude for some students. Through this analysis, a number of issues have come to light regarding the design of certain features within the product that will be addressed in future iterations of the software.

5.1.4: Design of activities and choice of readings

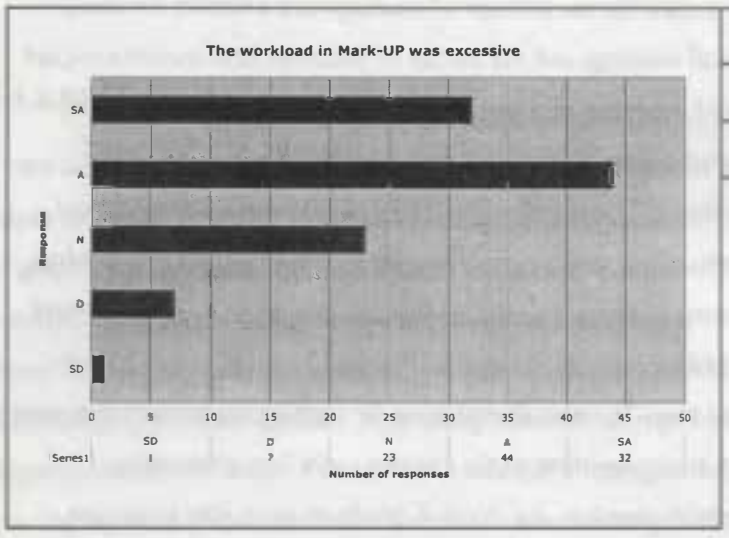
The final series of factors inherent to Mark-UP that needed exploration related to the course design. Since Mark-UP is simply a shell for the storage of readings and a toolset for using them, the choices made in the actual readings and the nature of activities that students engage in are an obvious factor in assessing its value as a tool for stimulating cognitive regulatory processes. An examination of impact of these decisions makes up the final aspect of the exploration of factors inherent in the design of the product that affect its use. Like any tool, Mark-UP is prone to multiple forms of use and abuse. From the outset, however, the product was designed with a specific learning strategy in mind. Students engaged in readings around weekly topics, and each reading had a design problem that required learners to apply their understandings in a more practical way. The actual strategies for reading comprehension were introduced week by week through the integration of the various tools for summarising, annotation, URL posting and forum discussion. By Week 6, students were able to choose which tools to use to assist their learning.

Subjects had little negative to say about the learning design within Mark-UP, evidenced by the paucity of comments relating to course design both when they had to respond to Mark-UP in their Week 4 activity and in the final survey conducted at the end of semester. A common theme through the survey and the Week 4 Mark-UP response was that they enjoyed the reciprocal interaction inherent in reviewing each other's work and engaging in discussion on topics. Nevertheless, there was one issue that did come through strongly, specifically the amount of work involved in using Mark-UP each week. While some of this was related to the issues above, the majority of comments about this factor concerned the readings and activities themselves. This section explores subjects' perceptions of the workload within Mark-UP to ascertain the impact this had on their overall acceptance of the system. This concept is explored in the light of their understandings of the expectations of the course, their experiences with the frequency and amount of activity required, as well as the difficulty of individual readings and activities.

5.1.4.1 Workload in using Mark-UP

Mark-UP required subjects to post two responses per week. The first involved addressing a design problem. The second dealt with activity around the reading: summarizing, annotating and so on. Subjects were generally not given a word limit, though it was explained in lectures that approximately 300 words was required for each problem. Overall there were 11 readings with assigned activities to be completed throughout the semester. This proved to be burdensome for many students. In the second semester survey, subjects were presented with a

statement about the workload within the system. Figure 5.13 demonstrates the overwhelming agreement to this statement.



Agreement	76
Disagreement	8
Ratio of Agree/Disagree	9.50

Figure 5.13: Subjects' response to workload

With a mean score of 3.93 and the second highest ratio of agreement to disagreement of any of the statements in the survey, this was a major issue for students. The open-ended question exploring factors that influenced subjects' use of Mark-UP received 14 responses directly related to the workload. Various reasons were given, including the workload of competing units, and other assignments, particularly towards the end of semester. Within the system, the biggest issue of workload related to the length of the readings themselves.

Ironically, the latter issue is an aspect of the course that had changed little from previous semesters; in fact the number of readings was reduced from previous semesters, resulting in only one reading per week. Nevertheless, by as early as Week 4, students were complaining about the amount of reading involved: 'The biggest dislike about the markup is number of page. Does it have to be that long every week? Hmmm.. shorter markup would be much nicer and appreciated' (Subject 61). One student commented on the level of work involved compared to other units, arguing, 'I also felt that the work load was too much, taking into account that all my other classes also have weekly assignments and at some point I was also meant to be working towards my first assignments' (Subject 18).

The issue of the amount of reading appears to be a combination of difficulty, and sheer length:

> *Reading 3 covered topics that were somewhat familiar to students and therefore, it was easier to comment on and distinguish between what they agree and what they do not agree on. In contrast, although very important, reading 4 was long, tiresome, and by page 13, there was too much new information. Its use was therefore not as beneficial as if topics had been introduced first and related in greater detail, perhaps a later week. (Subject 122)*

To a certain extent, the way in which students used Mark-UP itself appeared to contribute to the effort involved, particularly where users read from the screen rather than printed out the hard copy article. One student stated, 'The amount of pages to read on markup can be too much, reading and skimming 23 pages from a laptop screen or 15 inch monitor can be very testing' (Subject 35).

Some initial difficulties with the reading process were related to the fact that the product made use of readings from multiple sources rather than a single text. Firstly this led to some repetition between readings, one student commenting, 'Yes, I also think that the readings in some cases are a bit much to read on screen. However, I think that if the readings were cut down and sifted through a bit more it would not be as much of a problem as there is often repetitive information within the readings that is unnecessary' (Subject 96).

Unsurprisingly, the readings that caused the most difficulty within the first few weeks were the ones that were from academic journals rather than websites or text books:

> *The content of the reading itself requires concentration in reading and understanding it, especially week 1 and 4. In my opinion, students who already have multimedia background will find the reading challenging, however for students who start from zero, it will require much more effort to understand the reading (Subject 28).*

Of course, reading comprehension is a major focus of this product and it does need to be challenging. The issue is to balance the level of challenge with the readings and to ensure they and the activities are relevant to learners' needs. The implementation of this appeared to be moderately successful:

> *The readings are often in too much depth, and too complicated as compared to the lectures, yet through layered information within them it is possible to follow them. I feel have found it a bit easier than others to follow some of the concepts in the readings of mark-up due to the 2 years of secondary education I studied here at ECU. I think without it I would have had less knowledge to build upon, and would have found these reading much more complicated. A plus of mark-up is its clearly defined weekly concepts. Each week is focused on a totally different topic, while being consistent and relevant to the unit subject matter (Subject 7).*

This was not true for all students, however. One student complained:

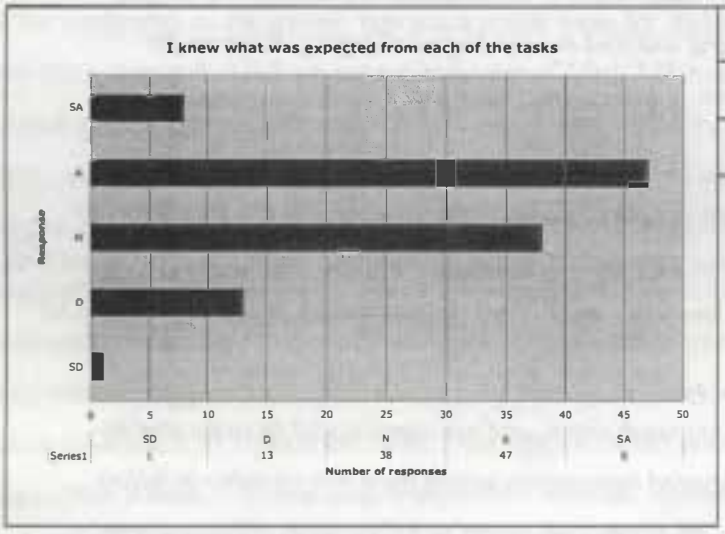
> *'The rather large weekly workload is beginning to take its toll, people are unsure how much is too much (or not enough) with no clear guidelines on how*

much work is actually expected. Regardless, it is a good activity, that just needs a little more variety and clarity each week (Subject 7).

This raises the issue of the activities based around the readings and the application of the concepts within them. Many students responded positively to the activities, with statements such as, 'the prescribed activities are varied and this keeps the courseware interesting,' (Subject 93) and, 'the weekly activities are good although they are time intensive' (Subject 101).

It was generally acknowledged that doing the activities was a necessary component of the learning process, one student admitting, 'If there were not any activities then students would just read the readings without really thinking about them, but by having activities students must invest time and effort to answer them and therefore have a greater understanding of the readings' (Subject 83).

Subject 7's comment about a lack of guidelines within activities was not typical. The statement about the clarity of the activities received a generally positive response.



Agreement	55
Disagreement	14
Ratio of Agree/Disagree	3.93

Figure 5.14: Subjects' understanding of expectations

The large number of neutral responses shown in Figure 5.14 does indicate some uncertainty though. One student commented, 'most of the activities are fairly simple and easy to understand however summarising 10-25 pages in an expected 300 words is not really reasonable unless you require point form' (Subject 57). While design problems had an expectation of approximately 300 words, this was the only reading activity which had a word limit. Two other students commented on not knowing exactly how much to write for each activity.

Overall, the level of work within this implementation of Mark-UP appeared to be a major influence in users' response to the system. In the final survey question which asked for

improvements to the system, one common thread was related to reducing the workload of the environment by using shorter readings, and having activities only once every two weeks rather than weekly. One student suggested, 'Shorter reading could make student more willing to read the reading, hence more indepth thinking and learning could be done.' Another also suggested not using Mark-UP towards the end of the semester when students are at their busiest. Only one student suggested Mark-UP should be made 'harder'.

One can conclude that the very implementation of Mark-UP itself created an expectation of effort to which students were not accustomed. What was considered an expected level of activity for reading course materials and applying concepts within them proved to be more than students would normally do. This therefore contributed to an impression among subjects of Mark-UP as an onerous environment.

5.1.4.2 Other issues in course design

Overall students accepted the instructional design implemented within Mark-UP beyond its obvious expectation of a greater amount of work than they were accustomed too. There were few other comments made about the actual activities and readings within Mark-UP and it appears that the structure of the course was readily apparent, Subject 66 observing, 'The readings themselves are well structured, making them logical and easy to follow and the content is very informative.' Another student acknowledged, 'Organisation of content topics, readings and weekly activities are very well organised' (Subject 56).

Some problems with structure are inevitable. For example, the structure within a reading is outside of the control of the designer beyond its basic selection. Some students had issues with the actual information design of readings, one commenting:

> *The Mark-UP reading is just a long piece of writing that doesn't seem to be organised or structured. To achieve this a table of contents or index would be helpful. On the point of the reading being a long piece of writing, it also doesn't seem to take advantage of any of the benefits of the online interactive environment, particularly in regards to the use of hyper-linking or hypertext (Subject 34).*

The flexibility of the course design caused concern for some subjects. The initially high level of structure and limited choice giving way to a more flexible approach elicited mixed feedback. Some subjects did not like to be locked into a weekly process, while others felt a little lost when the safety net of single prescribed reading activities were removed. This aspect impacts strongly on the self-regulatory potential of the environment and will be discussed in

conjunction with those research questions. Nevertheless, one aspect of flexibility is worth noting here. Mark-UP was made available to subjects in a staged process. Some of the tools were still being refined, which meant at times that a Mark-UP activity was made available only a week or two before it was due. This was constraining for one student, who claimed, 'I think we should have the links to the next few weeks at least, that way we can work ahead and if we get the chance to do the reading and understand it well then during the lectures and tutes we can already have a good understanding of what we are learning!' (Subject 96). Another student, however, valued accessing the materials when they were most relevant, having 'gained prior knowledge of these concepts through previous multimedia units and the weekly lectures prior to each mark up reading' (Subject 78). Still another advocated its value as a complete replacement for any form of face to face learning. Ultimately, there appeared to be some difference of opinion in the way the course was structured, but this was an issue relating to individual expectations and preferences rather than objective measures of what is effective learning. Such issues will be examined in more detail through an exploration in the next chapter of individuals' approaches to managing their own learning.

5.1.5 A summary of how factors inherent in the design and implementation of Mark-UP affected its use

Overall, Mark-UP appeared to have been a successful environment in terms of its useability and instructional design, though it is clear that a further iteration of design and implementation will strengthen these aspects of the product. A significant amount of negativity was directed towards the workload within Mark-UP. While the regular and strategic reading of articles had always been an expectation of this course, this was obviously an unrealistic one in terms of students' expectations of units such as this. However nearly all students persevered with the workload, and this was undoubtedly a contributing factor to the value of Mark-UP as a learning environment. Therefore a balance was required to ensure an adequate breadth and depth of activity within Mark-UP while maintaining a manageable and realistic expectation of work.

There were few issues with the instructional design of the environment, although some consideration needed to be given to the type and difficulty of readings to ensure an appropriate level of challenge for students. While the scaffolded nature of the implementation of Mark-UP tools proved to be a minor problem for some of the more self-regulating students, the product was still viewed as flexible enough to accommodate most subjects' needs.

Mark-UP's lean design proved to be successful with students. Awkward features of the interface, such as its management of windows and use of graphical elements needed

refinement however. Students struggled with these problems at first, though familiarity with the product and the consistent use of such features enabled them to overcome the high initial cognitive load. The product has a high bandwidth requirement, and this will remain true. While manageable through a dial-up connection, Mark-UP is best used within a higher capacity environment.

The results suggest were no obvious 'holes' in Mark-UP with regard to its useability. Students used all of the tools available without any major difficulties. On the whole, the most successful aspects of Mark-UP were the tools that allowed learners to apply their understandings to specific design tasks or problems. However, the level of demonstrated comfort with the tools associated with reading strategies also supports the conclusion that Mark-UP was a conducive environment for the application of reading comprehension strategies.

This first section has focused on the factors inherent within Mark-UP that affected its use. As well as the product itself, however, the manner in which it was implemented was a necessary factor to consider in evaluating Mark-UP's potential as environment to support the self-monitoring processes inherent in cognitive self-regulation. These factors external to the product include the subjects' backgrounds with regard to study, their comfort with technology, and ability to manage their time and motivation. Also, issues beyond the students' control will have affected their experience with the product. These include their access to technology as well as the supportiveness of their social environments. The next two sections examine how subjects' backgrounds and the external environment were found to contribute to their experiences with Mark-UP.

5.2 Research Question Two: What factors inherent in subjects' backgrounds affect their use of the Mark-UP environment

The concept of individual difference is one that remains a contentious one within the field of learning design. The idea of 'learning styles' in particular, is open to critique on the bases of a lack of a clear definition of the term, a paucity of valid and reliable means of measurement of the concept, as well as difficulty in identifying the relevant characteristics of learners and instructional settings that impact on learning (Curry, 1990). However, understanding subjects' backgrounds with regard to their orientation towards learning, their previous experiences, and how these influence their level of comfort and use of Mark-UP was necessary to develop a clear understanding of how the product supported their cognition. This second research question was explored through an examination of two aspects. The first part examined subjects' backgrounds with regard to previous studies, and explored the affective components

of subjects' self-regulation, specifically their level of self-concept, motivation, and use of volitional strategies and how these impacted on their use of Mark-UP. The second part explored subjects' prior experiences with technology to see if this enhanced or inhibited their use of the product.

5.2.1 Subjects' self-perceptions on affective dimensions of self-regulation

As has been demonstrated, self-regulation is a concept that exists as the interplay between affective and cognitive factors. While the cognitive aspects of self-regulation formed the main focus of this study, and are discussed at length in the next chapter, learners' perceived levels of self-concept, motivation, and volitional control are likely to impact greatly on their use of tools such as Mark-UP.

Questions relating to volitional self-regulation were asked of the students near the beginning of semester to enable these factors to be understood. These questions addressed the main components of volitional self-regulation: self-concept; motivation; and the use of volitional control strategies. Results are presented in table form, usually as averages responses. *Weighted* results are also shown to provide an overall response to the concept, taking into account the negative or positive nature of each statement. Negative items are shown in the following tables in italics.

The results suggest subjects generally found studying made them feel good about themselves (Table 5.3). However, many indicated they were uncomfortable giving opinions in class, an important issue to consider since Mark-UP required subjects to make annotations that were visible to all students. They also indicated a tendency to blame themselves when they received negative feedback, as well as concern about the risk of failure.

Table 5.3: Perceptions of self-concept: Survey 1

Statement	Mean Survey 1
I worry about failing my units	*3.93*
I tend to blame myself when I receive negative feedback on assignments	*3.44*
Giving an opinion in class is a nerve-wracking experience	*3.11*
Studying makes me feel good about myself	**3.08**
Overall level of perceived self-concept (weighted average)	**2.62**

Scale: 5 strongly egree, 4 agree, 3 neutral, 2 disagree, 1 strongly disagree

The subjects showed themselves to be optimistic overall about their studies but the high agreement to the negative comment 'I worry about failing my units' shows a certain defensive pessimism was present. It is clear that many students did not feel confident of their abilities and were concerned about how they may appear to others.

As the central process that underpins self-concept and activates volitional control strategies, subjects' levels of motivation are an important gauge of their overall ability to regulate their effort. The subjects in this study proved to be generally lacking in motivation; in particular they reported perceiving difficulty in studying subjects they do not enjoy (Table 5.4). Given the compulsory nature of the unit in Interface and Information Design in which Mark-UP was implemented, such negativity would have proved to be a barrier for some students.

Table 5.4: Self-perceptions of motivation: Survey 1

Statement	Mean Survey 1
It is hard for me to find the motivation to begin studying	*3.53*
I tend to give up when study is difficult	*2.75*
I find it difficult to study subjects I don't enjoy	*4.14*
Overall level of perceived motivation (weighted average)	**2.61**

Scale: 5 strongly agree, 4 agree, 3 neutral, 2 disagree, 1 strongly disagree

Subjects also expressed difficulty in finding the motivation to begin studying (Table 5.4). Once started, however, they appeared to have a reasonable level of perseverance, as evidenced by the somewhat lower level of agreement to the statement regarding giving up (2.75 compared to 3.53). This would suggest that subjects felt the need to maintain focus on their work and could effectively manage that, despite an overall low level of motivation to learn subjects that are not intrinsically enjoyable.

This ability to maintain effort despite poor motivation can be seen in Table 5.5. It is clear that many subjects perceived themselves to have existing volitional control strategies:

Table 5.5: Reported volitional control: Survey 1

Statement	Mean Survey 1
It is important for me to work my way through course readings even when they are uninteresting	3.67
I avoid other activities when I need to study	3.11
I work best when I set myself specific lengths of time to study and stick with them	3.08
Giving myself rewards is a useful way of maintaining effort when I study	3.33
Overall level of perceived volitional control (weighted average)	**3.30**

Scale: 5 strongly agree, 4 agree, 3 neutral, 2 disagree, 1 strongly disagree

In particular, the mean of 3.67 for the statement about working through uninteresting course readings indicated subjects felt it important to apply volitional control to course readings (Table 5.5). However, to say that you value something is not the same as actually doing it. When questioned about what strategies they employed, subjects' responses were more muted. This is understandable given the fact that students may effectively exercise volitional control while using only a subset of all the strategies available. On the whole, though, there was a

general sense of agreement to all of the strategies named in the survey, particularly for the strategy of self-reward. The general positive agreement shows subjects used an array of techniques to maintain effort.

In conclusion it appears that subjects generally had a low sense of self-concept and motivation. However, after at least 12 years of formal schooling it is not surprising that some volitional control strategies may have been developed. Nevertheless, it would suggest that many students were not positively oriented towards learning: that it is a chore, with which they have developed methods of dealing, rather than an intrinsically enjoyable and rewarding process. This generally low level of volitional self-regulation must be taken into account when further exploring the self-monitoring processes in which subjects engage. One cannot claim that these students had a strong sense of self-worth. Despite 'hoping for the best' in their studies, a strong 'fear for the worst' and low level of intrinsic motivation will inevitably have impacted on their activity within Mark-UP.

5.2.2 Previous experiences with technology

In an informational processing model of learning, a major area of focus is the existing skills that students bring with them, particularly where learners are engaged in activities which require a capacity for self-regulation, such as on-line distance education (Miltiadou & Savenye, 2003). New information is learned through a process of framing it with existing understandings of the world. In the use of technology, prior experience has proven to be a contributing factor to students' attitudes to and acceptance of computer aided instruction (Mitra & Hullet, 1997). As part of the exploration of subjects' use of Mark-UP it was important to ascertain subjects' comfort with the technology and draw conclusions about the extent to which this would have impacted on their experiences.

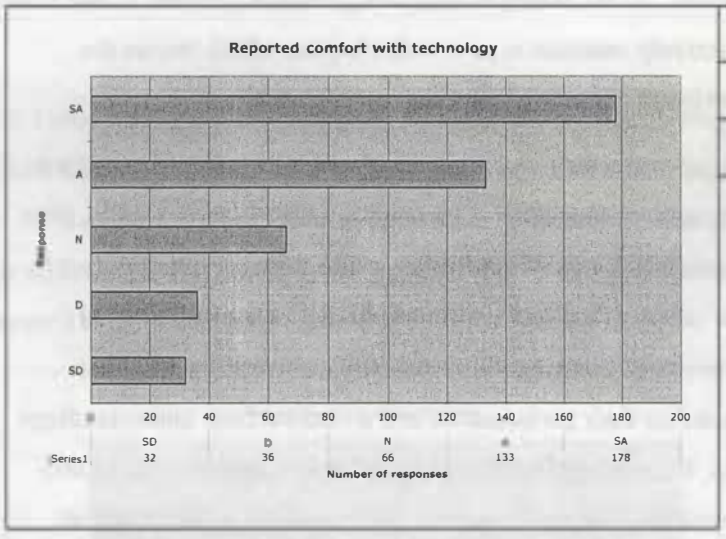
The overwhelming majority of subjects in this study were students of Computer Science, Software Engineering, or Interactive Multimedia, which created a strong expectation for positive experience and comfort with technology. The findings were consistent with this expectation. Table 5.6 shows that while there was some negativity towards the concepts of using Apple Macs and reading off screen (averages 2.95 and 3.38 respectively), all other statements about technology contained within the first survey demonstrated a strong level of comfort (4.40 to 4.59).

Table 5.6: Reported comfort with technology

Statement	Mean Response
I don't like using Apple Mac computers	*2.95*
Reading off a computer screen is uncomfortable for me	*3.38*
I am comfortable with using technology	4.44
I am familiar with using an Internet web browser	4.59
I classify myself as a competent computer user	4.40
Weighted Average	**3.82**

Scale: 5 strongly agree, 4 agree, 3 neutral, 2 disagree, 1 strongly disagree

The strength of this support can best be seen when the frequency of responses for all items for this dimension results are collated, factoring in the nature of the response (positive or negative indication of comfort with technology).



Agreement	311
Disagreement	68
Ratio of Agree/Disagree	4.57

Figure 5.15: Reported comfort with technology

The large ratio in Figure 5.15 (4.57) can be attributed in part to the overwhelmingly positive response to the statement about familiarity with a web browser (no disagreements, and only three neutral responses). However, while subjects were strongly disposed to technology, their discomfort with Apple Macs had the potential to limit outcomes, especially when considering the fact that the Mark-UP was implemented in an Apple Mac environment. Given the technological basis of the subjects' studies, it is over-stating the point to claim that they had an inability to work with this platform. Instead, the discomfort can be attributed to a predisposition towards alternative operating systems and a subjective preference. The discomfort of reading from a screen was anticipated and would probably an issue for all users regardless of their technological background. Overall, one can conclude that the users of

Mark-UP did not have a negative bias towards the use of technology. Nevertheless, requiring students to read from the screen, as well as the configuration of the university computer laboratories, may have been a factor that negatively influenced users' experiences with the product.

5.2.3 Conclusions about the impact of subjects' backgrounds on their use of Mark-UP

The strong positive support for perceived comfort makes it safe to discount subjects' prior experiences with technology as a major influence in the implementation of Mark-UP. What this does raise, however, is the question of how subjects who had little previous exposure to technology would experience the product. Subjects had already shown a strong level of critique of the system, as well as an ability to demonstrate strategies for 'working around' issues in the interface. Learners with less technological experience are unlikely to develop these strategies with the same facility. While failing to specifically define 'people' (Puetz, 2000) argued 30-40% of people actively resistant to new technologies, which makes the design issues identified in the previous section become even more urgent.

Another feature of this subject group was their overall low level of volitional self-regulation. While subjects were able to claim some strategies for maintaining effort in their studies, their general lack of motivation and overall lack of self-confidence make this an important fact to bear in mind when examining the nature of activity within Mark-UP. Fear of failure and inability to orient themselves to activities that are not intrinsically motivating will affect students' abilities to accurately monitor their performance and articulate their understandings within the Mark-UP system. Thus, further investigation of the affective components of self-regulation was warranted when exploring the self-monitoring processes in which students engaged during the implementation of the product.

5.3 Research Question Three: What external environmental factors affect the use of Mark-UP?

So far, factors relating to the design and implementation of Mark-UP as well as relevant issues relating to subjects' backgrounds have been reported. The model of self-regulation that informed this research, however, identified both internal and external components. As well as subjects' own perceptions of themselves and their backgrounds, issues relating to the learners' environment that may have influenced their use of the product required investigation. This final stage involved an exploration of the quality and level of access to technology, as well as

social and environmental impacts on the level and quality of time that could be given to the use of Mark-UP.

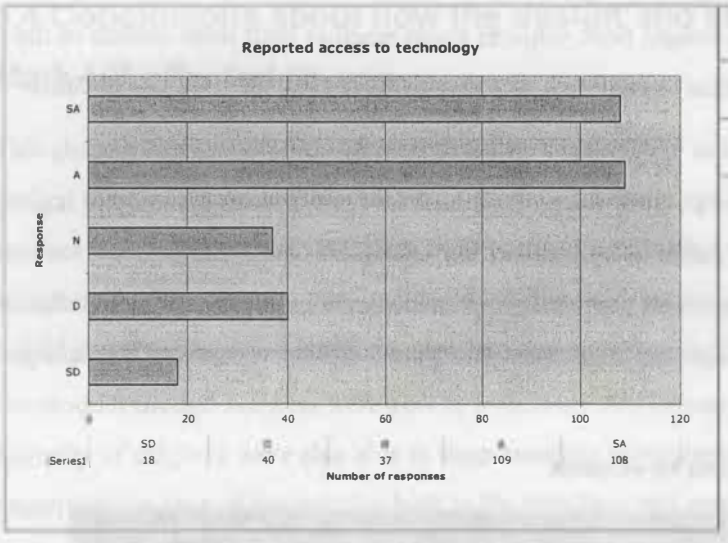
5.3.1 Access to technology

An issue beyond individuals' experiences and comfort with technology is the actual access and availability of the technology required to use Mark-UP. Information was gathered from students at the beginning of the semester to enable conclusions to be drawn about the availability of adequate technology to run Mark-UP from home or work (Table 5.7).

Table 5.7: Subjects' reported access to technology

Statement	Mean Response
I have a good computer set-up at home	3.93
I have a good Internet connection at home	3.60
I have regular access to the Internet at home	4.21
I have regular access to the Internet at work	3.22
Overall level of access to technology (weighted average)	**3.74**

As Table 5.7 shows, most subjects had little problem accessing the technology required to run Mark-UP. This is reinforced by the ratio of agreement to disagreement presented in Figure 5.16. It is clear, however that at least some subjects were dissatisfied with their level of access to technology, evidenced by the greater number of responses that disagreed rather than were neutral to the statements regarding access in Table 5.7.



Agreement	217
Disagreement	58
Ratio of Agree/Disagree	3.74

Figure 5.16: Subjects' reported access to technology

Most subjects had regular access to the Internet at home and it can be assumed therefore that many students would potentially have used Mark-UP at home. Exploring the nature of current Internet access further, the Australian Bureau of Statistics reports that in September 2003, the

number of Internet subscribers was 5,211,000. Of these, 4,516,000 were household subscribers. 499.000 of these households had non dial-up access, marking a 53% increase from the previous 6 months, and being the first time the level of dial-up access has fallen below 90% (*AusStats - 8153.0 Internet Activity, Australia*, 2003). This would suggest a strong move towards broadband access. However, the vast majority of current users of Mark-UP would be connecting to the system via a 56k modem if accessing it from home. When considering comments made about bandwidth requirements of Mark-UP it is clear that many users attempted accessing the environment in this mode but with only limited success. Of less concern is the quality of subjects' computers themselves. Most had a good computer set-up at home, which allows one to conclude that limited connection speed was a bigger factor in subjects' experiences with Mark-UP from home rather than the power of their home computer systems.

5.3.2 Social environmental

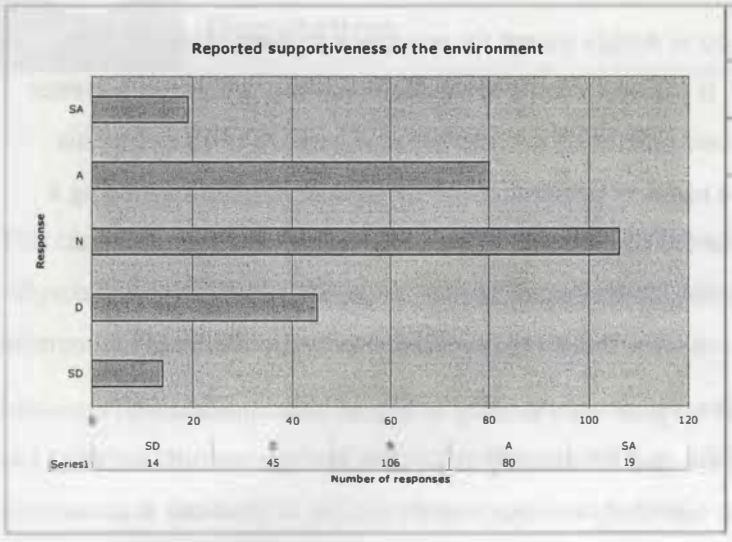
It is tempting for learning designers to assume that their course is the most important thing in students' lives. The reality is that most students pursue several units of study per semester and of the 12 subjects interviewed after the implementation of Mark-UP, most also had part-time work to manage along with their studies. Deakin University's counselling service is one of the many that have recognised the need to help students to be able to balance study with relationships and personal responsibilities, claiming, 'all of your relationships, for good or bad, affect every facet of your life, including university' (Deakin University Counselling Service, 2003). Information was sought from subjects about whether their lives outside of the university impacted on their studies to explore how this may have affected their use of Mark-UP.

Overall, students claimed to have a conducive environment for study at home, though it is clear that their coursework does suffer as a result of their social lives and other responsibilities. Table 5.8 demonstrates that while their social lives impacted on their study, subjects were better able to manage this than external responsibilities such as work or family commitments.

Table 5.8: Social influences reported by subjects

Statement	Mean Response
I have difficulty fitting my study in with my other responsibilities	*3.09*
My social life interferes with my course work	*2.88*
I have a conducive environment in which to study at home	3.48
Overall level of supportiveness of social environment (weighted average)	**3.17**

Taken as a whole, the external environment was not a major factor one way or another. The mild overall agreement to the supportiveness of the environment shown is even less compelling when the large number of neutral responses is taken into account, leading to an overall ratio between agreement and disagreement of only 1.68 (Figure 5.17).



Agreement	99
Disagreement	59
Ratio of Agree/Disagree	1.68

Figure 5.17: Reported environmental influences

These results suggest strongly that the social environment was not a major influence with this group of subjects in terms of their ability to manage it in conjunction with the requirements of Mark-UP. However, it does act as a reminder that such activity is just one of the responsibilities that contemporary students have to accommodate.

5.4 Conclusions about how the design and implementation of Mark-UP affected its use

This chapter has explored the perceived utility of Mark-UP in terms of useability and course design, taking into account the nature of the subject group and the manner in which the product was implemented. The study has revealed that Mark-UP generally worked successfully throughout the semester with regard to its technical stability and design features. Initial problems such as a coding error and session time-outs created some negativity towards the product though subjects were able to overcome this insecurity as they started using it. The majority of subjects were also able to accommodate some design features that impacted negatively on ease of use relating both to the interface and graphical design of the product as well as issues with its implementation into the existing courseware management system. Problems relating to icons, pop-up windows and a lack of help for formatting text are issues that can be improved in future iterations of the product.

Mark-UP proved to be sluggish through dial-up connections, and this is an aspect of the product that is difficult to amend. Ultimately, as Internet bandwidth increases, the requirements of the product will be better accommodated, but it did impact negatively on those subjects who tried to use Mark-UP from home.

There were few issues with the course design except for one major problem relating to the level of activity within Mark-UP. It placed students in a mode of study that had much greater expectations of effort than they were previously accustomed to. There are two sides to this issue. On one hand, it led to some negative perceptions of the product in terms of it being a 'chore'. On the other it is clear that the consistent level of work across all of the tools and activities within Mark-UP meant that students were actively engaged in their learning; possibly more than if readings were set without any specified activity around them.

It must be noted that this group of subjects were tending to lack motivation for study, particularly of units that they did not find intrinsically enjoyable, and this overall lack of reported volitional self-regulation was likely to impact on the quality of the work that was created with Mark-UP. Nevertheless, their backgrounds demonstrated an overall positive orientation to the use of technology that would have helped them to overcome some of the problems with Mark-UP's interface. Overall Mark-UP created some barriers for students in reading academic texts; however it also afforded subjects the opportunity to participate in complex types of activities around the readings, findings that appeared to form a sound basis for the exploration of the types of self-monitoring that subjects engaged in as learners which was to follow.

6 Exploring the Forms of Self-Monitoring that Take Place when Students Use Mark-UP as an Environment to Support Cognitive Self-Regulation

This chapter reports on the second aim of this study, specifically an exploration of how subjects' use of the Mark-UP environment helped to promote the metacognitive processes inherent in cognitive self-regulation.

Metacognitive skills 'enable people to apply interactive reflection to their actions and reaction and to obtain continuous feedback' (Al-Hilawani, 2003, p. 148). This process of self-monitoring is the 'hub' of self-regulation, and leads to 'self-reactions that assist students in making increasingly accurate strategic calibrations in subsequent academic endeavours' (Hubbard & Simpson, 2003, p. 63).

The main components of self-monitoring have previously been defined as planning, monitoring and evaluation (Blakey & Spence, 1990). This chapter explores how subjects engaged in each of these while using Mark-UP. Each concept was explored individually through analysis of interviews with selected subjects, their Mark-UP portfolios, and the Mark-UP responses relating to specific questions and texts of the group as a whole. It could be argued that the separation of planning, monitoring and evaluation is a somewhat arbitrary division. After all, the strength of these processes is in the 'strategic calibrations' entailed within them. They are interdependent, iterative, and may take place at a fine level of granularity. Nevertheless, at specific stages throughout the semester subjects were asked to make plans and evaluate their performance while using Mark-UP, which allowed for a discrete analysis of the individual components. As with the previous research aim, this second aim was explored through a number of discrete research questions as the focus of the enquiry:

Research Question 4: What were learners' previous experiences of learning metacognitively

Research Question 5: How did Mark-UP support subjects' *planning* as a component of metacognitive self-monitoring.

Research Question 6: How did Mark-UP support subjects' *evaluation* as a component of metacognitive self-monitoring.

Research Question 7: How did Mark-UP support subjects' *monitoring* as a component of metacognitive self-monitoring.

Responses to these research questions have been organised in three chapters, each of which discusses separately the discrete metacognitive components of self-monitoring.

This chapter presents findings about research questions 4 and 5, which sought to explore subjects' previous metacognitive experiences as well as how the Mark-UP environment supported subjects' planning.

6.1 Research Question Four: What were learners' previous experiences of learning metacognitively?

Before engaging in a detailed analysis of how subjects used Mark-UP as an environment to support self-monitoring, it was important to develop a clear cognitive profile of the group. In order to do this, data was sourced from a survey conducted near the beginning of the semester and through interviews with 12 subjects conducted towards the end of semester. This data enabled conclusions to be drawn about the metacognitive background of the subject group as a whole. It also provided more detailed vignettes of individual subjects to create a basis for the analysis of the self-monitoring processes they engaged in later in this chapter.

This exploration was conducted therefore from two angles:

- a description of the interview subjects' backgrounds with regard to their prior experiences operating metacognitively, as well as any experiences that may have impacted positively or negatively on their use of Mark-UP; and
- an exploration of the subject group as a whole to characterise their perceived metacognition, self-monitoring, and cognitive strategy use.

These two approaches were then compared to draw conclusions about how the subjects were oriented towards the self-monitoring they engaged in while using Mark-UP.

6.1.1 Description of interview subjects

At the beginning of the semester, students were requested to volunteer to be interviewed towards the end of semester about how they used Mark-UP. As an incentive, they were offered a free movie ticket. From 16 volunteers, 12 subjects, who provided a representative distribution of gender and ethnicity, were selected for interview. Each interview lasted approximately 45 minutes and questions were asked about their age, work and study backgrounds, orientation towards reading both for leisure and learning, impressions of Mark-

UP as a product, perceptions of their learning within it, as well as any personal changes they had perceived as a result of having used it (see Table 4.3).

The following pages focus on the subjects' backgrounds in terms of their previous responsibilities and experiences in working and studying independently, their orientation towards learning, and their impressions of Mark-UP and how they used it. Subjects' expectations of their performance are also presented along with their actual final mark, scored against the following criteria:

- Fail 0-49%
- Pass 50-59%
- Credit 60-69%
- Distinction 70-79%
- High Distinction 80-100%

In order to provide a clear characterisation of each subject they are presented individually before being discussed in terms of their metacognitive backgrounds. Subjects' names have been changed to protect their identity.

6.1.1.1 Claire

Claire was a 23 year-old female and this was her first degree after having briefly started a degree in psychology. Her work background consisted of working for a friend of her parents, babysitting his children and doing clerical duties in his legal firm. She felt that this position had a level of responsibility because she was in a position of trust in that, 'he knows or we know exactly what's going on so I know and tell him what's when and where.' Claire did not see herself as a good student in the unit, primarily because she felt she did not put in the effort that was required. She disclosed a background of attention deficit disorder without hyperactivity; she was a good student generally but had a tendency to be 'dreamy'. This was not diagnosed until quite late in high school. She felt this contributed to a general disinclination for reading. Claire did not read for leisure, claiming, 'I'm more right brained which is more visual rather than left so comprehension to me is a real pain.' She had learned to cope with reading for learning by keeping 'busy', having difficulty in applying herself to work unless she had 'a target; then it's a bit of a competition' for her. She was aiming for a Distinction in the unit.

Claire had a strong background in technology, though she did not describe herself as expert. She accessed Mark-UP from home through a modem, finding the responsiveness of Mark-UP sluggish but manageable. Her approach to using Mark-UP was primarily to print the readings out rather than read them from the screen, using highlighting as a strategy to maintain focus.

Her preference was to think about the readings and write down her ideas before posting to the system. If Mark-UP were not around, she described her main learning strategy as looking at ways to apply material to something, stating, 'I've got to have something to relate to. If I can't relate it then I can't really remember it.' Mark-UP was not confusing for her: 'It's pretty basic and straightforward because it's all in front of you like you can see how it's going to link and where it's going to go'. Nevertheless when asked if she enjoyed it, she was ambivalent, claiming 'at times it had its moments ... I did enjoy the activities,' but 'I didn't like the commenting that much because it was more of a chore'.

Final Mark – 68 Credit

6.1.1.2 Craig

Craig, a 19 year-old male student of ECU's Bachelor of Communications, had a limited background with regard to work and study. He had just completed his first paid multimedia work, which made him 'cynical' and 'bitter' because of what Craig perceived as a 'really shady' client who failed to meet up to his responsibilities. Other than that Craig did not feel that his experiences had affected his approach as a student. He admitted that he'd 'never been a great studier', that towards the end of the unit he was 'completely disorganised' and was amazed he had completed the main assignment, acknowledging, 'I have an irresponsible habit, it's my right and ... yeah hopefully I'll grow out of (it) one of these days.' He did not describe himself as very success-oriented: 'I want to pass, does that count?' He was aiming for a Credit or Distinction but that was not 'striving to achieve'. Craig's approach to reading for learning was mainly to just read and occasionally summarise points. He stated he did not have difficulty in reading for learning though he did find some of the readings 'a bit dry' and abstract. He read 19th century crime fiction for leisure.

Technology was not an obstacle for Craig. He explained the specifications of his up-to-date computer system, demonstrating a sound knowledge of the equipment. Generally he used Mark-UP from the labs but would use it from time to time from home, and found no difficulty with the speed through a dial-up connection. He alternated between reading from the screen and printing the readings out but mentioned he would have preferred to have had a printed reader he could purchase. He also varied in his approach between typing his response directly into the system and preparing in advance depending on the level of difficulty. Overall he did not enjoy Mark-UP. He found the useability 'tolerable', and it always worked for him, but mentioned the page navigation as a weakness of the system. He found summarising useful, but did not like annotation. He believed 'it would vary from individual to individual' in terms of usefulness, but he was 'pretty much in there making annotations for the hell of it'.

Final Mark – 63 Credit

6.1.1.3 Dean

Dean, a 20 year-old student in the Bachelor of Science (Software Engineering), was undertaking his first degree while doing part-time work as a computer technician. He did not describe his background as one which has required a high level of responsibility, stating, 'I have to fix (computers) one at a time, make sure they're fixed properly, but other than that I just fix things' though he did say he was starting to be given more responsibilities such as checking stock and explaining procedures to new staff. He did not see himself as a good student in the unit, admitting he was 'lazy' though he tended to perform better when he had to complete group work because of the responsibility required. On the whole, though, he was not very success-oriented: 'I aim for a pass and if I get better then I surprise myself'. He was hoping for a Credit in this unit but was probably 'borderline or something'. Dean was not an avid reader, claiming that while he used to read, 'I just got lazy somewhere between now and two minutes.. five hours.. a couple of years ago, a long time ago.' He only read non-fiction and did not really enjoy reading for learning, particularly when they 'start using big words and then you have to start figuring out what the word is.'

He reported a strong level of confidence in his use of technology. His computer was over two years old and he shared a dial-up connection to the Internet with his family, so mostly accessed Mark-UP from the computer labs. He did not prepare his Mark-UP responses in advance: 'I just did it directly within the tool. I'm not organised enough to do it separately.' He alternated between printing and reading directly from the screen depending on his 'mood'. Dean was unable to describe any strategies he used for reading before the use of Mark-UP beyond stating that in studying, 'I just read. It's Lazy.' When asked if he enjoyed Mark-UP, Dean was quite positive, enthusing, 'we could give our own views and see what people thought of our views'. While he noted an initial problem with the use of arrowheads containing some hidden information, for the most part he found it easy to use, that it was 'good all round. I could do it at home... I could do it here'.

Final Mark – 53 Pass

6.1.1.4 Belinda

Belinda was a 48 year-old student of the Bachelor of Communications. Originally from the USA, she had previously conducted a year of pre-medical studies, but did not proceed with it, having had difficulty with organic chemistry and deciding she did not want to be a doctor. Her background contained a broad mix of studies and work experience, as well as parenting, all of which she felt had given her a strong foundation for working independently. Finding herself recently divorced and with a boy in his late teens, she decided to return to study to enhance her employability. Belinda was very success-oriented. She felt she would only be awarded a

distinction in the unit because of a poor performance in Mark-UP in the second part of the semester. After having received a mark of 9.5 on 10 for her partly completed portfolio, she reduced her effort on the reading activities as an act of 'childish defiance' because she found them not to be useful, describing them instead as 'busy work'. Belinda was an avid reader despite being dyslexic. She was keen science fiction fan, but also enjoyed reading about technical matters, and was currently reading a book about the scripting language PHP. She felt she had good existing reading strategies.

As has been shown, her attitude to Mark-UP was quite negative. This was more because of a feeling that it was unnecessary for her than because of problems with the system. She had twelve years of experience with computers and had previously worked as a service administrator for an Apple Computer distributor. Belinda used the Internet for research as well as chat, and had a network of computers at home. These shared a single dial-up connection to the Internet however, and she found using Mark-Up from home unfeasible when her family were also on-line. She did most of her initial reading off line, printing and annotating the readings by hand. She felt posting to Mark-UP was duplication of work already done. Even without Mark-UP, Belinda did not make much use of technology to help her reading, preferring the spontaneity of writing longhand and finding Microsoft Word 'not people friendly – it tries to correct misspelling, grammar … I get more frustrated with Word than I do just writing things out'.

Final Mark - 74 Distinction

6.1.1.5 Yvette

A 22 year-old female, Yvette was a student of Computer and Information Technology; her first undergraduate degree. As well as studying she had experience teaching piano and working as a supervisory sales representative for an insurance company. When quizzed further it was discovered she had been a team leader in telemarketing, a role which she described as quite responsible since she had to manage the team. She did not see this experience as having any impact on her ability to study. She described herself as a good student in the unit, though she didn't attend all sessions, was very success-oriented, and was expecting to get a Distinction. Yvette read biographies and books about biological science for pleasure, preferring factual material to fiction, but did not enjoy reading for learning, claiming 'if I had to learn it I would read it' but often chose not to read, preferring to learn on her 'own' rather than reading. In courses where reading was compulsory her main strategy would be to highlight, and make notes with the purpose of summarising, which she would then memorise.

Yvette's experience with Mark-UP was different from other students. She claimed that she had difficulty accessing the product, and it was discovered that this reason was due to her

being unenrolled from the university computer system for not paying her amenities and services fee. This meant that she was unable to access the product in the second half of the semester, but continued to do the activities off-line rather than fix her log-in problem. This meant that she was mimicking the processes of posting, but without actually engaging with other students, something she felt reluctant to do anyway, claiming 'I don't like giving out my ideas 'cause they might take it.' She described herself as a highly competent computer user, had access to adequate technology at home, but only connected through a dial-up connection. Despite her failure to use Mark-UP later in the semester, Yvette enjoyed using Mark-UP and claimed she would have liked to have carried on using it.

Final Mark - 62 Credit

6.1.1.6 Sylvia

Sylvia was a 20 year-old student from Singapore who had entered into the Bachelor of Communications after completing a pre-university course. This was her first degree. She had a small business back in Singapore in 'Cosplay', making costumes of characters in Japanese 'animé' cartoons (e.g. Sailor Moon) and organising corporate social events based upon this theme. She credited this background with providing her with a work ethic and an ability to manage several things at once. She saw herself as a good student in the unit and worked to get good marks, but emphasised these goals were intrinsic, that she was hoping to achieve for herself while acknowledging that there was a strong expectation for her to do well back home. Sylvia contended she would hand something in late rather than submit an assignment that was substandard but expected to get a Distinction or High Distinction in the unit. She was a keen reader, particularly of motivational books and fantasy fiction, and contributed stories to a fan fiction website. She was resistant to reading for learning initially, claiming to have been a poor student in Singapore and was only now starting to feel confident in her abilities to read for learning. She attributed her improved performance to the development of concept-mapping strategies.

Sylvia had a strong background in technology, and had a recently configured laptop computer. While she had a dial-up connection to the Internet at home which she found slow, she did not suffer any of the time-out problems experienced by other students and it always worked for her. Her approach to study was to print out the readings and prepare her responses in advance before typing them into Mark-UP. Overall, Sylvia enjoyed Mark-UP, describing it as 'fun' and despite finding the icons used in annotation a little confusing, found the Annotation tool particularly useful, valuing the feedback of other students.

Final Mark – 64 Credit

6.1.1.7 Frances

Frances was a 23 year-old student, studying her first degree – a Bachelor of Science in Computer and Information Technology. She had a part-time job as an office cleaner and being the most senior person at the workplace had some responsibilities such as managing keys and so on. However, she did not see her work experience as contributing in any way to her abilities to study. She saw herself as an average student and did not describe herself as particularly oriented towards success, though she was hoping for a Distinction in this unit. Frances read quite a lot, mainly biographies and magazines, but was not a good reader when it came to study, claiming she had difficulty with long words and found academic reading 'boring'. In a previous unit which required reading journal articles each week, she had purchased the book of readings but did not open it at all during the semester.

She described herself as a competent user of technology rather than highly skilled but spent a lot of time on the Internet, and maintained a personal weblog for her friends back home in Singapore. Frances' computer set up at home was not particularly powerful – a Pentium III laptop running Microsoft Windows ME. However she had broadband Internet access at home, which was where she completed all of her Mark-UP activities, finding the environment 'more relaxed because you can read and then go and make a coffee or tea then eat in front of the computer'. She had no difficulty with accessing the system or with its speed. While she initially found the navigation system in Mark-UP confusing, Frances soon learnt to click the 'load' button to access pages and did not identify any other problems in its use. Her approach to Mark-UP was to enter her work directly into the system rather than prepare in advance. If readings were longer than approximately ten pages she would print the reading out; otherwise she read directly from the screen. Frances was unable to identify any particular reading strategy that she would have used if Mark-UP were not available, claiming 'I just normally read them and try to understand them' and admitting, 'I normally read the lecture notes' rather than set texts. Asked if she enjoyed Mark-UP, Frances said, 'very much... getting to read what other people say and then whether they disagree or don't disagree ... it was quite interesting'.

Final Mark - 60 Credit

6.1.1.8 Jake

Jake was a 21 year-old student in the Bachelor of Science in Internet Computing. This was his first degree, though he had a range of work experience, having worked as a supermarket assistant and then a petrol station attendant. He described his current position as one of responsibility since he was often the only one in charge of the station. However other than providing him with the financial means to study, he did not see these experiences as

contributing in any way. He felt he was a fair student, particularly in this unit where he had contributed more than he normally did. Jake did not see himself as a keen reader for leisure. While he read in high school, he got 'too busy' and now only read car magazines for pleasure. However he felt he had good reading skills for learning claiming to read, 'pretty fast and I retain quite a bit'. When asked how success-oriented he was, Jake admitted, 'I've had a bit of a rough spot lately in terms of drive' but he felt this aspect was improving. Believing that he had done quite well in the exam and understood a lot of the content that he would achieve a mid Distinction in the unit, 'probably about 75'.

Jake described himself as a competent user of technology. His home computer was 'real old' and he did not have access to the Internet at home so completed all of his work in Mark-UP at the university. He felt the performance of the system was very good within the labs and did not have any difficulties accessing it or using it: 'I found it fairly simple ... it's pretty easy to use'. He did, however, get confused when all of the reading tools were made available in Week 6, stating, 'I didn't realise that you only had to do whichever ones suited you.' His approach to using Mark-UP was to type his work directly into the system, though he would frequently paste it into Word as well to spell check his submission. In the early part of the semester, Jake printed the readings out, however he ran out of printing credits later in the semester and resorted to reading directly off the screen. When asked what strategies he would have used if Mark-UP were not there, he replied, 'probably none, probably gone through them all at the end before the exams.' He cited previous units where he would do the readings for the first few weeks but would give up as he started getting into assignment work. Jake enjoyed using Mark-UP for the most part ('it was pretty good') but felt his performance in it wasn't as strong as it could have been as he had a tendency to fall behind.

Final Mark - 64 Credit

6.1.1.9 Debbie

A 23 year-old female, and student of the Bachelor of Science in Internet Computing, this was Debbie's first degree, though she had started a degree in Interactive Multimedia at another university after having completed a Diploma in this field at Technical College. Her reason for transferring was because she did not find the degree challenging enough and there was too much duplication with her existing skills. Debbie also had experience in developing on-line courseware for technical colleges for two years. This had made her aware of a skills deficit, which is what prompted her current studies. She felt her experiences had made her work harder, as well as helped her to 'grow as a person intellectually'. She felt she was a good student in the unit, though had fallen behind in her Mark-Up a little towards the end of the semester. Debbie saw herself as 'a high achiever' and said she would be disappointed if she

scored less than 75% in the unit. She had recently taken up reading for pleasure after a gap of several years with an aim to improve her vocabulary and cultural literacy. Stating that she was 'sensitive' to different writing styles, she preferred 'straightforward' types of texts to those that were excessively 'wordy' though overall she did not feel herself to be a poor reader.

She was a highly skilled user of technology, but only had a limited computer set-up at home. She described her home system as 'really buggy'. It caused lots of problems when trying to access on-line materials with standard websites, so she did not use Mark-UP at home. Overall she had no difficulty with the product, finding it easy to use. Her approach was to print readings out and annotate them by hand before typing her response directly into the system. She found it useful to transcribe her longhand responses as it gave her a further opportunity for revision. If she did not have Mark-UP, Debbie jokingly said she would have failed, before clarifying the statement by saying that the structure and assessment tied to Mark-UP provided her with a goal to work towards. However, while she said she enjoyed using it, she did feel that the actual strategies she used could have enabled her to do the readings off-line because on the whole she preferred to summarise rather than annotate or contribute to forum discussions, finding little value from others' comments.

Final Mark – 77 Distinction

6.1.1.10 Brian

Brian was a 19 year-old male student of the Bachelor of Science in Software Engineering. He had previously had some work experience within a local multimedia company but had not been in any position of responsibility. Brian did not see these experiences as having made him a better student. He felt he was a good student in the unit; that he did his work despite a tendency to 'muck around' and 'make waves'. Asked if he was a success-oriented student, Brian claimed he just wanted to pass, and would only gauge his performance in this unit as somewhere between a pass and 'the bottom end of Distinctions'. While he read novels for leisure, he said he did not enjoy reading, and if readings for study were 'too long and drawn out' he would 'put them on the back burner'.

Brian described himself as a highly skilled user of technology. He had a powerful computer at home, but only a dial-up connection to the Internet. He used Mark-UP from home sometimes, finding it manageable but slow. He found Mark-UP personally easy to use given his background but felt novice users might have found the number of pop-up windows confusing. Brian did find Mark-UP's tendency to time-out frustrating, but when questioned acknowledged he had not experienced this problem after the first few weeks. He preferred to print readings out and annotate them by hand, and would then copy them directly into Mark-

UP. The Annotation tool was his favourite and when asked if he enjoyed Mark-UP he said that he did, 'because you are definitely gaining a benefit out of it'.

Final Mark - 62 Credit

6.1.1.11 Alan

Alan was a 32 year-old male who was originally from Malaysia but had been living in Australia since he was a child. He had completed a technical diploma in computer programming several years previously and was working as a computer technician. This role involved dealing with clients, and analysing and developing network solutions. He felt these experiences had enhanced his study skills by improving his ability to take responsibility for his work and fulfil his commitments in group assignments. Alan saw himself as a good student in the unit, was a hard worker and was generally success focused. While he was hoping for a Distinction, Alan felt that his performance in using Mark-UP had trailed off during the second part of semester due to competing assignments. Overall he was not an avid reader but read when he 'got the time'. Reading for learning was not a major problem for him, though he did find it hard to motivate himself to read articles that he did not find immediately relevant.

He saw himself as a highly skilled user of technology. He had a 'basic' Pentium III laptop at home that, while functional, was not particularly powerful, and he only had a dial-up connection to the Internet. Nevertheless Alan completed most of his Mark-UP activities from home, reading from and typing directly into the system. He found the system 'only occasionally' too slow, attributing this lack of speed to his completing activities at a time when the server would be particularly busy rather than actual size of the images and text he was downloading. He did not feel any need to print the readings out, finding that 'more of a hassle'. If he had not had Mark-UP he would have made his own notes about the main points of readings and lectures and would have compiled them into a portfolio in a similar fashion to what was available in Mark-UP. Overall he found Mark-UP easy to use, though he found the navigation and pop-up windows confusing at first. He enjoyed using it in the first six weeks, but found it very demanding later on in the semester when he was completing other units.

Final Mark - 69 Credit

6.1.1.12 Duncan

Duncan was a 22 year-old student in the Bachelor of Science in Software Engineering, having previously been excluded from his degree in Computer Science after he failed the same unit twice. He was working in telemarketing for the deaf society, and while he felt this position was not a particularly responsible one, he credited it with requiring him to develop time

management skills. He described himself as lacking in motivation and self-management skills when he first attempted university but now saw himself as a 'pretty good' student, though he did not feel that multimedia was his 'thing'. He did not claim to be very success-oriented, saying he did not want to fail, but when questioned further acknowledged that he hoped to maintain his Distinction average. He enjoyed reading novels, but did not specifically enjoy reading for learning, though he could make himself do it.

Describing himself as 'pretty good' with technology, Duncan had a powerful computer at home that ran the Linux operating system. Since he lived in student housing, he had a broadband connection to the university's network and had no problems accessing Mark-UP, claiming, 'Mark-UP was really good for me I could just make it really quick.' Despite his confidence in the system he copied his responses into Mark-UP from a word processor 'just in case'. Most of the time he would read directly from the screen, though he did print out approximately three of the readings. He could not identify any specific reading strategy that he would have used were Mark-UP not available ('I would read them. Yeah, that would be it though'), and acknowledged that even that would probably have tailed off towards the end of semester. On the whole he enjoyed Mark-UP but complained that there was a lot of work. He noted a few issues with the interface such as the page navigator but felt they were 'not a big deal'.

Final Mark - 84 High Distinction

6.1.1.13 Conclusions about interview subjects' backgrounds

It is evident that these subjects were diverse in terms of their backgrounds and prior experiences in operating metacognitively. As well as representing an age gap from 19 to 48, and three different courses of study, it is evident that Mark-UP was used in many different ways and was also valued differently by the subjects. Table 6.1 summarises the background of each student as well as an interpreted level of reading, technical, motivational, and overall metacognitive attributes, scored on a three point scale: high; medium; and low. This interpretation was based subjects' own statements about these as well as more objective sources such as subjects' abilities to identify the strategies and processes they engage in while using Mark-UP and reading texts. Their overall attitude towards Mark-UP is also presented from positive, through neutral, to negative, where a positive attitude was demonstrated by a stated enthusiasm for the product and keenness to work with it, a neutral attitude was demonstrated by ambivalence or apathy, and where a negative attitude could be determined by a subject's preference to use other ways of reading than through the Mark-UP system.

Table 6.1: Interview respondents' backgrounds

				Interpreted Level of				Attitude to	Final Result	
Name	**Age**	**Gender**	**Degree**	**Metacognition**	**Reading**	**Technology**	**Motivation**	**Mark-UP**	**Intended**	**Actual**
Claire	23	F	B Comms	High	Medium	Medium	High	Neutral	Distinction	68 Credit
Craig	19	M	B Comms	Medium	Medium	High	Low	Neutral	Credit	63 Credit
Dean	20	M	BSc Soft Eng	Low	Low	High	Low	Positive	Pass	53 Pass
Belinda	48	F	B Comms	High	High	High	High	Negative	Distinction	74 Distinction
Yvette	22	F	BSc C & IT	Low	Low	Medium	Medium	Positive	Distinction	62 Credit
Sylvia	20	F	B Comms	Medium	Medium	High	Medium	Positive	Distinction	64 Credit
Frances	23	F	BSc C & IT	Low	Low	Medium	Medium	Positive	Distinction	60 Credit
Jake	21	M	BSc Int Comp	Medium	Medium	Medium	Low	Neutral	Distinction	64 Credit
Debbie	23	F	BSc Int Comp	High	Medium	High	High	Neutral	Distinction	74 Distinction
Brian	19	M	BSc Soft Eng	Low	Low	High	Low	Positive	Pass	62 Credit
Alan	32	M	B Comms	High	Medium	High	Medium	Neutral	Distinction	69 Credit
Duncan	22	M	BSc Soft Eng	Medium	Medium	High	Medium	Positive	Distinction	84 High Distinction

Legend:	
B Comms	Bachelor of Communications
BSc Soft Eng	Bachelor of Science - Software Engineering
BSc C & IT	Bachelor of Science - Computers and Information Technology
BSc Int Comp	Bachelor of Science - Internet Computing

Interview subjects' interpreted metacognitive levels

As Table 6.1 shows, interview subjects exhibited the full range of metacognitive levels. These levels were interpreted according to three categories. Metacognitively *high* or *strong* subjects showed self-awareness across all aspects of their lives. Those interpreted as *medium* or *moderate* demonstrated some self-awareness but not in all instances or across all domains. Those subjects interpreted as metacognitively *weak* or having a *low* level of metacognition on the other hand tended to show little self-awareness or notable inaccuracies in their self-perceptions. Belinda, for example demonstrated a high level of existing metacognitive awareness. She was older (48), had a broad range of life experiences and was success-oriented. She was able to clearly articulate the strategies that she used for reading and learning and describe her use of Mark-UP in those terms. Claire and Debbie too appeared to demonstrate a high level of awareness. Both being 23, they were a little older than some of the other students. While Claire did not see herself as a good student in the unit, she was able to describe in detail strategies for both volitional and cognitive self-regulation such as defining a challenge for herself, looking for ways to apply her understandings and so on. Debbie too was clearly aware of her own learning processes, having transferred to the degree because she found her previous one lacked challenge for her. Of the males, Duncan was able to reflect accurately on his performance. Like Debbie and Claire he had transferred from a previous degree, although he indicated this was as a result of a poor previous performance. While he was less able to define specific learning strategies than some of the other subjects, his description of himself as an improved student was credible given a final mark that was the best of all the interview subjects. Another one of the older students, Alan (32) had previous work experience that required a level of self-regulation and was also able to predict his performance quite accurately. In fact all of the above subjects were quite accurate in predicting their final mark, correctly identifying or at least coming close to identifying their final grade.

This could not be said for all subjects, however. Of the others there was a tendency to have inflated expectations of their final grades. While subjects such as Craig, Brian and Dean had little confidence in their abilities and hoped merely to pass, Frances and Jake expected over 70% but in the end received marks in the low 60s. Yvette claimed to be a good student, although she had not sought to fix her university log-in account and admitted that she did not attend class very regularly. In this case it was not surprising that she received a mark of 62%. What was surprising was her expectation of a Distinction. Among the lower performing subjects there appeared to be two general orientations towards learning. The first group, including Dean and Brian, demonstrated particularly low levels of volitional self-regulation. These admitted to being lazy students (Craig went to far as to describe himself as

'irresponsible') and also failed to describe in any detail cognitive strategies that they typically used for learning. The second group tended to be less accurate in terms of their ability to gauge their own skills as learners. While Sylvia, for example, was able to describe an approach to mind mapping that she had garnered from a book on the subject, she demonstrated a tendency in the interview to misunderstand questions. When asked about the work that she did in her final assignment, it also became clear that while she was doing work that was interesting and innovative, it did not meet the requirements of the assignment. Yvette's flawed self-perceptions came through when asked her attitude towards annotation. Her reason for not using it was based upon her intellectual defensiveness, being unwilling to share her ideas for fear that others would steal them. This was quite surprising given her somewhat average overall performance.

One intriguing aspect of these interviews was that two of the subjects who were interpreted as highly metacognitive on the basis of their age, ability to articulate their learning needs and strategies, also identified themselves as having a learning disability. Both Belinda, who claimed to be dyslexic, and Claire, who said she had attention deficit disorder, were capable of articulating complex positions about themselves as learners. It would appear that they had developed strong regulatory skills to accommodate these dysfunctions.

Interview subjects' interpreted reading levels

The interview subjects provided a mixed picture of their skills as readers. Table 6.1 shows that in fact few of the subjects could be identified as having a high level of existing reading skills. While Belinda claimed to be a strong reader despite her dyslexia, and both Debbie and Claire described approaches that they used to assist their reading, others such as such as Yvette, Alan, Francis, and Sylvia described difficulty in reading for learning. These latter students tended to be the ones who reported inaccurate perceptions of themselves as learners too. This proved to be a different characteristic to subjects such as Dean, Craig and Jake, who attributed their poor reading mainly to a lack of motivation than a lack of skill. Nevertheless, most subjects reported some difficulty with reading texts that were difficult to relate to practical examples or were excessively theoretical.

Interview subjects' interpreted levels of technology skills

One area of consistency among subjects was their level of expertise in using technology. All subjects described themselves as competent users, some highly skilled. This reinforces the findings in the previous chapter that technology skills among subjects would have had little negative impact on the use of Mark-UP. In using Mark-UP, few of the interview subjects described any great difficulty with the product, though most were able to critique aspects of its design. It appears most students were able to find a way to work effectively with it.

Interview subjects' patterns of use with Mark-UP

While most subjects appeared to be competent users of technology, the approaches they took to using Mark-UP were actually quite varied. Many, such as Claire, Belinda, and Debbie printed readings out, annotated them and then copied their work into Mark-UP later. These subjects were also able to describe strategies they would have used for reading were Mark-UP not available and typically were the better students. However Duncan, who achieved the strongest final result of all the interview subjects, argued that he would have done nothing with the readings other than 'read them', entered his work directly into Mark-UP and printed the readings out infrequently. This is more consistent with those interview subjects who demonstrated lower volitional self-regulation such as Jake, Dean and Craig. While generally the better students used existing strategies and then applied them to Mark-UP, this was not true for all of them, and there was less consistency among the students who exhibited poor volitional control or metacognition.

Interview subjects' attitudes towards Mark-UP

There appeared to be a clear pattern between how subjects used Mark-UP and their attitudes towards the product. Table 6.1 shows that those subjects who could demonstrate a high level of metacognition and had existing reading strategies generally found less value from Mark-UP than those that did not. This was true for Debbie, Claire, and particularly Belinda who resented the 'busy' work involved in Mark-UP. On the whole, the others enjoyed using the product. Duncan again provided an atypical profile, being a strong achiever while finding the use of Mark-UP generally useful. This may be somewhat tied to his acknowledgement of having previously had poor motivation. Generally those who identified volition as an issue were more neutral to the product, while those that could be identified as metacognitively weaker (such as Frances and Brian) claimed to enjoy using it.

The role of interview subjects' backgrounds to the study

These findings suggested a range of issues that needed to be considered when exploring the nature of subjects' activity within Mark-UP. In particular they emphasised the importance of the affective components of self-regulation in contributing to subjects' experiences of the product. It is evident that many subjects equated their level of performance with their ability to maintain effort. It also drew into question the accuracy of subjects' perceptions of themselves as learners. Some subjects clearly saw themselves as quite able students and yet made statements that were inconsistent with that, such as Yvette's view of herself as a good student and her positive attitude towards Mark-UP, despite rarely having used it and having poor attendance. These factors needed consideration when analysing the discourse within Mark-UP to provide an accurate context for the work these subjects did in it.

This also impacted on the ability to make comments about the subject group as a whole. The breadth of diversity demonstrated among interview subjects has provided a means to qualify the findings in the next section of this chapter exploring the reported existing metacognition, self-monitoring processes and cognitive strategy use for the cohort of students studying the unit.

6.1.2 An exploration of the broader subject group's perceived metacognition, self-monitoring, and cognitive strategy use

To provide a broader context and triangulation for the findings relating to interview subjects' use of Mark-UP, some demographic information was sought as to how the subject group as a whole originally saw themselves in terms of their perceived levels of metacognition, self-monitoring, and cognitive strategy use. Information was gathered from the survey conducted at the beginning of the semester where they responded to statements that identified each of the above components of cognitive self-regulation as well as a general ability to work and study independently. 90 students in total responded to the survey. Subjects were required to indicate their agreement with statements identifying concepts integral to cognitive self-regulation using a 5 point Likert scale (1 for Strongly Disagree through to 5 for Strongly Agree). Each of the three components of metacognition, self-monitoring and cognitive strategy use is discussed in the following three sections, and then conclusions are drawn in light of their overall responses to learning independently. Where items represented a negative indicator of the metacognitive scale these are italicised in the tables.

6.1.2.1 Subjects' perceived metacognition

Four statements were presented to students relating specifically to metacognitive concepts. Overall, subjects perceived themselves to be operating at a metacognitive level, achieving an average of 4.00 (Table 6.2).

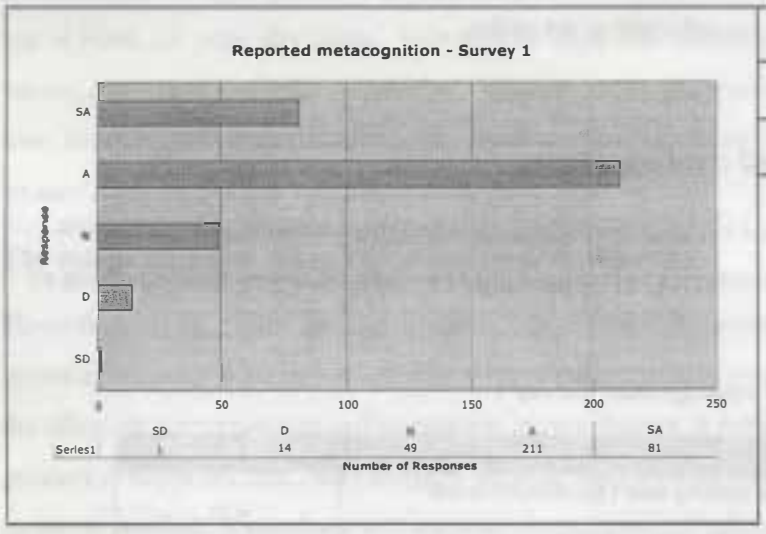
Table 6.2: Self-perceptions of metacognition: Survey 1

Statement	Mean Survey 1
It is important for me to find ways of applying what I am studying to real settings	4.22
I find relating information to my own experiences valuable	4.02
I know how I learn best	3.70
I know what I am good at as well as the things I have difficulty with	4.07
Overall level of perceived motivation (average)	**4.00**

Scale: 5 strongly agree, 4 agree, 3 neutrel, 2 disagree, 1 strongly disagree

The results showed that subjects were strongest in their orientation towards the application of metacognition to a to direct outcome of learning, with an average of 4.22 for the statement addressing the need to apply learning to real settings (Table 6.2). This, combined with the positive response to learners relating new information to previous experience, demonstrated a strong focus on the application of metacognition to the completion of useful and personally relevant tasks – a feature consistent with the practical nature of the multimedia course and the overall focus of the university. It would appear that for this group of students, the concept of metacognition was tied primarily to direct experience rather than perceived at a level of abstraction. However, subjects perceived themselves to be metacognitive in a general sense rather than when specifically tied to learning. Despite responding positively to the comment about knowing what they were good at as well as their difficulties, they were more muted in their response to the application of metacognition to their learning processes (average 3.70 compared to 4.07 – Table 6.2). It would appear, therefore, that subjects felt less confident in their abilities to apply metacognition to a specific domain rather than responding to less focused 'motherhood' statements about metacognition.

Figure 6.1 shows the aggregate of responses to all four questions identifying metacognition. In examining the concept of metacognition holistically, one can see that it was a salient perception among subjects. The percentage of agreement compared to disagreement, discounting neutral responses to the statements, was 95.11% - nearly 20 times more responses agreeing to statements identifying metacognition than disagreeing (Figure 6.1).



Agreement	292
Disagreement	15
Ration of Agree/Disagree	95.11%

Figure 6.1: Reported metacognition: Survey 1

This high percentage indicated many subjects certainly perceived themselves to be metacognitive. When unpacking this concept, however, the stronger response for the first and final statements suggested that many subjects felt more comfortable with the idea of it linked

to practice, or presented as a general concept rather than applied to a less familiar domain, such as their understanding of themselves as learners.

6.1.2.2 Subjects' perceived self-monitoring

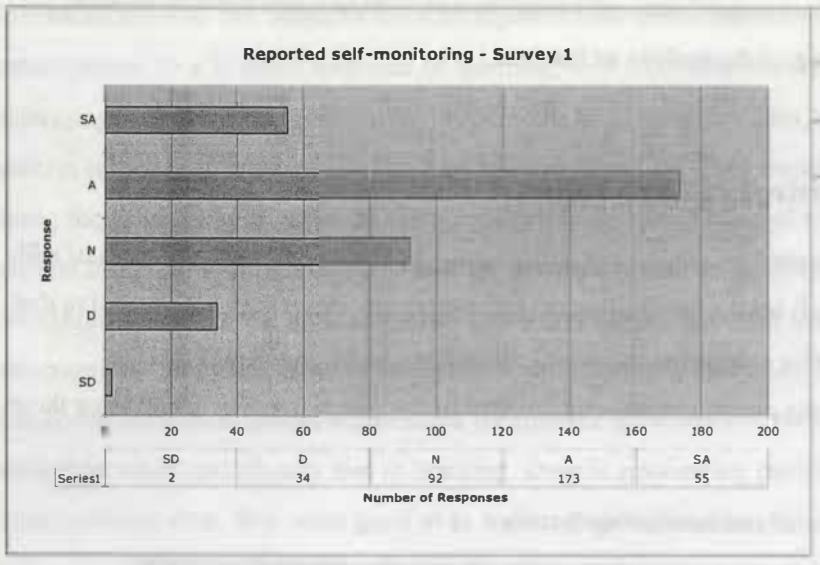
As has already been discussed, metacognition is informed by the underpinning process of self-monitoring. Given the high level of overall perceived metacognition, it was not surprising that the cohort of subjects in this study also perceived themselves to value self-monitoring processes, evidenced by the overall positive agreement to the four statements identifying these (Table 6.3):

Table 6.3: Self-perceptions of self-monitoring: Survey 1

Statement	Mean Survey 1
It is useful for me to think about my studies before I go to class	3.61
I compare what I've achieved in learning to what I planned to achieve	3.45
I find it useful to set myself goals for learning	3.57
I find it helpful to compare my ideas with other students to make sure I am on the right track	4.11
Overall level of perceived self-monitoring (average)	**3.69**

Scale: 5 strongly agree, 4 agree, 3 neutral, 2 disagree, 1 strongly disagree

The majority of subjects appeared to be much more comfortable with self-monitoring when gauged against an external reference point rather than their own expectations of themselves. With an average agreement of 4.11 for the statement addressing subjects' value of comparing their ideas with others compared to an average of 3.45 to the statement exploring whether subjects compare their achievements with what they planned to achieve, it appeared that subjects tended to mistrust their own judgements of their performance (Table 6.3). This was further reinforced by the somewhat higher agreement to the first and third statements. While many subjects found it useful to set goals for learning and think about their studies before attending class, it would appear that while planning was important to them, some subjects did not engage as heavily in the other components of self-monitoring, specifically monitoring and evaluation. While the overall agreement to self-monitoring is still positive (Figure 6.2) it seems that at least some students did not engage fully with the concept, failing to close the self-monitoring loop with effective monitoring and evaluation of their goals.



Agreement	228
Disagreement	36
Ration of Agree/Disagree	86.36%

Figure 6.2: Reported self-monitoring: Survey 1

As a group, the subjects were less positive about their abilities to monitor their performance, indicated by the lower percentage of agreement compared to disagreement (86.36%, Figure 6.2) than for metacognition (95.11%, Figure 6.1). It would appear that not all of the students who reported positively to the statements of metacognition engaged in self-monitoring processes.

6.1.2.3 Subjects' perceived cognitive strategy use

Ultimately the metacognitive awareness of learners and their engagement in self-monitoring processes are evidenced in the development and application of cognitive strategies for learning. This final component of the model of cognitive self-regulation was explored through the identification of six specific strategies and subjects' agreement to statements about their use were obtained from the first survey.

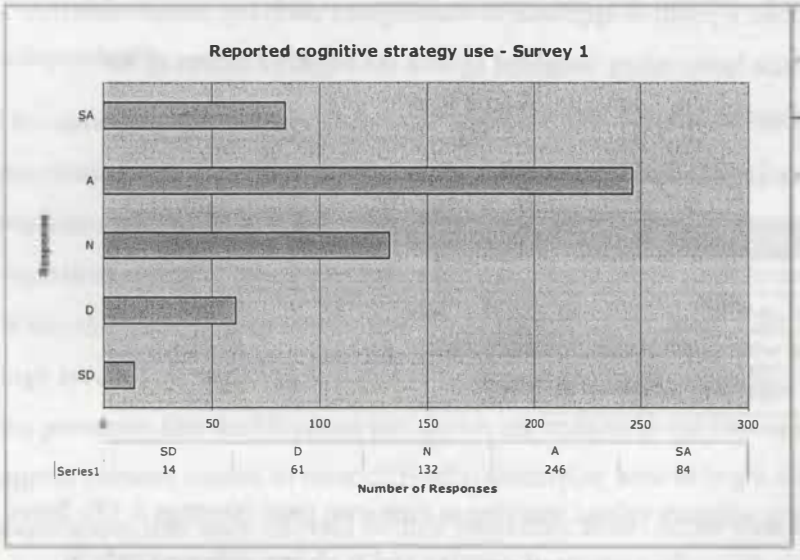
An average level of cognitive strategy use determined by calculating the *weighted* average of all responses (treating the response to the first statement as disagreement since it represented a negative concept of strategy use). Overall, subjects reported an ability to regulate their cognition through the application of specific strategies (Table 6.4):

Table 6.4: Self-perceptions of cognitive strategy use: Survey 1

Statement	Response
When I sit down to study I have difficulty working out where to begin	*3.58*
Making notes in my textbook helps me to make sense of what I am reading	3.51
Making notes helps me understand what I am studying	3.97
I understand concepts better when I imagine them in practice	3.87
Summarising passages helps me to understand the content to be learned	3.56
Translating course materials into my own words improves my learning	3.74
Overall level of cognitive strategy use (weighted average)	**3.51**

The strategy of making notes was the most widely reported among subjects (average 3.97, Table 6.4). Subjects also found value in translating materials into their own words. Agreement to both of these concepts suggests students were familiar with annotation and summary, two of the main reading strategies scaffolded in Mark-UP. When directly referred to however, the strategy of summarising scored a somewhat less enthusiastic agreement (3.74, Table 6.4). Many subjects also did not value making notes specifically to assist the reading process (3.51) as strongly as they did for general comprehension (3.97). This suggested that the value in summary annotation was in the process of making it more relevant and meaningful for the subjects rather than directly identifying and comprehending the main points of readings. This was reinforced by the subject group's somewhat stronger inclination to understand concepts better when imagined in practice (3.87, Table 6.4).

As Figure 6.3 shows, the aggregated responses to perceived cognitive strategy use suggested many subjects used a variety of strategies to improve their learning:



Agreement	330
Disagreement	75
Ration of Agree/Disagree	81.48%

Figure 6.3: Reported cognitive strategy use: Survey 1

However, the perceived cognitive strategy use of the group as a whole was less resounding than both their reported self-monitoring and metacognition, with an overall agreement of

81.48% once neutral responses were discounted (Figure 6.3). One notable finding was that many subjects reported difficulty in working out where to begin when they sat down to study, which contributed to the overall lower percentage of agreement in Figure 6.3.

Another important consideration was the fact that subjects were not presented with a full range of cognitive strategies. Simply because a subject did not use a specific cognitive strategy did not mean they failed to use or develop others. However, subjects' continuing difficulties in working out where to begin with study suggested that for the majority of them at least, there was still a deficit in this area.

In conclusion, while the subject group as a whole reported a strong level of metacognition, the consecutively less positive responses to self-monitoring and cognitive strategy use suggest that at least for some subjects, perceived awareness is not transferring down through engaging in the processes and practical outcomes of metacognition. This raises questions about subjects' actual abilities to regulate their own cognition and the next section explores subjects' perceptions of cognitive self-regulation as a whole.

6.1.2.4 Subjects' overall comfort with cognitive self-regulation

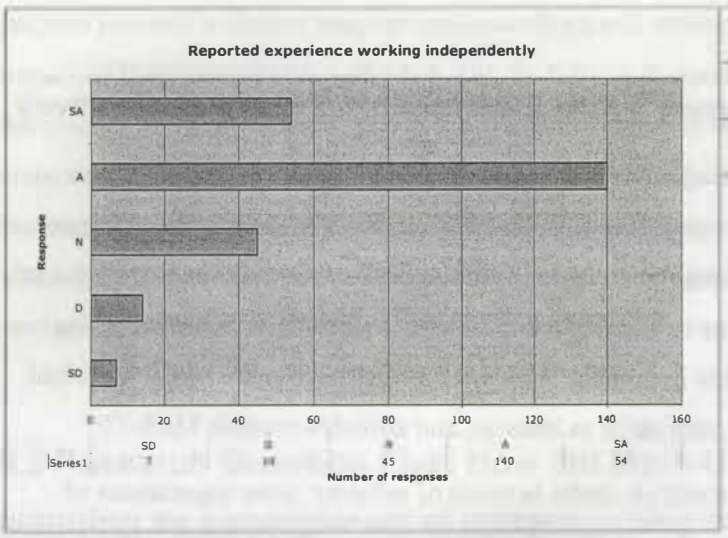
Ultimately, self-regulating students are characterised by an ability to work and study independently. To explore the outcomes of metacognition, self-monitoring, and cognitive strategy use, subjects were presented with three statements identifying an overall ability to operate independently.

On the whole subjects reported a positive approach to working and studying independently, though the average was a little lower when weighted against the negative nature of the statement addressing a preference to learn face to face (Table 6.5):

Table 6.5: Reported cognitive self-regulation: Survey 1

Statement	Response
I prefer to study at my own pace	4.19
I prefer to learn face to face than on-line	*3.75*
I am comfortable with the idea of working and studying independently	4.10
Overall level of cognitive self-regulation (weighted average)	**3.51**

Table 6.5 demonstrates many subjects valued studying at their own pace (average 4.19). Some were a little less enthusiastic about the concept of working and studying independently in general (4.10) but as the high level of overall agreement in Figure 6.4 shows, the group as a whole still felt generally positive about their abilities to regulate their performance.



Agreement	161
Disagreement	53
Ration of Agree/Disagree	75.23%

Figure 6.4: Reported cognitive self-regulation: Survey 1

Nevertheless, many subjects did indicate a clear preference for learning face to face. Whether this was because of a perceived inability to manage their learning processes independently or a result of external factors, such as the social aspects of learning face to face, was unclear. However, it led to an overall percentage of agreement to disagreement of 75.23%. This was lower than subjects' reported metacognition, self-monitoring, or cognitive strategy use. Once again, this result suggested subjects' preference to seek an external reference point from which to gauge their performance.

Most subjects demonstrated a positive perception of themselves as metacognitive. If one were to discount the statement about learning face to face (Table 6.5), the overall number of agree responses would have been 38 times the number of responses indicating disagreement in Figure 6.4, suggesting that as a group, subjects also felt capable of working and studying independently.

However, it is also evident that many subjects did not report the same capacity for self-monitoring or cognitive strategies as they did to the actual idea of metacognition and self-regulation. This suggested that for many students at least, the components of cognitive self-regulation were not integrated into a fully articulated understanding of how they learned. While the vast majority of subjects were receptive to the idea of self-regulation and reported a high level of metacognition, some of these may not have been necessarily engaging in all of the processes that the literature has shown are integral to the concept. In particular it would appear subjects tended to have difficulty identifying how to begin study and valued experiences that were relevant to their immediate needs rather than those that were experienced at a level of abstraction. This was particularly true of the self-monitoring processes they engaged in, which were best understood when matched against an external reference point such as other students' ideas than the evaluation of their own plans.

6.1.3 Conclusions about learners' prior experiences of learning metacognitively

In order to explore subjects' existing abilities to regulate their cognition, information was gathered about the subject group as a whole through their responses to statements addressing the components of cognitive self-regulation (metacognition, self-monitoring, and strategy use) as well as their overall dispositions to learning independently. Interview subjects were also questioned about their backgrounds in terms of their prior experiences and whether these had influenced their studies, their existing skills as learners, and attitudes towards Mark-UP.

Both these forms of data provided mixed results in terms of subjects' prior experiences of metacognitive learning. While it is clear that nearly all subjects reported a metacognitive awareness in one form or another, questions were raised about the accuracy of some of these perceptions. Although subjects such as Belinda and Caroline could clearly articulate strategies and processes they engaged in for learning, others such as Yvette and Dean could not substantiate their assertions with actual evidence of reflection or techniques they used to inform their learning process. Similar findings came through from the broader exploration of subjects' perceived levels of metacognition, self-monitoring, and cognitive strategy use. While the overwhelming majority of subjects could confirm themselves as metacognitive, less compelling results were achieved when probed in more detail, with high reported perceptions of metacognition being undermined by somewhat weaker indications of self-monitoring and cognitive strategy use. Ultimately the subordinate processes and strategies to metacognition were best understood by many subjects when framed around activities that were personally relevant to them, and this concept was reinforced by many of the interview subjects who reported difficulty with reading only where they were considered too 'long winded', abstract, or lacking in clear application.

Such dissonance was also exacerbated by the continual role that the affective dimensions of self-regulation played in subjects' perceptions of themselves. Several of the interview subjects reported poor motivation for study and claimed this as the main contributing factor to their overall lack of performance as students. The reasonably weak self-concept and motivation was substantiated by the overall focus from subjects on external measures of performance such as feedback from other students rather than an ability to evaluate their performance against their own goals.

Ultimately, subjects' assertions of metacognition and use of cognitive strategies were not necessarily a clear measure of their understandings of themselves and their learning processes. An assertion of metacognition could be inaccurate, and strategies could be applied without reflection or the ability to abstract to a general position about learning. It is evident that

subjects reported a diverse range of understandings and strategies and that inevitably had impact on their experiences with Mark-UP. To fully understand such experiences, a focus on the manner in which subjects used to the product to annotate texts and apply their understandings to solving design problems was required. This was conducted through a thorough exploration of the processes that underpin metacognition; specifically, the planning, monitoring and evaluation that subjects engaged in when using the product, as reported in the next section of this chapter.

6.2 Research Question Five: How did Mark-UP support subjects' planning as a component of metacognitive self-monitoring?

Planning is integral to self-monitoring, not least because it provides the benchmark for the monitoring and evaluation that takes place in metacognitive regulation. However, it can at many levels. Goal Orientation is a term that is often used to identify the nature of students' plans. Students can be focused on learning or performance. Students oriented towards learning goals 'strive to master a particular task and improve themselves', while performance-oriented students 'are concerned with positive evaluations of their abilities in comparison to others' (Miltiadou & Savenye, 2003). It is the learning goals that are most allied to concepts of self-efficacy and self-regulation since they are more indicative of an internally reflective process.

Data about subjects' abilities to plan was obtained from two main sources: subjects' Mark-UP portfolios when they were required to respond half way through the semester to tutor feedback on their partly completed work and describe plans for improvement; and subjects' interviews where they were asked about their intentions and aspirations for study when beginning the unit. Analysis of these forms of data was done in three steps:

1. the plans of the whole subject group (126 students) were explored to identify the types of planning that subjects engaged in while using Mark-UP and the extent to which these types of plans indicated specific goal orientations;
2. the 12 interview subjects' stated goal orientation in interview was explored to identify the nature of their orientation to learning and the subject matter; and
3. interview subjects' actual planning within Mark-UP was compared to their goal orientation to investigate how the product encouraged the type of planning that is most associated with self-monitoring activity.

Each of these three explorations is described in turn.

6.2.1 Plans for improvement made within Mark-UP

All subjects using Mark-UP were required to submit their partly completed portfolio in Week 5 and received feedback on their progress so far. They were then required to reflect on this feedback and develop plans for improvement in the following way:

> *Reflect on feedback you have received from your submission of your partially completed portfolio. Respond to the comments identifying your strengths and weaknesses regarding your ability to read and understand documents of this type. Provide some strategies that you can use to improve this aspect over the next few weeks.*

The responses to this statement formed the basis of an analysis of both the interview subjects' plans in terms of their stated goal orientations as well as an exploration of the abilities of the group as a whole to apply metacognition to developing an approach for improvement. Each of these is explored in turn.

6.2.1.1 Evidence of planning for improvement among the broader subject group

To provide a means of understanding the nature of subjects' planning as evidence of metacognitive activity, the whole group's responses to the feedback they received half way through the semester and the plans for improvement they articulated within Mark-UP were analysed to identify categories of planning with a view to exploring how these evidenced self-monitoring processes. 106 subjects in total responded to this Mark-UP activity. In analysing these responses it appeared that subjects' planning could be categorised according to the following criteria:

- subjects who defined their plans in terms of effort applied (76 subjects);
- subjects who defined their plans in terms of improved learning (37 subjects); and
- subjects who failed to identify any plans (20 subjects).

It must be noted that a small number of subjects identified both learning and effort in their plans, hence the greater aggregated number of responses by category than the total responses as a whole. Each of these types of responses was explored to identify the ways and extent to which they were indicative of metacognitive self-monitoring, with a view to proposing how Mark-UP could best support the development of metacognitive planning.

Subjects who defined their plans in terms of effort

Assessments and plans based upon regulation of effort proved to be the most pervasive in subjects' responses. Even those subjects who were able to articulate plans in terms of learning

processes often also described plans for volitional control. For many subjects, the issue was with quantity of work. Comments such as, 'I need to make longer annotations and post URLs' (Subject 97) were common. One subject noted, 'I only posted 1 or 2 (URLs) so this was most definately a weakness, and could have given me more marks definitely' (Subject 19). Even a student who felt she had performed adequately observed, 'I hope to perhaps do some more research on the internet on the topics and post some more urls for my fellow students' (Subject 27).

Most of the responses that focused on quantity of work proved to be the weakest in terms of the metacognition evidenced. Subject 45 commented:

> *The feedback motivates me to include more annotation relating to the readings and experiences. I would also need to post more URL for research and better understanding on the readings. These are the aims I need to improve for the rest of the mark ups. From there I will be able to gain a higher mark (Subject 45).*

This focus on marks indicated a limited goal orientation. It is evident that subject 45 was not considering the learning processes in which she was engaging, but was judging her learning in terms of the marks received and with an assumption that more is better. One mitigating factor for those subjects who were focusing on improving the quantity of work was the fact that some of the feedback they received for their part submission directly mentioned this lack. Several of the 106 subjects noted they received feedback that there were 'not enough' of one or more types of activity. This may have been a weakness on the part of some of the tutors themselves who may have drawn attention to a deficit of learning evidence by defining it in terms of quantity. Certainly, comments such as 'the major criticism I got was that some of my responses to the tasks and my summaries were brief' (Subject 66) and 'I was asked to put more annotations in' (Subject 42) suggest that many of these subjects were probably responding appropriately to somewhat limited feedback they received. This therefore brings into relief the importance of the feedback provided within Mark-UP as a means to promote planning. However, some subjects were able to go beyond their limited feedback to develop plans for improvement:

> *It was suggested that more application in my responses was needed. This is a issue which is simply solved. I simply have to write more and respond in more depth to the readings. Tying the readings together (where necessary or possible) will also provide adequate evidence of an understanding of the readings. (Subject 113).*

Such evidence of specific strategies, however, was generally absent in those responses that identified quantity or effort as the major focus for improvement. One subject was able to clearly describe a volitional strategy, stating, 'I tend to get distracted by things like radio, television and other entertaining things. I suppose I should move away from distractions when reading' (Subject 68). However this response was not typical. For those subjects where plans were not identified in terms of learning strategies, descriptions of specific strategies for maintaining effort were also sparse. One subject stated she would 'try to keep on top of the workload as the pressure from assignment deadline increases' (Subject 50) while another claimed, 'to gain more marks for this assignment I have to put more time and effort into it' (Subject 5).

While it is tempting to write off such responses as evidence themselves of the subjects' lack of effort it is clear that for many of them, the gap between understanding and acknowledging a problem and identifying a plan for improvement was a difficult one to bridge:

> *As English is my second language I could not explain very well I thought about. There always has been limited writing skill. I know what this is a task I must overcome. Therefore, now I know that what I have to do for the next assessment. I am going to try to understand as much as I can by rapidly reading till I satisfy and I have to put my effort more than other people. I do expect to improve myself in short time. However I still have to try my best for coming up assessments (Subject 33).*

The above subject acknowledged that one of his difficulties was with English but his plan for improvement was based purely upon effort, and then in comparison to others rather than against a personally formulated goal. This limited evidence of metacognition was not uncommon for those subjects who primarily identified plans relating to effort and it is clear that for some students at least, there needed to be greater support provided within Mark-UP to assist students their planning

Subjects who defined their plans in terms of improved learning

The second most common type of planning evidenced within Mark-UP was based around strategies for learning. On the whole these indicated a more comprehensive understanding of themselves as learners. While it was not true for the majority of students, there were still many who could describe an identified weakness and propose strategies for improvement.

Such plans often revolved around reading comprehension. Subject 66 noted:

> *Over the next few weeks I will definitely try to have a more in depth look at the tasks we have to do and hopefully this at the end will improve my score for the*

second part of the portfolio. The other thing I need to improve on is to try and get more involved in the forum discussions so as to get other points of views from other students and inturn enhance my understanding of the readings. I will also try to look at other related readings on similar topics, either from books or online, for a better understanding of the readings (Subject 66).

While the above statement is still a little vague in terms of the specific processes the subject needed to engage in, it did demonstrate an ability to understand the value of sharing ideas with others, and engaging in multiple sources of information to develop conceptual understandings. It appears that Mark-UP's ability to provide support in planning through discussion was one of its strengths as a medium for planning. This emphasis on sharing information was also reinforced by another subject, who claimed, 'this is all about sharing knowledge, so I have to consider contributing to the knowledge of the collective' (Subject 64). One student was able to fully articulate a plan she had developed to improve her reading:

I basically agree with my mark for my submissions. I think the main problem was that I lacked depth in my resonses and that I did not annotate the readings as much as others. I think through doing assignment 2 I have achieved a better understanding of the readings as I have applied them to our learning package. I have 3main strategies for the readings: 1. Read everything twice. 2. Read conclusion first then the text. 3. Discuss reading with peers (Subject 108)

It appears then that the shared workspace provided within Mark-UP helped subjects to develop plans in two ways. Firstly, it acted as a repository of collective ideas where individual understandings could be augmented, with each annotation or forum post being a 'brick' in building a shared understanding from which more complex understandings and plans for improvement could be built. Secondly it enabled more direct peer feedback to address misconceptions and direct subjects' planning of strategies. These regular direct and indirect forms of feedback once again highlight the implicitness of planning as part of a broader evaluative loop. It is a process that requires continuous review to ensure the validity and effectiveness of such plans.

Mark-UP also used such feedback as a means of encouraging plans beyond the domain of reading comprehension. Another type of learning plan that was manifest was about improved writing skills. While some subjects felt they could understand reading concepts they often had difficulty communicating these understandings, leading one subject to comment, 'I just use too general wording' (Subject 118). Her approach to improvement consisted of reviewing others' comments: 'The strategy I use now would be first have a look on others mark-up first,

try to generate my points with others' opinions, may grab one or two specific wordings that suite what I try to put into words'.

The plan of using peer feedback to improve the writing process was not anticipated since unlike the approaches identified by subject 66 for reading comprehension, these were not specifically modelled in the system. Nevertheless, subject 118's approach of using peer review to improve her writing was not unique, with 68 noting:

> *I seem to focus too much on the weekly activity by writing too much and not being as specific as most students (rambling). I came to that conclusion after I realised a similar mark could be obtained with responses containing less words when I saw a friend's feedback page. The time spent of rambling could be better spent on annotating the text (Subject 68).*

The creation of a plan that is unique to the learner is probably the best evidence of metacognitive activity since it is these plans that are personally developed through an understanding of the learning process rather than received through instruction. While subject 39 was a little vague in his approach to his 'tendency to write too much in generalities', his focus on understanding questions shows an ability to think beyond the actual artefact of his written submission: 'I believe I need to read the question a bit more clearly and try to answer what they are asking'.

Overall, it appears that Mark-UP accommodated multiple forms of plans with subjects who could identify specific strategies for improvement in their learning demonstrating more metacognition than those who were focused on effort or quantity. Even where strategies were more oriented to the physical process of learning rather than the cognitive aspects, such plans tended to be formulated through self-monitoring. Two subjects (3 and 7) articulated a revised plan of annotating hard copy versions of the reading before using Mark-UP; plans developed from evaluating their own performances rather than from feedback they would have received.

This suggests that to reinforce the value of Mark-UP as an environment for metacognitively regulated planning, activities should be designed in such a way as to encourage students' development of and articulation of specific learning strategies. While it appears that tutor feedback provided a sound basis for the formulation of plans for some students, the most manifestly metacognitive planning was developed through self-analysis and peer interaction rather than tutor review. Future learning designs using Mark-UP could make use of such internal and peer forms of feedback to inform the planning process.

Subjects who failed to identify any plans

As well as plans made to improve learning and effort, a smaller, but still noticeable, group of students did not actually define plans for improvement. While it is tempting to classify these students as less metacognitively active than the others, in fact it appears that these subjects could be grouped into two different orientations towards their learning.

The first and most obvious group is those students who demonstrated little or no reflection in their responses. Comments such as 'I am not happy with my mark but I deserve that mark. I hope I do better in the second portfolio' (Subject 2) were not unusual. What is interesting about this comment was the tendency of the subject to blame himself rather than identify methods to improve his work. This was in fact true of many of the subjects. Subject 92, for example, seemed to be floundering in Mark-UP:

> *i 've got a very bad grade on this type of activity. because it's new and not knowing what is exactly need to be done. i find hard to get along with these type of activities. it may be because of the excessive activity content.*

Statements such as 'I know I'm really bad' (Subject 13) suggest some learners suffered from poor self-concept and this would be bound to impact on their ability to accurately monitor their learning. With its focus on cognitive rather than affective dimensions of self-regulation, Mark-UP was not designed to accommodate this issue. However, as the generally low level of reported self-concept and motivation of this group of students has shown, the emotional aspect of self-regulation was a continuous background issue to subjects' development of cognitive regulatory skills. An environment that was more encouraging and active in promoting students' self-concept may have improved the planning process for this group of subjects.

Another aspect of this lack of plans is that it indicated an inability to respond effectively to a task. The task requirements were explicitly stated as, 'provide some strategies that you can use to improve this aspect over the next few weeks.' In failing to do so, some subjects did not engage in the process of planning at all, and the fact that this lack of planning was not followed up within Mark-UP meant that there was no direct support for low performing subjects in specifically addressing inadequacies in their planning process

For other subjects, however, a lack of planning was more indicative of a general feeling that they were using Mark-UP adequately, and therefore no modification was required. Subject 1, for example, was quite comfortable with his performance:

> *mmm, can't really say much. I think I did well. The MarkUp has been beneficial that's for sure. Made me have to read, it has been interesting since I don't read much. Nice to comment using the MarkUp thing. Recommended to do more Annotations. Have done so or try to, I think that point was made since I think I*

missed one whole article on annotations. I felt I didn't need to comment on that at all since everyone summed it up pretty well. Anyways, I think I'm doing good.

What is interesting about these types of comments is that they often indicated a depth of reflection equal to those subjects who clearly defined plans for improving their learning. One common feeling was that there was no need to make annotations where they felt that the concepts were self-evident or had already been discussed in enough depth; that 'everyone has said everything that needs to be said and anything I add would just be a repeat' (Subject 54). Another pattern was in reflecting on the value subjects had already gained from Mark-UP, though this was not a requirement of the activity. Comments such as 'the annotation strategy has helped me in absorbing the idea(s) of the readings by receiving feedback from other students' (Subject 62) and 'looking for other sites which assist with my understanding of the reading and adding them to my annotations is very helpful as it provides other view points' (Subject 101) indicate an ability to reflect on the activity that they are doing, even if they are not stated specifically as plans.

Some subjects evidenced sound reasoning for not altering their approach to using Mark-UP. Despite some negative feedback on her annotations, Subject 18 observed:

I found that my annotations are often initial thoughts that come into my head, that, when I look back on then (esp. in my study for the exam) help me to get back into that line of thinking to understand the context of the reading in my mind.

A consistent theme that came through these responses was that the annotation system itself provided feedback from which students could monitor their learning, and that this allowed for a more continuous reflection than simply asking students to reflect and make plans based upon tutors' feedback, as was the case here:

The format of Mark-Up means that to a degree the feedback we receive is immediate and this is definitely an advantage. The summary section of the annotations has been one of the most useful tools for me, as have the specific tasks related to the reading. Being able to see the other students responses to the weekly problems is also extremely important in contextualising my own approach and providing peer feedback. (Subject 28).

However, not every subject found value in the product. A small number of the subjects who did not identify plans for improvement were quite negative about the process. Two of the students chose not to modify their performance, and in the case of one, actually withdrew effort from the process. Ironically, these were also subjects who appeared to be operating at a high metacognitive level. One acknowledged the value of the readings and claimed, 'I'm

happy with the level of support that I provided to other students and that I extended my understanding of the content beyond the readings,' but having decided to complete the second assignment on his own instead of in a group situation contended, 'Mark-UP will take a back seat to assignment 2' (Subject 127). Subject 117 went further, arguing:

> *I have a high level of understanding with regards the English language and am good at interpreting a large proportion of academic texts so find the use of mark-up more of a hindrance than a help most of the time – why must I be forced to add stuff in an annotation form if I have no need to?*

Both of these subjects pointed to an issue with the educational design of Mark-UP. In scaffolding the cognitive strategies for reading, some of the more metacognitively aware students found the approach constraining and impinging on their existing strategies rather than helpful. The claim that 'those who really need to use it will get good use out of it, but it is a waste of time for those who don't need it' (Subject 117) was probably quite accurate.

6.2.1.2 Conclusions about the nature of planning within Mark-UP

As has been shown there appeared to be divergences in the ways in which subjects engaged in planning when required to reflect on the feedback received from their partly completed portfolio. While many subjects were able to used the feedback to form fully articulated plans for improving their learning, others were unable to move beyond the confines of their own self-doubts, and interpreted performance in terms of how others viewed them or their own inadequacies in terms of effort. For those subjects, planning was less fully articulated, tending to be discussed in terms of effort and quantity rather than the pursuit of learning goals. Finally, a few subjects found the planning processes that they were engaging in were unnecessary, or even counterproductive to their own learning strategies as was the case with Subject 117.

While it could be argued that Mark-UP provided a sound means of planning for many students, the variety of plans demonstrated by the whole subject group raised a number of issues about how Mark-UP could best support planning at a metacognitive level. These findings in particular raised questions about the roles of goal orientation, self-concept, and the flexibility of the environment to support a range of metacognitive levels with students.

In order to triangulate these findings and to provide a more detailed exploration of the relationship of the design of Mark-UP to promoting the most appropriate forms of planning for cognitive self-regulation, the goal orientations and plans of the 12 interview subjects were analysed, and form the basis of the next section.

6.2.2 Interview subjects' stated goals for studying the unit

It has already been shown that the cohort of students made plans that were indicative of both process-oriented goals in the form of learning plans and outcome-oriented goals in the form of performance plans. To further explore the relationship between goal orientation, planning, and the manner in which Mark-UP supported the development of plans through metacognitive processes, 12 subjects were asked in interview about how keen they were to study the unit in Interface and Information Design and their success orientation. This section analyses these responses in the light of how the goals demonstrated correlated with the interpreted level of metacognition identified in section 6.1.1.13. This provided a basis for the exploration of their actual plans, with a view to identifying the ways in which Mark-UP could best promote metacognitive planning.

All twelve subjects identified some level of enthusiasm for the unit though the majority made note of the fact that that this was a compulsory unit of study for their chosen course. Subjects such as Claire, Belinda and Debbie, as well as demonstrating a high level of metacognition through their ability to clearly describe the strategies used throughout Mark-UP and the processes they engaged in, were also able to show a focus on success and an ability to predict their final grade more accurately than some of the other subjects (Table 6.1). However all subjects when asked to what extent they were success-oriented defined it in terms of grades, indicating that external measures of success were considered important by all students.

Several subjects, though, did articulate goals beyond performance. When asked about what she thought was important for her studies, Claire acknowledged the importance of learning as well as performance goals to her study in the unit: 'It's different because it depends on what you're going to measure it by. If you're measuring it by personal knowledge then it's got a lot of things that you might want to learn for yourself just for interest'. Belinda was more emphatic on her emphasis on learning over performance goals, differentiating herself from weaker students by arguing, 'we're grown ups and we are here to learn. If you don't want to learn go to TAFE. If you're not here to be a grown up and act like a grown up and do the work, it's not your job to babysit'. One of her criticisms of Mark-UP was that she felt it imposed its own goals on her learning, and that its role was primarily for weaker students, being 'there to check you had done the reading'. Belinda set her own personal goals to the extent that they did not always ally with Mark-UP activity. After receiving 9.5 on 10 for her partly submitted portfolio, she consciously reduced effort as an act of 'childish' defiance because she perceived it was not meeting her needs as a student. She also expressed the same attitude towards lectures. While she valued the lectures in Information and Interface design

because they were 'interesting' and 'jumped off' into concepts she found personally challenging and relevant, she was critical of lecturers whom she felt did not add value to the material they were presenting: 'Why drive all the way in from "The Vines" to read off the screen?'

Given the previous discussion that the plans of the overall cohort were most fully articulated when defined in terms of learning it was not surprising that the interview subjects who were identified as being the most metacognitively aware also tended to talk in such terms. However, this ability to have internally developed goals based upon learning processes rather than performance was not unique to those interview subjects interpreted as operating at a high metacognitive level. Sylvia was considered to be only moderately metacognitive, primarily because of a tendency to misinterpret questions and statements and inaccurately judge things such as the expectations of assignments (Table 6.1). However, this tendency for tangential thinking appeared to contribute to her thinking of study in terms of her own goals rather than those of others. While she was very much aware of the importance of performance-related goals, she did not subscribe to them herself, stating, 'In Singapore it's very important for us but here I fight within myself – like in Singapore you challenge other people.' Sylvia described herself as 'very' keen to do the unit because she wanted to learn about effective web design. When it came to class attendance she stated, 'even if only three students coming I will still come'.

Some other subjects defined as operating at a medium metacognitive level were also able to articulate goals beyond external measures of success. Jake initially enrolled in the subject because it was required but he also acknowledged, 'I thought, sounds alright from the e-course description' and sought to gain skills from the unit that would help him in other areas: 'just seeing all the different learning approaches and how to design for those.. doing Java and PHP was good too.. I noticed all the links and how they worked together'. For some though, the goals for studying the unit were less motivated by learning considerations. Duncan expected the unit to be easy: 'I didn't know there was a lot of reading, a lot of work involved. I thought it was going to be like the other multimedia units, they're pretty laid back but this one had a lot more work.' He admitted at the end of the semester, 'I don't know if multimedia is really my thing,' preferring programming to designing communication-based products. This is another example of performance rather than learning-related goals. Debbie, who was interpreted as operating at a higher metacognitive level (Table 6.1), also saw the unit initially as an easy option:

> *I wanted to do it because I knew I was doing four units I thought, "well, okay, I have some prior knowledge to this kind of information so I should be okay,"*

and then, of course getting all of this reading... and you should have heard me!! ... But I actually got into it in the end.

In fact, when asked if she was interested in the unit, she was also able to clearly articulate learning goals that were much more focused on the learning process, being fascinated by 'the whole theory behind it all, and it's like a whole psychology almost in its own self I guess and how things can influence people ... and in the end we become in control of what people see and learn'. This is not true for all subjects, though. While Frances, despite her low interpreted metacognitive level (Table 6.1), could articulate an approach to the unit based upon its intrinsic value ('this unit lets me know that there are lots of things to have for a good website so I like this unit ... I didn't know what multiple intelligence was'), Alan, was much more oriented towards marks, stating, 'I always a hard worker and was trying to get the best marks and I've been doing that in all my other units I think most of the marks have been distinctions, high distinctions, only a couple of credits'

It would appear then, that while process-oriented goals are more closely allied with self-regulation than performance goals, many students can perform quite successfully with a more pragmatic approach. This raises questions about the types of plans that Mark-UP needed to promote. While ideally, the product should have encouraged the development of learning goals within all students it is clear that that was not the case. Alan, for example, was interpreted as operating at a high level of metacognition. He was older, could clearly describe learning strategies he used and his final score of 69 was only one mark off his expectation of a distinction. Duncan was the highest performing of the subjects interviewed despite his initial focus on 'quick marks'.

This would suggest that the design of activities within Mark-UP should not necessarily promote learning goals above performance goals. Certainly Alan appeared able to apply his understandings of himself as a learner to the successful use of the system rather than to improve his learning processes; however to claim that Mark-UP should have focused on performance goals rather than learning goals may be overstating the case. In spite of the importance of performance to all of the interview subjects, those subjects interpreted as demonstrating a lower level of metacognition were still the least likely to articulate learning goals.

Dean's plans for example were quite mixed. He enrolled in the unit because the unit was better presented than computer science units: 'compared to a lot of the computing guys they just come up there with like a web document and three lines and then they start droning on and on'. But he also demonstrated some orientation to learning, albeit a limited one, claiming the unit met his expectations: 'it was pretty much about information and interface design. It

wasn't about anything else and that was kind of nice'. At the lower end of the metacognitive scale, both Craig and Brian failed to describe any goals beyond passing the unit. When asked if they were keen to do the unit, they both merely noted that it was compulsory and hadn't really given the unit much forethought. Yvette merely claimed, 'I am motivated to finish my assignments so that is... it's part of the weight of my final marks so I have to do it, I am determined to finish it'.

This reinforced the findings in the previous section about the correlation between metacognitive level and goal orientation. The subjects judged to be *metacognitively strong* such as Debbie, Claire, and Belinda (Table 6.1) were also the most able to describe plans for learning that were based on processes rather than external measures of outcome. At the other end of the spectrum, those subjects interpreted as lacking metacognition such as Brian and Craig were more focused on marks and gave less consideration to learning processes. However the fact that some subjects interpreted as metacognitively strong, such as Alan, only stated performance goals, while some subjects judged weaker, such as Sylvia (Table 6.1), exhibited an orientation towards learning goals suggested that goal orientation was not the only aspect of planning relevant to metacognition. Nevertheless, the pervasiveness of performance goals across the majority of interview subjects combined with the lack of learning goals articulated by those subjects who were interpreted as *metacognitively weak* reinforced the fact that in order to effectively support metacognitive planning, Mark-UP needed to provide a means for students to define goals in terms of learning AS WELL AS performance.

To see whether this actually occurred, subjects' plans for improvement made during the implementation of Mark-UP were analysed to examine the relationship between subjects' goals, their plans, and the affordances of Mark-UP with regard to their metacognitive development. In particular, the potential of Mark-UP for developing self-concept and the flexibility of the environment were examined as potential impacts on its role as a metacognitive environment for planning.

6.2.2.1 Interview subjects' plans for improvement compared to stated goal orientation

When required to respond to the feedback provided on their partly completed portfolios half way through the semester, only 10 of the twelve interview subjects responded to the activity. Ironically, it is those subjects who were interpreted as having strong existing metacognitive skills that tended to avoid this activity. Both Claire and Debbie provided no answer to the question, and Belinda's response reflected her negative attitude towards the product:

I appreciated the feedback on my efforts...I put a great deal of time and effort into that assessment and it was gratifying to know that my time was not a 'waste'. (though in retrospect I expended WAY too much effort for the coresponding 9.5 marks You know I always do the reading...I just find markup to be a gross inconvenience and a hassle.

For these students it appeared that formally articulating a plan was not seen as important, and Belinda's reference to Mark-UP in the light of this process emphasised the fact that the product itself was an imposition on her existing strategies. Alan and Frances were the two other subjects who failed to identify any specific strategies for improvement. Frances merely commented, 'I am quite pleased with my marks', while Alan's comments reflected a preoccupation with issues relating to effort and workload:

Alot of effort was put into the first 5 weeks of the portfolio, The comments made by shane was very encouraging and positive. Posting URLs in markup is time consuming excercise especially if you are working fulltime and trying to have meetings and work in teams to achieve a goal. I find that it becomes difficult to maintain the markup when projects are in progress that requires you to have to make a choice to sacrifice the time normally spent in markup.

To a certain extent, these responses were expected given the profile of these two students. While Frances was able in interview to express a goal beyond performance, this statement was much more consistent with her overall interpreted low level of metacognition (Table 6.6). Alan's orientation towards external measures of performance was once again evident in his response.

However, it could be argued that in some respects there is an implicit plan evident in Alan's statement – specifically, a decision not to expend the same level of effort over the following weeks. This allies quite strongly with the comments made by Belinda. In fact, both subjects identified a 'law of diminishing returns' when it came to Mark-UP activity. A significant amount of extra work was required to gain the relatively few marks awarded to an excellent response. In this sense they were quite correct and the reduction of effort, where only 20 marks remained compared to 40 for the final assignment, could be seen as an appropriate response. Certainly it is a metacognitive one in that it is one that was generated from an awareness, if not of learning, then of how the 'game' of study is played.

This may explain to a certain extent why Debbie and Claire did not respond to the question, although they were both able in interview to demonstrate an orientation both to performance and to the process of learning. Claire admitted in interview that she found the process of reflecting on her performance and planning strategies 'quite odd'. She did not respond to the

question because she was happy with her performance and if she had any problems with her feedback she would have sought advice from her tutor. Debbie, who received 8.5 on 10 for her part submission was happy with her submission and did not receive any prescriptive feedback so felt that suggesting improvement would be an artificial activity.

This suggests that Mark-UP had limitations as an environment for promoting planning, particularly among the 'top' and 'tail' of the cohort in terms of their interpreted existing metacognitive skills. For the better subjects, Mark-UP was excessively rigid in foregrounding a process that was inherent for them anyway. For the weaker subjects, Mark-UP did not provide enough scaffolding to promote the development of goals geared towards learning processes rather than performance outcomes. This is not so much an issue for the stronger students. There was still evidence of planning in the ways in which Debbie and Claire approached their work, but it was done less formally than was required within this implementation of the product. Claire was correct in finding the process 'odd'. The abstract nature of planning was counter to the focus of the unit on developing design skills through authentic design activities and solving problems. This is one of the reasons why subjects were only required articulate their plans once throughout the semester. In fact, it would appear the activity of planning worked most effectively as a remedial tool for weaker students, but even then there were issues with its implementation that limited its value.

One of these issues is the fact that not all subjects received prescriptive feedback from their tutor. Both Debbie and Frances had the same tutor, and when asked to expand on her Mark-UP plans, Frances claimed, '*** told me you're doing average and all you have to do is keep it up and add a little bit more to get better marks.' In this sense it was clear that Frances lacked an ability to plan strategies for improvement without external remediation, consistent with her low interpreted metacognitive level.

This suggests that inadequacies in the implementation of the product meant that there were many subjects who were not engaging fully in the process of planning for learning instead of performance. Of the remaining subjects, there was a tendency to think of plans in terms of effort or quantity. Duncan observed, 'to ensure a high mark for the final submission, a consistent level of effort will be required over the coming weeks.' This sentiment was echoed by Brian, who wrote, 'strenghts exist with answering the questions asked, but weaknesses are with the lack of URL's and only doing the required minimum of annotations. To improve this over the next few weeks i will do research for url's and post more annotations.'

In fact, it was the subjects interpreted as *metacognitively moderate* who were able to articulate the most comprehensive plans for improvement. Sylvia reflected her intrinsic orientation to learning by suggesting, 'It was also mentioned that I made some good points. The good points

seemed to be more of personal thoughts rather than from readings. Hence I will be developing more of my own opinions as I read the next few week's readings.' Jake was able to go further, identifying plans for improvement that went beyond the feedback he received:

> *I was told to be myself a bit more and to say what I really thought about the reading. I was also told my comments were very good and to keep up the good work. I received 7 out of 10 To improve I feel that I should be more open with my opinions and no be too technical or complicated in explaining my opinions. I also think that I tend to just respond to current annotations instead of starting new topics. Overall I feel that I am going quite well.*

Even Dean, who was interpreted as having a lower level of metacognition, showed an ability to effectively reflect on his performance:

> *I think that although i got a fairly low mark, i learnt a lot. I found out that i didn't say enough and that i needed to show that i understood the issues more. I found that although i did understand the articles i wasn't showing that in what i was saying, this has always been one of my weakness, i understands things, but i don't convey that to the marker. (that also explains my marks for English Literature).*

Where Dean failed, however, was in his inability to extend beyond evaluation to develop a plan for improvement. Nevertheless, his self-awareness was encouraging, and in many ways evidenced more metacognition than Yvette, who merely identified putting her work into tables as a strategy for improvement since 'it is simple and straight to the point. It is more effective and less time consuming. Future answers would most likely be placed in tables where possible.'

A summary of interview subjects' interpreted metacognitive level, goal orientation and depth of planning is presented in Table 6.6:

Table 6.6: Interview subjects' interpreted level of metacognition, goal orientation, type and level of planning compared

	Interpreted Level	Planning		
Name	of Metacognition	Goal Orient.	Type	Interpreted Level
Dean	Low	Performance	None	Medium
Yvette	Low	Performance	None	Low
Frances	Low	Mixed	None	Low
Brian	Low	Performance	Effort	Medium
Craig	Medium	Learning	Effort	High
Sylvia	Medium	Learning	Learning	Medium
Jake	Medium	Mixed	Learning	High
Duncan	Medium	Performance	Effort	Medium
Claire	High	Mixed	N/A	High
Belinda	High	Learning	Effort	High
Debbie	High	Mixed	N/A	High
Alan	High	Performance	Effort	Medium

Overall, it appears that planning is a complex process that has some connection with both goal orientation and overall metacognitive level. In terms of the value of Mark-UP in promoting planning there appeared to be stronger support for its value to those subjects interpreted as moderately metacognitive than low or high. Some of the subjects operating at a higher metacognitive level such as Belinda and Alan expressed planning within Mark-UP in terms of 'bang for buck' with regard to marks, even though they demonstrated different goal orientations (Belinda's focus on learning, compared to Alan's focus on performance). It appears that subjects with a high interpreted level of metacognition knew when to restrict effort as well as to augment it. This was also true for Craig who, having been interpreted as moderately metacognitive, went so far as to refute the feedback he received:

> *One of the issues that I got from my feedback was that some of my posts weren't long enough. Although this may be true, I choose quality over quantity! I notice that many of the annotations on the mark-up seem to be make purley for the sake of taking up space and I would rather that people made useful and productive comments rather than filling things out just because they feel obligated to!*

Craig's comments show a clear plan to maintain a similar approach to using Mark-UP despite the feedback he received, while Duncan identified volitional control as his main focus for improvement. Nevertheless, for these subjects, Mark-UP provided a means for quite sophisticated articulation of plans. It would appear that the formal activity of activity of planning as it was defined within this implementation of Mark-UP was geared very much towards the zone of proximal development of those subjects interpreted as having a medium level of metacognition, all of which evidenced medium or high levels of planning.

The biggest limiting factor within this implementation of Mark-UP was its failure to promote metacognitive planning among the metacognitively weaker students. There appeared to be two main causes for this. With an inability to regulate their plans through internal feedback, these subjects had a greater requirement for external (tutor) feedback. If this was weak, it had a deleterious effect on their planning. At the other end of the process, poor plans were not remediated within Mark-UP, since there was only one activity which required subjects to do so. While subjects were required to evaluate their performance at the end of the semester, the lack of an immediate review of the appropriateness of plans meant that a formative approach to the development of metacognitive planning was absent in this implementation. What was

required was a feedback mechanism, either within the product or conducted face to face with the tutor, that could assist in the development of appropriate plans.

6.2.3 Conclusions about the role of Mark-UP in supporting planning as a component of self-monitoring

Planning has been examined in terms of subjects' goal orientations and how these related to the nature of plans that were developed. Interview subjects demonstrated both performance and learning goals, with some subjects accommodating both types. Generally those that had mixed or learning goal orientations were the ones that appeared best able to demonstrate self-monitoring when articulating plans for improvement.

As an environment for promoting planning, Mark-UP appeared to be most effective for those subjects who were interpreted as metacognitively moderate by assisting subjects to develop plans that were both process-oriented and indicative of a higher level of self-monitoring than would have been expected. For the stronger and weaker students, Mark-UP seemed less effective. Two of the reasons for these related to the lack of flexibility of the product with regard to planning and the perceived artificial nature of formal planning for improving learning rather than to complete a specific task. For the subjects interpreted as metacognitively stronger it appeared that Mark-UP was an inconvenience in formalising a process that was quite natural and implicit to their learning anyway. For the weaker subjects, bigger issues were the inadequacy of the environment in providing adequate external feedback from which to form plans, a lack of a second iteration in which plans were reviewed and modified, and in a more general sense, as indicated by the plans made by the whole cohort of students, an inadequacy of the environment in supporting the development of a strong self-concept to assist in accurate self-perceptions to guide the planning process. One persistent issue in planning was the frequency of planning being defined in terms of effort. The poor self-concept discussed in the previous chapter appeared to manifest itself as a focus on marks, or in the worst cases a tendency for self-blame over performance. Since those who tended to engage in self-blame were for the most part less able to articulate metacognitively developed plans, the continuing interplay between affective and cognitive self-regulation suggested that the environment needed to promote both aspects to ensure an appropriate level of development.

It appears that Mark-UP did support the multiple types of planning in which these subjects engaged, but in restricting the planning of subjects with an existing high level of metacognition and in failing to articulate the process of planning for the weaker subjects some opportunities were lost. One of the main issues related to this is that of planning being a

discrete component of self-monitoring while being very much dependent on monitoring and evaluation as guiding concepts. In order to complete this picture, the next two sections report how Mark-UP provided a means for the monitoring and evaluation of learners' cognitions.

7 Exploration of how Mark-UP Supported Subjects' Evaluation as a Component of Self-Monitoring

Following the analysis of how Mark-UP was used and its limitations and affordances as a learning tool, the main research aim of this study was to explore the forms of self-monitoring that take place when students use Mark-UP as an environment to support cognitive self-regulation. This was conducted as an exploration of the planning, monitoring, and evaluation that Mark-UP supported, as subjects used it to develop understandings of text-based readings and apply those to design problems. Chapter 6 has examined the role of Mark-UP in supporting the planning component of self-monitoring. The purpose of this chapter is to explore research question 6, which asked how Mark-UP supports subjects' evaluation as a component of metacognitive self-monitoring.

Metacognitive evaluation involves making judgements about one's cognitive capacities and limitations while engaging in a learning situation. Evaluation can take the form of judgements about appropriate strategy choices while learning and reflection on thinking processes.

As with planning, evaluation is integral to the process of self-monitoring. Nelson and Naren's previously discussed model of metacognition (Figure 2.2) has been expanded on by Shimamura (2000, p. 314) who argues, 'the role of the meta-level is to evaluate what is being monitored, and based upon this evaluation, control object-level processing by a feedback flow of information'. Metacognitive evaluation therefore provides closure to metacognitive activity, where judgements are made about the value of initial plans while also engendering a further iteration of metacognition, that is the reformulation of plans.

It is therefore impossible to completely separate metacognitive evaluation from other constructs that inform it:

> *... Constructs such as goal orientation, value, efficacy, and control beliefs can serve as mediators to conceptual change and influence cognitive factors such as selective attention, activation of prior knowledge, use of deeper or more surface processing, problem finding and solving, metacognitive evaluation, and volitional control and regulation. (Limon, 2004, p. 180)*

Evaluation is also something that is typically an internal process rather than one that is externally manifested. Most evaluation would be done in an implicit way and to expose such processes may inhibit the authenticity of the learning tasks in which students engage. This implicit form is discussed in the next chapter, which explores the ways in which Mark-UP supported monitoring through its various tools. The purpose of this chapter is to explore evaluation as it was conducted through the design of activities within Mark-UP. The dominant tools for this process were the Design Problem and Portfolio tools. As with planning, subjects were asked at specific instances to evaluate their learning processes. This required subjects to explicitly evaluate the plans they made through the Design Problem tool by reflecting on the feedback they had received and their portfolios as a whole. In exploring how Mark-UP supported this form of evaluation therefore, three forms of inquiry were conducted:

1. an exploration of the evaluations of the whole subject group made during the mid-point of the semester within Mark-UP (126 students) to identify the types of evaluations they engaged in and how these evidenced self-monitoring;
2. an exploration of the evaluations of the whole subject group made at the end of the semester within Mark-UP to identify ways in which their evaluations developed, and how these related to their stated plans and goals; and
3. an exploration of the 12 interview subjects' evaluations made within Mark-UP at the end of the semester, and during interview, to investigate the relationship between evaluation and interpreted metacognition and how the product encouraged the types of evaluation most associated with self-monitoring activity.

7.1 Exploring the types of evaluation evident in the whole group's mid-point evaluations within Mark-UP

At the end of 5 weeks, subjects were required to submit their partly completed portfolio for assessment and feedback. This feedback formed the basis of subjects' planning which was discussed in Chapter 6. Students were required to use the Portfolio tool to review their work to date. Then, using the Design Problem tool, students were required to respond to the following instructions:

> *Review your progress throughout the semester and enter your comments below, before returning to the main entrance screen of Mark-UP to collate your portfolio. Post your response here, addressing such issues as:*
> - *Which readings have been most problematic so far and why*

- *How you have overcome difficulties reading the weekly articles and which tools have been more useful for this*
- *Whether you have noticed any development in your ability to read documents of this type during the last few weeks, and if so in what ways*

The purpose of this activity was to identify issues with regard to the design of activities and readings within Mark-UP as discussed in a previous chapter, but also to engage subjects in self-evaluation through a review of their work collated through the Portfolio tool. In this case, the Design Problem tool acted as a more general response tool for subjects to submit their evaluations. Each of the discrete elements of the activity engaged subjects in different levels of evaluation. The evaluation of readings could be seen as an external evaluation and one which had limited requirements with regard to metacognition since it was grounded in a specific domain. The second point required a level of abstraction. Since it dealt with the deliberate selection and application of strategies for learning it would have required a greater level of self-awareness in the formulation of evaluations, therefore being more closely tied to self-monitoring activity. The final point was metacognitive in nature. A strong response to this point, for example, would have demonstrated a clear level of self-awareness and ability to evaluate performance at a level beyond any specific activity.

The exploration of the responses to this activity therefore took place in 3 further stages:

- an exploration of subjects' evaluations of the readings;
- an exploration of subjects' evaluations of their strategy use; and
- an exploration of subjects' evaluations of themselves as learners.

Each of these is discussed separately. Conclusions are then drawn about how and the extent to which subjects addressed each of these points and how the process of reviewing their performance through the implementation of a mid-point evaluation, using the Portfolio tool in Mark-UP, demonstrated subjects' abilities to evaluate their learning at a metacognitive level.

7.1.1 Subjects' evaluations of the readings

As was to be expected, most subjects were able to evaluate the readings, at least in terms of their level of comfort with them. Such an evaluation was grounded in a direct experience and required little abstraction beyond that. Nearly all subjects could identify readings that they preferred over others, and most were able to explain the reasoning for this.

The responses that demonstrated the weakest types of evaluation tended to focus on formal aspects of the reading such as the level of language used and the presentation. On the whole,

the hardest readings for subjects by Week 5 were the first and fourth readings, mainly because of their complexity:

> *The reading in week four was a little complicated and in parts, hard to follow. The wording was complex, and the in-text reference parentheses made the reading somewhat hard to follow. (Subject 36)*

Such types of responses were typical, and were generally characterised by a focus on formal aspects rather than the actual ideas within them:

> *The last 2 readings (Park I & Hannafin MJ and Fetherston T) has been most problematic, because of the "PhD type" of language that is hard to understand. Those two readings, although have good points in them, is frustating to read. They should have used simple words to get their findings across to the readers, instead of using "big, sophisticated" words. (Subject 37).*

The above example, however, did at least acknowledge the readings had 'good points', though this was not really described in any detail.

Most of the responses were more integrative in the way in which they were structured. That is, they included a description of the strategies they engaged in while working with readings. This required a higher level of metacognition since it involved subjects' conscious and deliberate selection of strategies based upon their evaluations of their understandings of the reading:

> *I have enjoyed using MarkUp this semester. Instead of only posting your solution to the allocated problems, it is fantastic to get feedback on your views and the perspectives of others. I found the week 4 reading (Empirically-based guidelines for the design of interactive multimedia) the hardest in relation to the other readings. Despite the fact that it was a long reading, I found it difficult to distinguish between the different learning principles. Although once I read through it a few times it started to make more sense. The annotation tool definitely helped me to understand the principles more by obtaining feedback from other students. The other readings have been quite interesting and I have found that I can apply the information in these readings to other units which is a great help. (Subject 129)*

The above example highlights multiple facets of evaluation that took place. Firstly, there was an evaluation of the difficulty level of the readings. As shown already, most subjects were able to respond on that level. What made Subject 129 different from previous examples, though, was her focus on the ideas within the reading rather than purely on the superficial

barriers that inhibited the experience with the text such as choice of wording and length. Subject 129 was also able to evaluate her own understandings as well as the text. Rather than simply claim that it was long and had difficult words, she could go beyond that to acknowledge the difficulties she had in distinguishing concepts. With this stronger response, therefore, it was not surprising that her evaluation of the readings was integrated with an evaluation of the strategies used to tackle them. This ranged from more basic strategies, such as rereading, to the use of annotation as a tool for comparing her understandings with others. The fact that she perceived an ability to apply the readings skills across other domains also suggested a high level of metacognition. The strong evaluation evidenced here was probably helpful in the development of that.

Even the weaker responses about the reading tended to incorporate some aspect of strategy:

> *I think the most problematic reading is week 4 reading. First of all, it is hard because it had too many page. The second thing is the big words, which I find quite hard since English is not my first language because I have to search the words' meaning in the dictionary. Sometimes, I have to read two to three times for some sentences and it a bit frustrating. There are too many quotes as well in this reading which annoyed me. Third, the table is also a bit confusing. However, the principles section is easy to read and easy to understand. (Subject 125)*

Subject 125 grounded her evaluation initially in tangible issues such as the length and choice of words in the reading, but did identify some strategy use as well. While repeated reading and dictionary use are not the most complex strategies, or the ones most indicative of self-monitoring, some self-evaluation was obviously necessary in order to make the decision over what strategy to use. The fact that the subject was also able to distinguish between topics within a reading suggested a reasonable level of sophistication in her evaluation, even if it was grounded primarily in the 'object' rather than 'meta' level which are both integral to metacognitive activity (Nelson & Narens, 1994).

It could be seen therefore that the mid-point evaluation of the readings did have some value in engaging subjects at both a very basic level of evaluation at which they could describe the reading they had difficulty with, but also at a higher level at which many tied this difficulty back to strategy use. The evaluation of readings, however, was obviously a more grounded task than having subjects specifically evaluate their strategy use and themselves as learners.

7.1.2 Subjects' evaluations of their strategy use

The next stage of the mid-point evaluation was for subjects to identify how they overcame difficulties reading the weekly articles and which tools in Mark-UP were most useful for this. It has been shown that most students identified the strategies used with the readings in conjunction with an evaluation of the readings themselves. This evaluation of strategies represented more complex evaluation, however. Rather than being tied exclusively to the artefact itself, it required subjects to be more reflective in selecting and evaluating approaches that they took when engaging in them. As such, effective evaluation of strategies would be highly aligned with cognitive self-regulation.

Most subjects responded to the point about overcoming difficulties with reading by using the tools in Mark-UP. The quality of such evaluations and the strategies themselves, however, varied. Some strategies defined were more functional in nature than addressing the specific issues of comprehension or application of the reading concepts:

> *I print out each reading and make notes on the hardcopy before adding annotations in Mark-UP. That also helps me to identify where I have made the annotations on screen so that I can go back and check for responses to my postings. (Subject 50)*

While the above response was a legitimate evaluation of difficulties in managing readings and described a strategy for overcoming them, there was little evidence of reflection about herself as a learner, although her annotation of paper based material may have been evidence of an existing reading strategy. A more common response specifically identified approaches to assist in learning. Responses such as 'I think the tutorials and the annotations have increased the understandings of the readings by being able to see other people's views about readings' (Subject 83), while not clearly demonstrating an understanding of the learning dynamics of reading others' opinions, could at least evaluate the effectiveness of it for learning. Many responses in fact identified annotation as an effective strategy, specifically because of its ability to provide reciprocal feedback:

> *Ever since Mark-UP is introduced in this unit I have been able to share opinions with other students and I find that is a really good learning process for students. (Subject 74)*

The majority of subjects were able to describe their use of strategies in some detail:

> *In spite of the length of the reading, screen (or scan?) read it first, try to get the main message the reading giving out at each section, read through it in detail*

the second time, drop a few notes, highlighting, and summarize those ideas. (Subject 118)

However, it was not the level of detail that indicated the strongest evidence of evaluation, but the ability to identify the value of the strategies and tool and the reasoning for their selection in terms of learning. One subject clearly understood the purpose of the activities in which he was engaged:

I have focused on the readings by first scanning for the main ideas and then reading and re-reading if necessary. In the various Mark-Up activities there has also been a significant amount of enforced reflection and application of the principles and theories from the readings. (Subject 131)

Another subject demonstrated an ability to evaluate the learning strategies implemented within the Mark-UP tools at quite a high level of abstraction, drawing on concepts within the course to act as a reference for her opinions:

The idea of annotating ... helps to reinforce the information in the article. Page 312 of article "evaluating Interactive multimedia courseware" states "products that actively involve users rate much more highly than those that exhibited low interactivity and just presented information to users". Therefore making us students annotate interactively makes us absorb more of the information in the articles. (Subject 110)

While less common than the responses that merely described the processes in which they engaged to improve learning, those that could clearly evaluate their effectiveness in terms of their own preferences and the nature of the activities themselves, were prevalent enough to assume that many students were evaluating at both the object-level of the activity (Mark-UP and the strategies within it) as well as the meta-level (understandings of themselves as learners).

It appeared therefore that engaging students in a mid-point evaluation of their strategy use was an effective use of the Portfolio tool. There was variation in the nature of these evaluations in that the evaluation of functional or management strategies demonstrated less evidence of metacognition than evaluation of learning strategies. The fact that the majority of students however demonstrated an ability to reason their strategy use indicated a nexus between the object-level of evaluation and the meta-level of evaluation which is discussed next.

7.1.3 Subjects' evaluations of themselves as learners

The final discrete element of evaluation in the mid-term evaluation was for subjects to observe any developments in their abilities to read academic texts throughout their use of Mark-UP. As well as implicitly involving an evaluation of Mark-UP as a learning tool, this form of evaluation represented the highest level of metacognition since it required an understanding from subjects of their own strengths and weaknesses. Given the level of abstraction required for this form of evaluation, it was understandably the least fully articulated response to the evaluation activity by subjects. It is also fair to say that it was the most difficult to interpret in terms of metacognitive activity, since it relied so heavily on self-perception rather than any objective reference for analysis.

As such, it was difficult to gauge the processing that underpinned a statement such as 'I don't believe the readings have affected my ability to read this type of document' (Subject 34). In fact there were several similar evaluations, just as there were a few that responded equally briefly but in a more positive tone:

> *I think I have developed a lot of reading skills for myself. Especially, I have known a lot of skills to make my reading easier than before. (Subject 14).*

Not all such responses were so clearly deficient in detail when it came to self-evaluation, however. Some of the subjects who replied in the negative regarding improved learning, could justify their response. Subject 55 contended, 'In the end this Mark-UP section really hasn't improved the way I learn or how much I can absorb, pen and paper is still the way for me' while Subject 69 claimed:

> *Nope, I can't say I have noticed any development there, I read stuff all the time, so this isn't new to me.*

Both of these responses seemed to be quite valid, and despite their brevity, not necessarily deficient in metacognitive evaluation. It would appear that both of the subjects had previously developed effective regulatory strategies to develop approaches to learning. Mark-UP did not necessarily add anything to this.

That was not true for most subjects, however. While many did not provide any evaluation of themselves as learners, the majority of those that did saw positive benefits to their abilities as learners. While many of the comments were vague and cursory, some subjects responded in depth about the benefits they found to their learning processes:

> *I think that over the last few weeks of doing these readings my ability to understand and critique what i am reading has improved. No longer am i simply just reading the content, I feel that you will get a lot more out of it by*

annotating. Being able to write feelings about what is being said in each page, really helps the learning process and this is why it has been so successful. (Subject 73).

It is clear from the above response that the subject perceived improvement in their abilities as a learner, and the focus on critiquing and drawing personal experiences into his reading highlighted the role of evaluation as both a product and process in this. Other subjects identified an improvement not just in their reading but in their ability to apply understandings to a different domain of learning:

During last few weeks I found myself has been improved although it's not a technical way, I understood what designing should be like theoretically. Now I can judge a web site whether it has good interface design, information design, instructional design and practical design or not. These skills will be useful when I face a designing project as a team member. (Subject 33)

This direct reference to transfer of understandings suggested a level of evaluation that was beyond simple application to a single context. However, its vagueness did not suggest the subject was able to understand himself as a learner as well as Subject 129, who was able to both evaluate the strategies she used as well as acknowledge how this impacted on her as a learner:

When reading through the documents for markup, I have noticed that I have started to notetake... I would rather write notes on the side as I am reading instead of reading the entire document and then try and remember what it was about. It's helpful in that I can put the text into my own words and therefore remember it more easily.I have also applied this type of reading and annotating to my other units and my understanding of documents has become more productive. (Subject 129)

Again, the transfer across to another aspect of her study was a clear indication of the evaluation occurring at a level of abstraction rather than purely within a specific context. While those responses that tended to consist of assertions of self-awareness rather than descriptions of processes which have assisted in their evaluation of themselves as learners did not necessarily delegitimise them as statements of metacognitive evaluation, the fact that several subjects were able to explain their evaluations of themselves as learners in terms of the activities in which they engaged in within Mark-UP indicated strong evidence to support Mark-UP's role as an environment for promoting metacognitive evaluation. As subject 3 stated:

I have noticed that i am more willing to persist reading a difficult text, and more conscious to develop an understanding of it. The use of Mark-up and annotation, ensures i take something away from the reading, rather than reading and forgetting. I am actually enjoying most of the readings and learning lots of relevant and interesting information. I can see how the main premise of each text contributes to the outcomes and assessments of the unit.

As well as a positive appraisal of the tools within Mark-UP it appeared from this response that the process of having subjects evaluate their own development at the mid-point of the semester by reflecting on their work through collating it in the Portfolio tool promoted evaluation at the highest level, that is pure self-evaluation. While such evaluation is typically implicit in much of academic work, this activity enabled such processes to become exposed and described by subjects, therefore enabling the conscious application of evaluation strategies. While many of the responses could be classified as 'motherhood' statements that did not necessary expose the reasoning for the points made, the evidence of evaluation demonstrating an understanding of transfer of learning and strategy use indicated that in the activity of subjects evaluating themselves during the mid-point of the semester enabled an explicit articulation of metacognitive evaluation to be made.

7.1.4 Conclusions about types of mid-term evaluations made within Mark-UP

The activity in which subjects were required to evaluate their performance part way through the semester provided evidence to suggest support within Mark-UP for evaluation at an object-level, in the case of the readings, a strategic level, and ultimately at an abstracted level of self-evaluation. Most subjects had no difficulty in applying understandings to a specific context, in this case, the readings in which they were engaging. The stronger responses, however, were also able to integrate concepts relating to the strategies they used while reading into their comments. In most case, subjects were also able to clearly explain the strategies they used for reading while using Mark-UP and argue their relative value in terms of their own learning. Such evaluations involved a higher level of abstraction than was typical with evaluating a reading, since subjects were required to link their knowledge of the strategies with their metaknowledge of their value for themselves as learners. Therefore, such evaluations, where well-articulated, indicated a strong link between the strategies subjects used and their evaluation of them at a metacognitive level.

At an even higher level of abstraction, subjects' evaluations of themselves as learners provided the most clear indication of evaluation as a component of metacognitive self-monitoring. It was understandable that fewer subjects were able to engage deeply in this level

of processing. Also, assertions about oneself as a learner did not necessarily provide evidence for such evaluation. Nevertheless, many subjects were able either to note no change in themselves as learners, typically as a result of the application of existing strategies which they felt more effective than those modelled in Mark-UP, or to observe a change in themselves and provide reasoning for that change. There were several of the latter responses, and these typically were able to evaluate how the self-monitoring they engaged in while performing Mark-UP activities improved their skills either as readers or learners.

Therefore it appeared that the use of Mark-UP to support an instructional approach that involved a mid-term self-evaluation during the semester was an effective means of making metacognitive evaluation an explicit and conscious component of the cyclical monitoring process. As subjects reach the mid-point of the semester, the Portfolio tool allowed them to reflect on the quality of their work in terms of critiquing the readings that they were marking up, the strategies that they used in doing so, and the impact that this process had on their learning approach. The findings can be summarised in the following way:

- all subjects demonstrated an ability to engage in evaluation of readings using Mark-UP, though this was the least indicative of metacognitive evaluation;
- the majority of subjects (84 subjects) demonstrated an ability through the use of Mark-UP to integrate strategic concepts into their evaluations and this process was more aligned with metacognition; and
- the strongest evidence of metacognitive evaluation was found when subjects evaluated their own learning (34 subjects), although this appeared to be less common than the other forms of evaluation.

An understanding of these types of evaluations provided the basis of the next stage of exploration. The process of self-monitoring has been defined as an iterative cycle of planning, monitoring and evaluation. In order to explore the integrity of that process as it took place within Mark-UP it was necessary to engage students formally once again in evaluation. This time, as well as evaluating themselves as learners, subjects were required to conduct this evaluation in the light of the plans they made following the feedback they received in their partly completed portfolios.

7.2 Exploring subjects' evolving evaluations in terms of planning at the end of the semester

The second part of this exploration of Mark-UP as an environment to support metacognitive evaluation was to examine how Mark-UP supported subjects evolving evaluations as they

modified their strategy towards the end of the semester. This involved the analysis of evaluations subjects made of their learning strategies and skills developed since receiving feedback on their submission of their partly completed portfolio, as well as an evaluation of the plans they made for improvement that were discussed in the previous chapter following this feedback.

In the final week of the semester, before submitting their portfolio, all of the students were required to collate their work and then answer a final question within the Design Problem tool:

> *Self Analysis: Review the work you have completed throughout the semester, and identify the ways in which your understandings have changed, both with regard to your conceptual understanding of course content and your ability to use strategies to help you understand the readings throughout the semester. How has your performance been in comparison to the improvement strategies you identified in week 7?*

This activity provided a final evaluative stage following the mid-term planning subjects engaged in after receipt of feedback from their partly completed portfolios. The activity deliberately required subjects to engage in the planning/monitoring/evaluation cycle by examining their previous work, as well as the external feedback received, and to discuss this in the light of their developing skills in strategy formation, content understanding, and directly related to their learning plans.

In analysing the responses to this question, one would have expected strong metacognitive evaluation to be evidenced within the quality of subjects' evaluations of their plans, through an ability to reflect effectively on the value they gained from implementing the tools within Mark-UP and an understanding of any improvement in their learning.

In fact there was evidence of all of these forms of evaluation, although once again there was some variety in the quality of the responses. The responses were analysed through constant comparison to identify commonalities in the responses which could then be classified into evaluation types. Through the analysis of all the students' responses to this activity, three specific types of responses emerged that dominated the responses to the questions: subjects who identified improvement in terms of the strategies they implemented; subjects who discussed improvement in terms of their plans; and subjects who did not observe any significant change by the end of the semester.

7.2.1 Subjects who identified improvement in terms of the strategies they implemented

By the end of the semester nearly all of the subjects demonstrated the ability to evaluate their learning, and their responses provided some of the strongest indications of metacognitive evaluation. This was not true of all of the responses, however. Many subjects could describe the strategies they used to improve their learning, but often lacked the depth to critique the value of them:

> *I think my reading skill have improved a bit than at that time. Even though my reading skill is not good yet, I would say I found out the way to read more efficiently. I did not have go through every single word. I tried to skim reading and then with that information, I understood easier and faster than before. Also as my knowledge about this unit get better. (Subject 100)*

Subject 100 described ways in which she had adapted her reading strategy to accommodate the requirements of the course and to assist her learning. Nevertheless, this response lacked depth. For example it was not clear from this, just *how* the subject understand 'easier' and faster than before through skim reading. Another example is Subject 98, who claimed:

> *Well, i guess i have improved some of my reading skills, and i found that i am less likely to do the annotations. Basically i have use the same skills to doing the MarkUp, but the thing different is after i have read the whole articles, i will search some website which are relate to the chapter, so i can read more information and improve my understanding of the topic, and then do my summary. (Subject 98)*

While the strength of this response was the subject's ability to apply her own judgement to the value of the toolset, using the Post URL rather than the Annotation tool, she was still not clear as to the processes afforded by the tools that assisted her development.

The vast majority of responses however, were more able to clearly tie the nature of their improvement with the reading strategy or tools that they employed. While not particularly well expressed, Subject 83, described her use of tools and strategies in terms of cognitive processes:

> *The mark up helped to understand the reading by doing the activities given we were made to think about the readings and then out the ideas into practice. So it actually made you think about what the readings where actually trying to say. (Subject 83)*

The value of deep processing was emphasised by many subjects. One went so far as to describe the value of Mark-UP in terms of its role as a collaborative medium as well as a tool for authentic learning:

> *I found that the mark up system was good at helping me engage with the reading better. The variety of activities certainly kept the course interesting for us. The most attractive part of the mark up system was the ability to dicuss the readings with the other students. It has certainly encouraged me to think more deeply about the issues raised by the readings. This has also enabled us to anchor the concepts presented in the readings with real world examples. (Subject93)*

The ability to evaluate individual strategies in terms of subjects' own needs and the cognitive processing that each of the strategies or tools promoted was surprisingly common. Similar to Subject 93, many subjects described the collaborative mechanisms within mark-UP as a valuable approach to use others' ideas to monitor understanding. Subject 102 claimed:

> *What I find most helpful are the annotations and discussion forums because they provide opportunities for students to interact with one another - asking for and offering opinions - thus promoting peer-learning. Moreover, upon submitting a response to a task, the ability to view other people's responses means that I am able to compare my response to theirs and hence pick up points of the readings that I missed. (Subject 102)*

This response was reinforced by Subject 129, who stated:

> *It was great in the 2nd half of the semester when all of the mark up tools were available insted of just one or two as this catered for all users with different learning styles and offered the user with multiple tools that aided in the learning of the reading. Every week I used the annotation tool as I found this very helpful. I could view other students anotatoins and this would help me understand a certain topic better as it had been discussed. It saved me time as I didn't have to go away and find that information and use the dictionary quite so much. I would like to think that I helped other student out in this way as well. (Subject 129)*

As well as being able to evaluate the Annotation tool in terms of its value as a feedback mechanism for monitoring her understandings as well as for articulating them for others s, Subject 129 was also able to demonstrate a high level of metacognitive evaluation by appreciating the flexibility in her ability to select the tools she considered most appropriate for her learning at a given time.

Nearly all subjects who evaluated their performance in terms of strategy could apply a high level of metacognitive evaluation to the choice of strategies. As subject 129's comments indicated, several subjects found annotation valuable and could argue why:

> *The annotations or discuss really made me participate with people whose taking this unit. Because the annotatios can respond, either agree and disagree, this makes it interesting . (Subject 61)*

Some preferred to summarise and could clearly explain the value of that approach in their own terms:

> *My understanding of the readings has changed from thinking of them as being incredibly boring, to something that just takes a day to complete. The way to learn the materials is through summarising the document and relating the sections to what I already know, this way I can write recalling something freely and keep the writing going at a steady pace. I did not find other users comment very helpful, as were often extracts from the reading or just rephrased the reading and did not add any new light, but did cost time in reading it. (Subject 34)*

While Subject 34 could clearly make a case for summary, others were just as adamant about the value of posting URLs:

> *I think the task of finding and posting URLs related to the weekly readings is effective in encouraging me to ponder over the articles, instead of reading and forgetting them instantaneously. Additionally, I have been able to apply what I have learned to new contexts, which helps me retain previously learned information, and build new schemata. (Subject 101)*

Ultimately, not everyone valued every tool or strategy that was promoted within Mark-UP, but the fact that 50 subjects were able to clearly argue for their choices of strategy and explain how they improved their learning, provided strong evidence that metacognitive evaluation was being demonstrated. Some subjects could even articulate how the processes they engaged in within Mark-UP could be applied directly to other domains of learning beyond reading comprehension:

> *If I don't quite understand the readings, I find myself browsing the library for more information about them. Some of Mark Up tasks involve applying the content of the reading on certain situation or giving a real life example for each point in the content. I found these tasks are useful to deepen my understanding about the content and how to apply it on different tasks. (Subject 128)*

This ability to reflect on one's performance, identify the strengths and weaknesses of strategies used and explore ways in which conceptual understandings could be applied across domains would appear to be strong evidence of metacognitive evaluation. In fact, such types of comments were common throughout subjects' responses to this question. Very few of the subjects simply evaluated their conceptual understandings without reference to the strategies used to develop them. Only one subject listed specific concepts learnt during the semester, and even then, some lip service was payed to the strategies afforded within Mark-UP to assist in this:

> *My understandings on certain topics have developed this semester. The main areas where my learning has excelled are:*
>
> *- differentiating between good and bad design and identifying the elements which can effect a good design*
>
> *- the use of mark-up and the benefits of annotating texts and reading others' opinions to expand my learning and understanding of the texts*
>
> *- the importance of behaviourist approaches in designing a learning environment, i.e. behaviourist, cognitive and constructivist*
>
> *The activities that I participated in throughout the semester, which allowed me to develop my conceptual understandings, were the mark-up tasks and assignment two. The mark up tasks challenged my understandings in certain areas such as the importance of design, analysis and feedback. (Subject 9)*

It appeared therefore that Mark-UP was successful in engaging subjects in evaluation of their strategy usage. The fact that very few subjects simply discussed their learning in terms of conceptual understanding suggested some development in evaluation compared to the mid-term evaluation conducted before the submission of subjects' partly completed portfolios. In the mid-term evaluation, the most common responses (50) were those that tended to focus primarily on the readings; and although many of the mid-term responses did discuss strategy use, there was still more evidence of object-level judgements than the more abstracted meta-level evaluation. By the end of the semester it appeared most subjects could discuss their performance during the semester in terms of the strategies they employed. Whether this was a result of engaging subjects in mid-term evaluation and planning following feedback is not certain. The prevalence of comments that tied learning strategies specifically to the toolset of Mark-UP suggested that at least in part, the process of using the tools themselves may have had a part of this. In negotiating their understandings of the readings by using the tools, the implicit evaluation within the continuous monitoring process may have impacted on their ability to evaluate their performance. Nevertheless, most of the responses were quite explicit

in the nature, suggesting that at some point such evaluations became conscious and external to the learning process. To explore this further, the next section discusses this more explicit form of evaluation by analysing the responses of those subjects who specifically referred to their plans in evaluating their performance.

7.2.2 Subjects who identified improvement in terms of their plans

Given the high level of metacognitive evaluation demonstrated in subjects' discussions about their choices of learning strategies, one might expect similarly high levels of responses evaluating the plans they articulated in Week 7 of the semester. Interestingly, 30 subjects did not specifically refer to plans, despite the question requiring them to do so. While it could be argued that many of the responses involved implicit critique of their plans, most subjects did not specifically restate their plans and evaluate them. Nevertheless, there was still a number of subjects who did so, although these tended not to be the ones that demonstrated evaluation at a high level of self-awareness.

It has been shown how planning could take the form of identifying strategies for process-oriented goals as well as performance goals, and how the former is most indicative of metacognitive activity. In evaluating their plans, the majority of subjects evaluated plans that were tied to performance rather than process goals. Subject 125 argued:

> *I would say my skills has not improved much compare to my first 5 weeks, but at least it has improved though. Honestly, from the comment that I got for my first part of the portfolio, I was motivated to improve more, so I can get a higher mark or at least the same mark as I've got before. For this, I try to apply the theories of the readings to the activities and I also add more annotations and more URLs. (Subject 125)*

Some subjects were quite formalistic in the way they measured performance, considering it in terms of quantity or effort rather than in the quality of their responses:

> *I have already managed to post more annotations and giving more detialed comments to others' postings. With that, I have also come to more websites and gather information from them, that I am able to post better comments and gain a lot deeper understanding about the topic. Thus, i can say, it has been going better since the previous one. (Subject 107)*

These types of responses were in keeping with the initial plans made following feedback on the partly completed portfolio, where many subjects identified issues with effort and quantity rather than learning. Subject 112 showed that this was still a major issue for him:

At the beginning of the semester, I had vowed to complete each markup on time which I did for the first half of the markup. The second half has been very difficult especially with so many other assignments to finish off at the same time. Also, I feel that too much concentration on the second assignment made me drift away from me completing the markup on time. (Subject 112)

Not all plans were geared towards such limited goals, however. One possible reason for the lack of discussion of plans at this stage of the semester, was simply because constant evaluation had rendered them obsolete:

Understanding the reading is a lot easier now. I think I've mentioned in week 7's assessment that the annotation is useful in helping me understand the readings. Sadly, I found that the other tools (forum and url post) did not help me at all in my understanding of the reading or the weekly exercises. I abandoned my strategy of trying to post more URLs precisely because I did not feel that it helps in any way. (Subject 56)

This response in fact demonstrates a clear ability to modify plans based upon new understandings. As subject 56 discovered posting URLs to be of little value to him, his choice to abandon the plan was an appropriate one. On the other hand, some simply did not see any reason to modify plans that were working well for them:

My strategies have stayed the same throughout; I make not of the most important points and their features for future reference. I find the mark-up system an excellent way to study. The summaries are just like making out own compiled notes, and when it is printed it is ready to be studied. (Subject 106)

While the above example may well have been informed by a strong level of metacognitive evaluation, its focus on the mechanics of the strategies used makes it a less compelling example than another student who was clear about the value of her plan and was able to show an emergent understanding of how the application of the plan had improved her learning:

Comparing to the previous portfolio submitted I have tried to link two or more readings together while doing my weekly activities, instead then referring to the week's reading only. I understood that it is important to relate readings to each other, because they do link, and looking at past readings does reinforce my ability to understand concepts, and eventually memorise them. The use of the weekly tasks reinforced my pre-existing opinions, about the way I learn the best, which is to put in practice what I read and learn. Finally, I learned to avoid the words 'in my opinion' by making sure that whatever I was writing

was referring to fact. I must admit, that this last point has been the main change in comparison to the previous portfolio. (Subject 82)

It would appear, therefore, that the role of Mark-UP as a tool to support metacognitive evaluation went beyond the specific instantiations of pre-evaluation, post-evaluation planning, and final evaluation that were implemented through the Portfolio and Design Problem tools at specific instances of the semester. In fact, evaluation did appear to be a more iterative and implicit process. As subjects' understandings of themselves grew, initial plans were modified or reinterpreted to the extent that the ideas used to inform them were no longer valid. Subject 82 for example, was able to take on board the feedback she had received and make plans accordingly. It also appeared that as she embarked on those plans, her understanding of herself as a learner and her own cognitive processes evolved, so that she understood exactly why her plans were useful to her. The fact that in articulating their evaluations several subjects made reference to the ongoing and continuous process of 'marking up' their readings through tools such as annotation and the weekly design problems suggested a more iterative process of evaluation took place than that provided purely by the mid-term and final evaluation activities.

7.2.3 Subjects who did not perceive any significant change in learning

There were a very small number of subjects who identified either little or no improvement in their learning. However, these did not necessarily show a weakness in subjects' abilities to evaluate their learning at a metacognitive level, in fact quite the opposite. The weakest responses in fact did claim improvement, but provided little evidence for it. Subject 66 stated:

My conceptual understanding of course content has definitely improved. I now find it much easier to go through long passages of text and now have the confidence to plan and strategize my reading. The markup tool is definitely the instigator towards my renewed zest for studying this kind of material and any other course material. For this I give it 5 stars. (Subject 66)

While it is tempting to flatter oneself with such a remark, there is little evidence of metacognition within the response, despite its assertion of improvement. Some examples of the plans and strategies the subject has developed and exactly how Mark-UP was an instigator in his renewed zest for study may have given more confidence. Nor did Subject 119's assertions of his abilities appear to be very well founded:

well, at least i know more the knowledge about the multimedia if compare before i start this course. Then, i also know many strategies in learning filed of

multimedia, it quite helpful for my studying..... i think i doing quite well in this unit. (Subject 119)

Subject 40 was probably a more truthful response for this type of subject:

I guess I am better than before, because I've worked very hard with mark-up tasks, and read a lot of extra articles to prepare writing for references, or to understand what the reading text means and so on. As you know, this unit has very much reading and writing challenges. Yes, surely, I've improved those skills. But I am not sure, how much I've improved; just I have tried to understand and to write right and more valuable answers. (Subject 40)

This would appear to be quite typical of the weaker students, who could identify *some* improvement without being able to effectively characterise it. Such responses, while few, tended to indicate that some subjects could gauge the intrinsic value of a particular activity, but could not extrapolate at a metacognitive level to attribute such values to their own personal goals and the development of their understandings.

Such weakness was not very evident in the seven responses that indicated no change. For one subject, Mark-UP simply did not provide a useful alternative to her already well-developed learning strategies:

The truth is I don't think the way I interpret things has changed at all I still need a pen and paper to fully understand these readings. That's probably the best strategy for me as I still need to see it and absorb it and then highlight it and make points and I can't do that on mark up. So my strategy hasn't change and in a way I guess that means the way I interpret the readings hasn't changed either. Pen and paper is still the way for me! (Subject 55)

For another subject it was not so much that Mark-UP did not add value to his learning, but that he had developed effective ways of working with it within the first few weeks, arguing:

I feel it has been the same. Completing weekly Mark-Up activities are helpful in increasing transfer by engaging the students in the work. By making the weekly activities assessable, I find that I apply myself a little stronger to learning the unit material, but no more/no less than activities 1-5. (Subject 36)

For another, there was still improvement, albeit in a very limited way. One subject argued, 'There was little improvement by myself though little is better than nothing i would say' (Subject 17). His argument for the lack of improvement, was not so much in his inabilities to engage in the strategies for learning within the Mark-UP tools, but because of his own volitional inadequacies ('I became slack'). A similar problem was experienced by Subject 64,

who argued his performance was 'just about the same'. When expanding on this however, he described issues with perseverance rather than with the learning design of Mark-UP:

> *i would say that as the semester started to get to its climax, available time for markup dimished. i still did the readings, i think that i was a week late with number 12, and commented where applicable. overall i think that i can see a definite improvement in my ability to read and grasp the import of what an article is saying in a short amount of time. (Subject 64)*

The negative impact of external factors relating to workload and motivation was recounted by several subjects and may have influenced the comments of Subjects 64 and 17.

Only two subjects declared absolutely no change, and these ended up being the interview Subjects Claire and Bettina. Both of these subjects claimed Mark-UP had little value for them. For Bettina, her 'participation in the markup activity since week 7 has been minimal (out of pure rebellion bordering on defiance perhaps)'. Claire was less vitriolic but equally clear in her evaluation of the role of Mark-UP in developing her skills as a learner:

> *I have gained quite a detailed understanding of the issues involved in interface design and how to go about them. However, I feel this understanding has not come about as successfully through markup as was expected. I feel my conceptual understanding has come about through applying to exercises such as commenting on a web page, not commenting on a reading.*

It appeared therefore that end of semester responses that identified little change in learning were not necessarily indicative of weak metacognitive evaluation. Ultimately it seemed that those responses that identified strategy use and planning provided a strong reference from which to interpret the extent to which their evaluation demonstrated metacognitive activity. The same could not be said for subjects who perceived little change. Nevertheless these responses did appear to demonstrate a range of metacognitive processes. Some of these responses indicated little self-awareness while others clearly showed a strong understanding of themselves as learners. Although Mark-UP appeared to be less valuable to both these types of students than for those who evaluated their performance in terms of the strategies they used or in relation to their plans, this did not seem necessarily an indication of its value as an environment to promote metacognitive evaluation. Instead, those subjects who could clearly explain Mark-UP's lack of utility to their learning clearly were able to do so from a position of awareness of their learning needs. It was mainly the small number of students who evaluated their performance with little reference to their learning strategies and specific skills they developed or perceived they already had, that did not make the best use of the product.

7.2.4 Conclusions about how subjects' evaluations evolved by the end of the semester

Subjects demonstrated a range of evaluation types throughout the semester as they used Mark-UP to reflect on their performance. These types varied in the extent to which they could be seen as providing evidence for metacognitive processes. The mid-term evaluations tended to focus on difficulties regarding the readings, with strategy use appearing somewhat secondary to that, and fewer responses that could directly discuss evaluation in terms of an abstracted level of awareness. Nevertheless, for the majority of subjects, the process of formatively reviewing their work through the Portfolio tool and responding through the Design Problem tool regarding their learning performance enabled them to articulate their evaluations of themselves as learners in an explicit way, which would probably not have happened had this reflective activity not been designed into the course.

By the end of the semester, subjects demonstrated types of evaluation more aligned to metacognitive evaluation. While the question was a little more general in nature referring to subjects' conceptual understandings and strategies they developed in the light of their plans, very few of the responses focused purely at the level of content mastery. Nearly all responses identified learning techniques they used throughout the semester, with a number of them referring to these in terms of plans.

The end of semester responses tended to show an ability to clearly differentiate between the cognitive processes inherent in their strategy use and how these matched their learning preferences. This stronger bridge between the object and meta-level evidenced in the end of semester evaluation types suggested some development in subjects' abilities to evaluate themselves as learners beyond their basic assertions of improvement.

One odd finding was that few subjects specifically mentioned the plans they defined part of the way through the semester. It would appear that the 'goal posts' had moved significantly between the two points of submission. While several subjects still did evaluate their goals in terms of external performance and effort, the propensity for subjects to critique their own strategy use would suggest some evolution of those goals. Whether this was a result of the specific instances of planning and evaluation embedded within Mark-UP is debatable. The tendency for subjects to attribute improvements in their understanding of themselves as learners and the strategies they used to the tools within Mark-UP suggested that the continuous monitoring inherent in these tools may have made some contribution to the value of Mark-UP as an environment for promoting metacognitive planning. This implicit evaluation is explored in the next chapter.

The question however remains, however, as to which subjects benefited most from the explicit evaluation activities designed into Mark-UP. It did appear that Mark-UP did not ensure a positive experience in self-evaluation for everyone. A few subjects were quite vague in noting their improved learning, and for a few, little perceived improvement was observed. For many of those subjects, the issue of volitional factors once again impacted on their experience with the product. One subject claimed:

> *There aren't very many changes in my work. In fact, I'll go so far as to say the quality of my work has declined from week 7. My excuse is that I've had so much work at the end of the semester that I find it very difficult to do the Mark-UP exercises. (Subject 56)*

Another subject lamented what he perceived to be a lost opportunity in Mark-UP:

> *Unfortunately the amount of work that has to be done each week for mark-UP makes life a bit difficult. While some of the readings have been crap, some have also been really good. And it would be nice to have been able to spend more time on summarising them properly. (Subject 7)*

Of all of the evaluations made at the end of the semester, approximately half of the subjects mentioned their own levels of motivation, the workload involved, or external factors such as commitments in other units as major influences on their improvement throughout the semester. Once again, this raises the integral nature of affective components to subjects' abilities to regulate their cognition. Despite the environment working effectively for most subjects as a means for metacognitive evaluation, issues of self-concept, motivation and volitional control still impacted strongly.

In the end, it also appeared that a few students did not appear to gain any value at all out of Mark-UP. Just as Subjects 7 and 56 did not show an inadequacy in their ability to evaluate themselves by arguing external factors that impacted on their performance, Claire and Bettina's comments were equally valid. The findings of this section of the exploration of how Mark-UP supported subjects' evaluation as a component of self-monitoring can therefore be summarised as follows:

- the end of semester evaluation demonstrated a stronger link between meta- and object-level evaluation, suggesting development in subjects' metacognitive evaluation since the initial self-evaluation activity;
- while evaluation against plans tends to be indicative of metacognitive evaluation, the limited evidence of planning as the basis for the end of the semester evaluations suggested a continuous evolution of plans as evaluation occurred in an implicit and continuous way; and

- not all subjects appeared to benefit from the evaluation process, and the role of affective dimensions such as motivation combined with subjects' existing levels of metacognition on their evaluations suggested the value of explicit evaluation varied depending on the needs of the subject.

It appears therefore that further exploration of Mark-UP as an environment for promoting evaluation is warranted. Research question 6 sought to explore how Mark-UP supported subjects' evaluation as a component of self-monitoring. The types of evaluation that subjects engaged in have been identified and the role of planning and further iteration of evaluation has been discussed. There remains the question of the relationship between interpreted metacognition and the evaluation process, with particular regard to the types of student who benefited the most from the product.

The next section, therefore, examines the role of Mark-UP in supporting evaluation within the group of interview subjects, to see to what extent their metacognitive backgrounds and experiences with the product influenced the ways in which it operated as a medium for their developing evaluation skills.

7.3 Exploration of the metacognitive nature of interview subjects' evaluations

In order to explore the role of Mark-UP as a means of supporting metacognitive evaluation across a range of existing metacognitive levels, the interview subjects' evaluations of their performance conducted in Week 5 and at the end of the semester were analysed. Firstly, subjects' foci in the initial evaluation are described in terms of the types of the evaluation demonstrated and the extent to which they were indicative of metacognitive processes. Their final evaluation was also explored. Here, the level of perceived improvement is defined as well as the focus of this improvement: whether it was based upon their understanding of the concepts; on their use of strategy; or against plans. From these forms of data, interview subjects' demonstrated abilities to evaluate metacognitively were gauged, and the role of Mark-UP in contributing to that could be ascertained.

7.3.1 Evaluations made by Interview Subjects within Mark-UP part way through the semester

As has been shown in the previous section, responses that could go beyond the evaluation of a specific artefact to the evaluation of self are best indicative of metacognitive activity. One would therefore expect that highly metacognitive students would be able to demonstrate

evaluation in all the ways defined in the initial evaluation. This would incorporate effective evaluation of the readings at the lowest level, of the strategies that subjects used to understand the readings at a higher level, and finally, at the highest metacognitive level, an ability to evaluate themselves as learners.

Of the 12 subjects selected for interview, only 8 completed this activity. When questioned in interview, there appeared to be a variety of reasons for this. Yvette, for example, argued reflection was something she 'would not normally do. If other people ... gave me comments, I would respond to it, but I wouldn't reflect on my work'. For Craig, such activities were 'purely about giving the tutor what they want' and so he found little personal relevance in the activity. Jake, who was left with 'a backlog of work to do' before submitting his partly completed assignment sacrificed the evaluation activity. Debbie on the other hand simply couldn't remember if or why she had not completed activity.

Those subjects that did respond to the activity displayed a similar pattern as the group as a whole. Nine of the interview subjects were able to describe the value they placed in the readings and the difficulties they had with that. While Frances simply noted which readings she had most difficulty with, others were more able to articulate the reasoning behind there responses. Brian was able to compare his abilities with separate readings based upon their length, quality of content, and layout:

> *Large reading have been more problematic as I am not a huge fan of reading. The week 4 reading was concise but large. I found week 5 a much better read, full of usefull information and a straight for layout helped to achieve a better understanding of the main concepts.*

Similarly, Duncan evaluated the readings in terms of their 'wordiness' and their length.

This narrow focus on the object-level of evaluation, such as the length or wordiness of the reading, was quite indicative of the subjects who demonstrated an overall low or medium level of metacognition. However, those subjects who were interpreted as medium to high in terms of their overall level of metacognition demonstrated a little more self-awareness when evaluating their experience with the readings, making reference to broader issues such as their application to real world problems and so on. Belinda, Sylvia, and Claire described their experiences more in terms of the nature of the content in the reading. For Belinda, for example, reading 4 was problematic, not because of the reading itself, but because she had so much that she wanted to say. Claire, on the other hand could articulate problems with engaging in theoretical texts, identifying conceptual as well as structural issues in the reading:

> *Week 4 and Week 5 have been the most problematic so far because they are long, tiresome, and relate to theory which is hard to relate to knowledge or*

experiences. They require a large amount of concentration and for quite long periods of time.

This difficulty in relating to personal experience demonstrated a keener level of evaluation than simply arguing that the reading was too long.

One of the intriguing aspects of this activity was that, as with the whole group, most of the interview subjects integrated their discussion of strategy with the reading, making it the primary focus of the evaluation. All of the responses received demonstrated some level of evaluation of their strategies. While Frances and Alan were somewhat limited in their responses, they were still able to explain which strategies worked best for them when it came to reading. Alan focused on finding a non-interrupted period of time and printing out the reading, while Frances specifically mentioned annotation as a valuable approach, although she did not explain in any detail why. The same was also true of Duncan, Jake and Sylvia. While Duncan listed many strategies he used, Jake and Sylvia could go further, explaining their personal relevance. For Jake:

I find annotating the readings to be very helpful in expanding upon and consolidating the information given in the lectures and tutorials. (Michael was excellent by the way :) I have always been pretty good at reading and comprehension, but I have found that combining the annotation feature allows me to summarise and clarify points as I go.

In this sense he was able to describe the personal relevance of the strategy in cognitive terms. Sylvia's evaluation was similar, but with a greater focus on the value of the strategy as a tool for personal confidence:

The annotation tool has been rather helpful as I could read the views of others and understand better what the article meant. I never had IT background in the past, and hence, reading such articles used to scare me. Now, I read it with more comprehension and with less phobia. I usually read the articles, then write down my own opinions and its main ideas, trying to see how they balance. If in doubt, i would usually use web references that has techno terminology search capabilities. The MArk Up system has been a rather innovative part of my learning IMM.

This ability to extend beyond a description of the strategy to explain the value of it was also evident in those subjects interpreted as more highly metacognitive. Claire could describe her approach to summarising the main ideas of a reading before annotating, but then could argue:

By breaking documents down first, I have been able to get an overview before commenting so I do not add something before it has been properly explained. Further, by discussing the concepts with other students, I get to see what issues other students are focusing on and whether or not I agree with them.

Belinda did not actually value the tools within Mark-UP. Nevertheless, she was quite able to explain why and argue for the value of her traditional strategies. For her, making physical notes in the margin of a printout was the most effective strategy. She described her favourite tools as 'printer/laptop and highlighter/ink pen', and was critical of Mark-UP which imposed strategies which she did not feel useful, claiming:

I found it time consuming (and difficult to manage with my overtaxed time schedule) to have to then go BACK to Mark-UP to add all of the comments I had made as I read.

Therefore, while quite negative of Mark-UP, Belinda's response as well as Claire's was clearly evidence of a high level of evaluation of their strategies.

It was not surprising that those subjects interpreted as highly metacognitive were also best able to direct their evaluations part of the way through the semester towards themselves. While Belinda simply said there had been no development in her understandings of herself as a learner, her ability to clearly articulate her needs and approaches evidenced a strong level of self-evaluation. Claire, too, was able to show strong self awareness. She could observe growth in her learning and could effectively attribute that to Mark-UP. Her claim was that originally:

I had been approaching the readings with hesitation as I did not want to make "stupid" comments or appear informal. I have now realised there is no point in being scared or hesitant to what you write but more to get something down which allows you to reflect and learn with others.

Claire was also able to add to this, stating, 'I am getting more interest in the topic since I have another unit also relating to similar concepts and thus can interrelate the two'. This ability to find commonalities between topics and frame them in terms of personal relevance demonstrated a sound ability to evaluate herself.

Of the other subjects, however, evidence of self awareness in observing any change in their learning was minimal. While Alan argued minimal change in his approach to reading, he could still claim some personal value from Mark-UP in terms of its flexibility and functionality, which showed some self-awareness. Sylvia too, could describe Mark-UP's value in building her confidence, claiming:

when dealing with something new or difficult as you get to know that others might also be trying to come to terms with what you're struggling with. And best yet, you get to help each other.

Nevertheless, the other subjects did not demonstrate much self-evaluation at all. Neither Frances, Brian, Jake nor Duncan described how they have perceived any change in the way they learned since using Mark-UP.

Such findings suggest that at least initially, Mark-UP was limited in the way it promoted evaluation during the mid-point of the semester, particularly for those subjects interpreted as metacognitively weak or moderate. Merely using the Portfolio tool to review their work and then respond in the Design Problem tool to an evaluation question did not provide adequate scaffolding for these subjects. In many ways this is not surprising, since it represented a first iteration of the evaluation process in an explicit way. However it does reinforce the notion of evaluation being part of a broader self-monitoring loop which operates in iterative cycles. While the types of evaluation evidenced both with interview subjects and the broader group as a whole suggested that Mark-UP acted as an enabling tool, it did not appear to actually promote evaluation at a level of abstraction. In order for it to operate effectively at a fuller level, one would expect greater evidence of types of evaluation more clearly aligned with metacognition following the process of feedback and iterative planning that took place following the mid-term evaluation. This, in fact, proved to be the case.

7.3.2 Evaluations made by the interview subjects within Mark-UP towards the end of the semester

The tendency for limited types of self-evaluation observed during the early part of the semester was in stark contrast to the response to the activity towards the end of the semester, where students were required to review their work and describe their performance against the strategies for improvement they identified after having received feedback on their partly completed portfolios.

Nine of the twelve interview subjects completed this activity. They were also asked in interview about whether they had perceived any improvement in their learning and for those subjects that did not complete the activity, their interview responses formed the basis of the interpretation that follows.

Of the 12 subjects, most could identify how they had improved in their learning through Mark-UP to some small degree. The exploration of the whole group showed that responses generally fit into the categories of: improvement identified in terms of strategies;

improvement identified in terms of plans; and subjects that found no improvement. By far the most common type of evaluation within the interview subjects was students who identified improvement in terms of strategies.

That did not always mean that a strong level of improvement was noticed however. Jake, for example did not complete the activity, and when asked in interview about whether he felt he had improved, he acknowledged some improvement, but felt that Mark-UP had more reinforced strategies he was already aware of, but did not use heavily previously:

> *I don't know if I'm a better learner... I think it was helpful for my learning... it's confirming that it's the best way for me to go through, as I go, making notes and then review my notes rather than ... I don't know... just reading it and not make any notes.*

This was a lukewarm response, but one still tied to strategy, and one that showed an awareness of the value of strategies used. Craig, too, while not completing the final activity because of time constraints, demonstrated a clear ability to evaluate his learning in interview, once again tied to strategy use. When questioned about whether he was a better reader as a result of having used Mark-UP he admitted, 'I suppose yeah. Maybe just developed a bit of an eye for key points. That sort of thing.' When asked how he had developed this skill he attributed it to, 'the summarizing, I think that's helped me'. In their written responses, Duncan and Claire also could attribute improvement in learning to strategy use. While Duncan's comment began 'I don't think my ability to understand the course material changed throughout the semester. I really used the same techniques for understanding the readings for each week', his further description of his strategies somewhat undermined this claim:

> *The mark-UP system did deliver a new learning method to me though, in the form of other student's views. Often someone would post a question that I also did not know the answer to, and a number of students would offer answers. This was helpful to me in understanding all the concepts.*

Claire, while not attributing her improvement necessarily to reading activities within Mark-UP could describe further improvement:

> *I feel my conceptual understanding has come about through applying to exercises such as commenting on a web page, not commenting on a reading. However, in saying that, I feel the time spent in markup was to an individuals advantage depending on how much they would like to take out of it. If the student spent much time researching additional URLs and information, he/she would be benefitted with a greater understanding of the subject matter. Also, the more time spent on each topic was additionally enhanced with the student*

improving his/her strategies to read these readings. My strategies to help understand the readings have come about through improved skim reading and better note making skills with additional research via Google giving a better understanding to the topic enabling me to challenge an idea if I do not agree with it.

In this example Claire could define clear improvements to her learning, and was able to distinguish between the Design Problem tool and the other reading tools such as annotation. While she did not personally value the reading tools as much, the strength of her response in terms of her ability to tie improvement to strategy and to objectively judge the value of Mark-UP for students with different skill sets makes this a strong example of metacognitive evaluation, demonstrating awareness both of herself and the needs of others.

In fact, noted improvement was not necessarily an indicator of their ability for metacognitive evaluation. While Frances identified a high level of improvement for her learning, her description of strategy was much looser than Claire's, focusing as much on peripheral issues, so that while she claimed, 'annotation really helped me a lot', she did not really identify features of that strategy she found useful, instead claiming:

With the Mark Up and the weekly task, it forced me to do my readings every week so that i won't fall behind. its great too coz all the mark up task is stored on the web. and i can retrieve it from uni or home or anywhere i am.

Yvette too, observed some improvement in her performance by mimicking the techniques of Mark-UP though she did not eventually use the tool directly. She claimed 'it helped me to learn', but was vague in what she attributed the improvement too, stating, 'I'd use Mark-UP next time... I like the annotations' but adding little beyond that.

Brian's self-evaluation demonstrated a clear sense of improvement. While most of the other subjects identified this in terms of strategies used, Brian was more focused on his initial plans:

The ways in which is mentioned i could change my Mark-Up to achieve a better score have come into practice, with the addition of adding a url to each reading and adding at least 4-5 annotations per reading. My understanding of the course has changed throughout the semester, I feel now that I have a better grasp on designing programs that the user "wants to" rather then "has to" interact with.

While the noted improvement is pleasing, once again, this was not a response that demonstrated strong metacognitive evaluation. His evaluation was in keeping with his initial focus on performance and effort in his plans. As such it was more formalistic in its approach.

Success was measured by the amount of posts he made. While he claimed that his understanding had changed throughout the semester, the vague platitude that accompanied the statement suggests that these were inadequate plans to fully engage the subject in metacognitive evaluation.

The same was true for Dean, who also evaluated himself against his performance goals, and who also tended to discuss things in somewhat vague terms:

> *think that i have started to say a bit more on my mind compared to earlier, however i think that it will be a while until i am able to fully convey my thoughts across through this form. Although i much prefer it this way compared to other methods. Hopefully my marks will show this.*

The two most interesting responses could be found in Belinda and Debbie's responses. Neither of them perceived any change at all in their performance. In fact, both subjects felt they had deteriorated. Debbie was able to acknowledge some improvement in confidence, but claimed 'I don't feel I produced such quality work as I had in the first half of semester due to time limits vs. workload'. Belinda's response was much more targeted to the value of Mark-UP for her. Claiming the reading activities were 'Busy-Work', she felt little value in maintaining activity towards the end of the semester:

> *My overall performance for the semester has been excellent... but my participation in the markup activity since week 7 has been minimal (out of pure rebellion boardering on defiance perhaps)*

7.3.3 Conclusions about the metacognitive nature of interview subjects' evaluations

A summary of findings related to interview subjects' planning and evaluation is found in Table 7.1. Subjects were interpreted as achieving certain levels of evaluation based upon the nature of their evaluations and the extent to which they could abstract from the object form, such as a reading or a specific technique, to a meta-level involving critique, a description of personal relevance and so on. All the levels were interpreted by the researcher, except for perceived improvement, which was described by subjects in their final evaluations. The three subjects who did not complete the final evaluation are marked with *(int)* to represent the fact that their improvement was interpreted by the researcher, based upon their interview responses rather than the subjects' own stated perceptions.

Table 7.1: Summary of interview subjects' Planning and Evaluation in Mark-UP

	Interpreted Level	Planning			Initial Evaluation			Final Evaluation		Evaluation -
Name	**of Metacognition**	**Goal Orient.**	**Type**	**Interpreted Level**	**Reading**	**Strategy**	**Self**	**Perceived Improvement**	**Focus**	**Overall Interpreted Level**
Dean	Low	Performance	None	Medium	N/A	N/A	N/A	Low	Plans	Low
Yvette	Low	Performance	None	Low	N/A	N/A	N/A	Low (int)	strategy	Low
Frances	Low	Mixed	None	Low	Low	Medium	Low	High	Mixed	Medium
Brian	Low	Performance	Effort	Medium	Medium	Medium	Low	Medium	Plans	Medium
Craig	Medium	Learning	Effort	High	N/A	N/A	N/A	Low (int)	Strategy	Medium
Sylvia	Medium	Learning	Learning	Medium	High	Medium	Medium	High	Mixed	Medium
Jake	Medium	Mixed	Learning	High	High	Medium	Low	Low (int)	Strategy	Medium
Duncan	Medium	Performance	Effort	Medium	Medium	Medium	Low	Low	Strategy	Medium
Claire	High	Mixed	N/A	High	High	High	High	Medium	Strategy	High
Belinda	High	Learning	Effort	High	High	High	Medium	None		High
Debbie	High	Mixed	N/A	High	N/A	N/A	N/A	None		High
Alan	High	Performance	Effort	Medium	Medium	Medium	Medium	Low	Mixed	Medium

Examining this table it appears that some patterns exist between subjects in the way they conducted evaluations throughout their use of Mark-UP. The following findings are discussed below:

- Mark-UP provided a means for subjects interpreted as highly metacognitive to demonstrate evaluation at a commensurate level; however Mark-UP was not highly valued by these students and appeared at times to duplicate or hinder existing metacognitive processes;
- subjects interpreted as metacognitively weak did not appear to demonstrate the full range of evaluation types, suggesting Mark-UP was limited in its ability to promote the types of evaluation most associated with metacognitive self-monitoring; and
- there appeared to be a 'sweet spot' in terms of Mark-Up's ability to support metacognitive evaluation for subjects interpreted as metacognitively moderate, who were able to use the product to demonstrate a broad range of evaluation types.

The generally few number of responses to these activities suggested that evaluation was not perceived as highly relevant by these students. The fact that there was little in the way of clear 'assessment' attached to the evaluation activities may have been indicative of the overall emphasis on performance rather than learning goals, though there were still two subjects who identified mixed or learning goals who did not complete all aspects of the activities. Nevertheless a pattern emerged within the evaluations that indicated a clear tendency for subjects who were interpreted to be at a high metacognitive level to evaluate their performance at a higher level of abstraction than those subjects who were interpreted as operating at a lower metacognitive level. Apart from Debbie, from whom there was a lack of data, all of the other interview subjects interpreted as highly metacognitive could evaluate at the object-level, easily describing the difficulties they had with readings, and at the process level, evaluating the effectiveness of the strategies used. These subjects also indicated medium to high levels of self-evaluation, demonstrating an awareness of their evolving learning processes. This could not be said of the other students. Typically, the lower level of metacognition was indicative of responses that tended to base evaluations on the strategies or readings.

Perceived improvement did not necessarily tie in closely to subjects' interpreted overall metacognition or ability to evaluate themselves metacognitively. In fact an inverse relationship appeared to be true for those subjects already interpreted as operating at a high metacognitive level. For these subjects, Mark-UP appeared to be a hindrance rather than a help, and subjects' ability to articulate the weaknesses they perceived in the product still indicated a strong level of metacognitive evaluation. There appeared to be little development

in the weaker subjects either. While Frances felt she had improved greatly as a learner, the vague means by which she attributed this improvement still only had her interpreted at a medium level of metacognitive evaluation.

There appeared to be a metacognitive 'sweet spot' in terms of the potential for Mark-UP as a tool for promoting evaluation. While the strongest subjects were quite capable of evaluating their performance they appeared to derive little benefit from it. The weaker subjects tended to provide limited evaluations of themselves as learners. It was the subjects who were interpreted as indicating a medium level of metacognition that appeared to derive the greatest benefit from the process. This middle group of subjects all appeared able to evaluate at the levels of reading, strategy and self to some extent. They were also best able to describe improvement in their learning and attribute that improvement to strategies. While the traditional model of self-monitoring involves evaluation of plans, one could argue that the focus on strategy was not a weakness here. In fact it was the weaker students who evaluated their plans, and these evaluations tended to demonstrate less self-awareness than those that evaluated strategies. For several of the students, such as Duncan and Craig, the focus on effort and performance seems to have been replaced by a focus on strategy in their evaluations. This suggests that a continuous cycle of planning and evaluation has been taking place, leading to probably informal revision of their initially limited plans.

7.4 Conclusions about the role of Mark-UP in supporting evaluation as a component of self-monitoring

This chapter has explored research question 6, which sought to examine how Mark-UP supported subjects' evaluation as a component of self-monitoring. The analysis of subjects' evaluations conducted at formal points throughout their use of Mark-UP during the semester indicated that subjects showed a range of types of evaluation and that the types subjects engaged in had some correlation with their interpreted level of metacognition. The reductivist nature of distilling the analysis of the complex activity that subjects engaged in while using Mark-UP into discrete points must be acknowledged. Nevertheless, in exploring how the product supported subjects in metacognitive evaluation the following findings can be made:

- engaging subjects in explicit evaluation through Mark-UP allowed a range of evaluation types to be generated, many of which were metacognitive in nature;
- the increased focus on strategy evaluation and perceived change in themselves as learners as subjects were using Mark-UP suggested that the metacognitive nature of evaluation evolved as they engaged in a second iteration of evaluation;

- Mark-UP appeared to work best for those subjects identified as metacognitively moderate than for the weaker and stronger students; and
- the continuous use of the tools within appeared to contribute to subjects' development of their evaluation as much as the explicit processes of evaluation and planning that subjects engaged in.

To expand on these points, while plans that were based upon performance goals rather than process goals tended to be less indicative of metacognitive activity, the fact that these goals appeared to change for at least a few subjects suggests that Mark-UP did engage students effectively in evaluation of their thinking processes.

These evaluations provided evidence of multiple levels of metacognition, from low level evaluations of the readings, to more abstracted discussions of the strategies they used, leading to highly metacognitive evaluations of themselves as learners. While initially it appeared that only those subjects interpreted as operating at a high level of metacognition were also evaluating themselves metacognitively, the increased focus on strategy evaluation while subjects were using Mark-UP suggested a dynamic that involved a high level of self-monitoring. Since the activities that took place during semester that had them formally planning and evaluating themselves were limited, and not tied implicitly to the tools and activities in which subjects were engaging on a weekly basis, it is encouraging that many of the subjects, when evaluating their performance at the end of the semester, indicated some change in themselves as learners. This lends support for the conclusion that evaluation is a continuous process.

The process of collating work through the Portfolio tool and evaluating learning by responding to questions using the Design Problem tool enabled a range of evaluation types to be demonstrated in the first iteration of this process. It was only in their final evaluations, however, where subjects reflected on their learning based upon the strategies they used throughout the semester and the plans they formulated following their mid-term evaluation and feedback, that the evaluations tended to demonstrate a deeper level of abstraction. It is not surprising that the second iteration was found to provide more evidence of metacognitive evaluation than the first, but the causality of this is still in question. Certainly the evidence of subjects' evolving plans and increased focus on learning strategy suggested that the defined activities of planning, portfolio review and responding to evaluation questions were valuable in contributing to the development of subjects' self-monitoring. However, the consistent reference to the tools within Mark-UP when students evaluated their strategies for learning, particularly in the end of semester's evaluation, indicated that the implicit processes which Mark-UP promoted may have also had a strong influence.

As the final point suggests, it would appear that beyond the defined activities of planning and evaluation in Mark-UP, such processes were also inherent in the activities of working with the readings, developing their understandings of the content through the use of the tools and applying them to design problems. This monitoring formed the basis of most of the activity in which students engaged while using Mark-UP, and therefore the next chapter requires a detailed exploration of the self-monitoring involved in reading activities and completing design problems, in order to characterise the nature of the self-monitoring as a means of promoting metacognitive activity, and the value of the tools within Mark-UP for assisting with this.

8 Exploration of how Mark-UP Supported Subjects' Monitoring as a Component of Self-Monitoring

This chapter reports the findings for the final research question, exploring how subjects engaged in self-monitoring through their use of Mark-UP. It has already been discussed how self-monitoring is a process that takes place through an evaluative feedback loop which consists of the components planning, monitoring, and evaluation. The roles of explicit planning and evaluation and the potential of Mark-UP as an environment to promote such processes have been discussed in Chapters Six and Seven. This chapter explores how Mark-UP was seen to support subjects' monitoring as a component of self-monitoring.

As the centre of the self-monitoring loop, monitoring itself is the process that provides the cognitive basis for planning and evaluation. Despite its centrality, it is also the least accessible component to research, since it is an internal process demonstrated by the planning and evaluation that are dependent upon it. In Mark-UP, specific instances have been identified where students were required to make plans or evaluate their performance. Monitoring, however, was a process that was integral to much of the activity within Mark-UP. Subjects' use of annotation, summary, discussions, problem solving and so on, all involved an element of monitoring. Monitoring was an inherent process in transforming concepts beyond a specific situation referred to in a reading to solve a problem, for example, or in gauging understandings by reflecting on other students' comments.

The purpose of this chapter is to describe how Mark-UP supported monitoring as a component of the self-monitoring process. Butler and Winne (1995) identified the key process in monitoring as 'internal feedback'. Unlike evaluation, it is an internal and, the authors contend, possibly unconscious process since it takes place at a high enough level of granularity to be automated. However, despite its elusiveness, it provides the basis for re-evaluation of plans and cognitions:

> *Goals are ... approached by applying tactics and strategies that generate products, both mental (cognitive and affective/emotional) and behavioral. Monitoring these processes of engagement and the progressively updated products they create generates internal feedback. This information provides*

grounds for reinterpreting elements of the task and one's engagement with it, thereby directing subsequent engagement. (Butler & Winne, 1995, p. 245)

Zimmerman & Martinez-Pons (1986) propose 14 categories of self-regulatory activity which specifically identify planning (goal setting and planning) and evaluation (self-evaluation, reviewing), as well as volitional components (self-consequences, environmental structuring) (cited by Young & Ley, 2003). Among them, four types of activities are particularly relevant to the concept of monitoring, since they are indicative of general cognitive monitoring rather than discrete components:

- organising and transforming;
- seeking information;
- seeking assistance from peers; and
- seeking assistance from experts and teachers.

While the last three of these may appear to be external rather than internal forms of feedback, in fact their role is in guiding the generation of internal feedback. Butler and Winne (1995, p. 248.) argue:

External feedback attending high-confidence errors will trigger monitoring that generates internal feedback in the form of functional validity information (e.g., the relationship between the learner's estimate of achievement and actual performance). An important corollary of this logic is that learners do not enter tasks as monitoring "blank slates." Self-regulation is inherent when conditions highlight inadequacies of calibration.

In other words, external conditions create a cognitive dissonance within the learner that engages them in the above regulatory activities using internal feedback to guide the process.

In order to examine how these processes were supported within the product and across the range of users of Mark-UP, the breadth of monitoring types needed to be identified and then analysed in terms of their value for supporting self-monitoring. The exploration of monitoring was therefore approached in two ways:

1. The role of the tools within Mark-UP in supporting different types of monitoring was explored by examining artefacts from the tools. With the annotation and Design problem tools being the most flexible and broadest in terms of the nature of monitoring demonstrated, this exploration was therefore conducted in three stages:
    - exploring monitoring in the Annotation tool;
    - exploring monitoring in the Design Problem tool; and

- exploring monitoring in the remaining tools within Mark-UP

Since the internal feedback itself was not evident in the subjects' portfolios, this was interpreted by exploring how the tools supported subjects' articulation of ideas, drawing inference from information, comparing their ideas with others, and questioning concepts. The types of monitoring discovered formed the basis of the second inquiry.

2. The second stage of the study was to explore the role of Mark-UP in supporting monitoring across a range of interpreted metacognitive levels and goal orientations. This exploration was conducted through more detailed analysis of the 12 interview subjects' portfolios and comments in interviews.

As with the analyses of planning and evaluation, some conclusions were then able to be made about those students for whom Mark-UP was most and least effective for monitoring and why.

8.1 Exploration of roles of the tools within Mark-UP in supporting monitoring

In Mark-UP, there were a number of types of activities that involved monitoring processes. The core of the product was the Annotation tool, which allowed students to add comments to a particular part of a text and to engage in a dialogue with other students about a particular issue. In this sense, it could involve each of the four help-seeking activities described earlier. It also provided a means for the articulation of knowledge and beliefs, and the modification of such beliefs, all of which could be attributed to the internal feedback mechanism inherent in monitoring. The Forum Discussion tool also provided an opportunity for learners to engage in these processes in a more general and discursive way, and the URL Posting tool allowed the regulation of understandings through further peer interaction by the identification, posting and rating of websites.

While the URL posting tool's focus on finding alternative sources of information involved some organisation and transforming, these complex activities were the basis of the Design Problem tool, in which students were required to use their understandings and apply them to a specific design problem.

To provide a means of discussing how Mark-UP supported the different types of monitoring, comments made by students within each tool were categorised and analysed according to the monitoring processes that informed them. These categories, based upon those proposed by Zimmerman & Martinez-Pons (1986), took the following forms:

- questioning, demonstrated by subjects' interrogating concepts and seeking assistance from peers about a particular issue;
- comparing ideas, demonstrated by the generation of a body of knowledge within a series of annotation by subjects adding to a concept, providing an alternative point of view;
- seeking information, demonstrated by subjects drawing from their direct experience, and connecting to other forms of information such as websites or readings; and
- organisation and transfer, demonstrated by the effectiveness of summaries and the ability to apply readings to solve different problems.

In the following section, each of the tools is discussed in terms of the types of response students made and how they provided evidence of the above forms.

8.1.1 Exploring monitoring within the Annotation tool

The design of the Annotation tool provided several categories which facilitated identification of the types of annotations students could make within the tool. Specifically students identified their annotation as belonging to one of the following types.

- Agree;
- Disagree;
- Summary;
- Question; and
- General Comment

As has been discussed in Chapter 5, many students found these categories somewhat arbitrary, and argued they did not effectively characterise the types of comments they were making. While few students were able to articulate specific replacement categories (comments tended to be quite general, ranging from there being too many categories, inappropriate categories, and not enough categories) it is evident that students did not think of their own activity along the lines. This issue was also exacerbated by the abstract nature of the emoticons used to identify them.

Additionally, in identifying a type of comment, the above categories do not actually suggest an underpinning monitoring process. While questioning can be considered indicative of monitoring, since internal feedback is used to generate the question (possibly as a result of cognitive conflict when confronted with an idea or issue that is difficult to reconcile with

existing understandings), the categories *agree*, *disagree*, *summary*, and particularly *general comment*, appeared to be too broad to subjects to be aligned to a specific monitoring process.

In fact, the *general comment* category was by far the most widely used within the Annotation tool, with the *agree* and *question* categories making the bulk of the other comment types. In order to explore these annotations in terms of monitoring. therefore, the first step taken was to review a series of annotations to identify the monitoring processes that informed them.

Seven examples of annotation were analysed. These came from the following readings:

Example 1: Reading 4 - Park & Hannafin (1993). This reading was selected as it represented the first time that all of the tools including annotation were available to the students. Since it was a reading that was identified in Chapter 5 as one of the more difficult ones for students it also provided a means to explore how subjects dealt with such readings. It also represented the first time students were required to complete the annotation activity, therefore supplying a large number of posts across the broadest range of students

Examples 2-5: Reading 5 – Fetherston (1997). This reading formed the main one for the analysis of monitoring. It was presented to students after they had become familiar with the Annotation tool. Since annotation was not a compulsory activity that week, it also provided the most authentic use of the tool as it enabled an exploration of the various purposes for which subjects chose to use annotations.

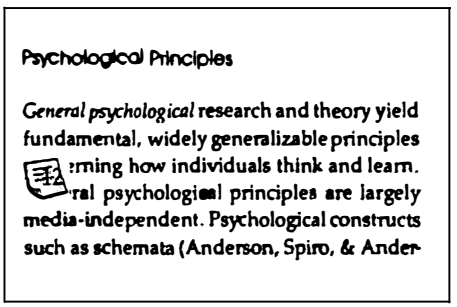
Example 6 & 7: The two readings by Newby et al. (2000) and Nielsen & Tahir (2002) were chosen for two reasons. Firstly they were qualitatively different from the previous examples in that they were both from books rather than articles. The discursive nature of the Newby et al. (2000) reading was also quite different from the bullet point nature of the Nielsen & Tahir (2002) reading. Secondly, they were also the two other readings that received the most annotations as shown in Chapter 5.

The reading examples themselves were selected randomly with the only criteria being more than five posts to provide some substance for analysis. It was found that seven examples provided a range of types of annotations, and that others did not contribute anything extra to this.

Each series of annotations is presented here in total to preserve the integrity of the discussion.

Example 1

The first example was taken from Park & Hannafin (1993). Figure 8.1 shows the section of the reading that was annotated in this example. It shows the role of psychology as a basis for the understanding of teaching and learning processes.



Psychological Principles

General psychological research and theory yield fundamental, widely generalizable principles ...rning how individuals think and learn. ...ral psychological principles are largely media-independent. Psychological constructs such as schemata (Anderson, Spiro, & Ander-

Figure 8.1: Original reading section about psychological principles

As can be seen from Figure 8.2, much of the discussion about this section of the reading regarded the nature of the reading itself. As such it provided a good example of metacognitive regulation of reading comprehension, albeit in an external critical mode rather than an internally reflective one. The main basis for discussion centred on the first comment, a single line summary of the paragraph. It appears that this initial rephrasing of this paragraph made the concept more accessible other students. Certainly, the negative comments such as 'complex wording for a simple message' and, 'I think some of the terms could be better explained' indicated a level of frustration with the manner in which the article was written. Two of the subjects resorted to using a dictionary while reading the article.

View existing annotations: | **Create new annotation**

[redacted] wrote... [respond]

How people think & learn. The psychological implications for learning system design

[created on: 2003-08-29 15:30:48]

[respond]

"quoted [redacted] .. How people think & learn. The psychological implications for learning system design..."

[redacted] wrote...

Couldn't they just say what you just simply said? They make it sound so complicated on something which is quite simple to grasp!!!

xjx

[created on: 2003-09-03 09:21:44]

[respond]

"quoted [redacted] .. Couldn't they just say what you just simply said? They make it sound so complicated on something which is quite simple to grasp!!!

xjx..."

[redacted] wrote...

i agree - complex wording for a simple message. Psychological principles are such a difficult concept to include though, especially as the way individuals think and learn will vary considerably based on their past experiences, culture, and surroundings. All a little crazy for me - imagine the possibilities!

[created on: 2003-09-03 09:50:55]

[respond]

"quoted [redacted] .. i agree - complex wording for a simple message. Psychological principles are such a difficult concept to include though, especially as the way individuals think and learn will vary considerably based..."

[redacted] wrote...

This is fairly "non-in-depth" view of the psychological principals as entire fields of study revolve around this very subject. No doubt you were subjected to some of the outcomes of the research throughout your schooling. This is what education and learning is based upon.

[created on: 2003-09-03 10:24:43]

[respond]

"quoted [redacted] .. This is fairly..."

[redacted] wrote...

I think some of the terms should be better explained. I had to read this document with a dictionary in one hand and the reading in the other. Apparently Schemata is a product of imagination in accordance to rule. (Macquarie Essential Dictionary. (2000). Macquarie Library, Australia. (p. 578)).

[created on: 2003-09-03 11:33:58]

[respond]

"quoted [redacted] ... Couldn't they just say what you just simply said? They make it sound so complicated on something which is quite simple to grasp!!!

xjx..."

[redacted] wrote...

you got that right - they try their hardest to expalain stuff with the most un-

Figure 8.2: student annotations about psychological principles

Given the apparent difficulty of the concept of psychological principles for the subjects, one way in which understandings were monitored was through a process of information seeking, drawing in a dictionary definition of schemata to assist in understanding it. Whether this was an effective approach is debatable. The fact that no-one responded to this comment could mean either the meaning was self-evident, or even more confusing. Given the source of the definition as a generic dictionary rather than a text on cognition, it is tempting to suspect the latter.

Example 2

The next three examples are sourced from the Week 5 reading (Fetherston, 1997).

The Week 5 reading sought to explore models of instructional design that were appropriate to multiple orientations to learning. The section of the reading below that subjects annotated emphasises the importance of the design context in choosing or developing an appropriate model (Figure 8.3).

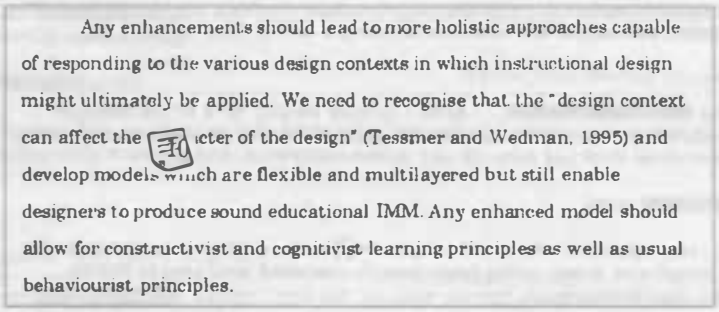

Any enhancements should lead to more holistic approaches capable of responding to the various design contexts in which instructional design might ultimately be applied. We need to recognise that the "design context can affect the [illegible]acter of the design" (Tessmer and Wedman, 1995) and develop models which are flexible and multilayered but still enable designers to produce sound educational IMM. Any enhanced model should allow for constructivist and cognitivist learning principles as well as usual behaviourist principles.

Figure 8.3: Original reading section about design context

The annotations of this section were more typical of the types of annotation subjects tended to make than those presented in Example 1. The majority focused on the actual content of the section, and the subjects' understandings of it (Figure 8.4).

The first comment, with its discussion of appropriate images for children and certain types of products, while effectively drawing real examples of design context in terms of audience and content, was somewhat off-topic since it did not address the issue of appropriate design models for a specific context. It is not surprising that two of the follow-up comments to this provided somewhat weak rephrasing of the section. Statements such as 'agree.. a theme influences all design characters' and 'design context does affect the character of design' added little to the discussion, the former in fact being quite awkwardly and confusingly stated. It is only in the third response to the initial comment that a strong evidence of monitoring became apparent. Here, monitoring was evident in the way in which the subject refocused the discussion on design models rather than design content. In explaining the paragraph and how it 'is suggesting the model should be flexible enough to allow for cognitive and constructivist learning principles' the author provides a point from which another subject was able to extend as well as draw in the value of the original off-topic post: 'I think they got the wrong end of the stick, yes the article is related to the models for instructional design and design methodologies versus actual web design. But their points are no less valid, just in the wrong context.'

View existing annotations: **Create new annotation**

[redacted] wrote... [respond]

Important point here. "design context can affect the character of the design". Of course it does, you shouldn't use explicit images on a site aimed at children (although this does happen quite a lot) and sites aimed at people researching cars, should include images and information on cars and so on. However this doesn't mean that the design principles have to be absolutely adhered to...a little flexiblity means more creativity.

[created on: 2003-09-28 09:26:34]

"*quoted [redacted] ... Important point here....*" [respond]

[redacted] wrote...

agree... a theme influences all design characters.

[created on: 2003-09-02 08:49:56]

"*quoted [redacted] ... Important point here....*" [respond]

[redacted] wrote...

yes i agree, this is an important point, design context does affect the character of design.

[created on: 2003-09-02 22:10:27]

"*quoted [redacted] .. Important point here....*" [respond]

[redacted] wrote...

I think that the article deals with models for instructional design and design methodology rather than web site design. What they're saying is that the model (or project methodology) used when creating instructional design can impact on the finished product. The author is suggesting that the model used should be flexible enough to allow for cognitive and constructivist learning principles, not just behaviourist principles.

[created on: 2003-09-03 12:03:01]

"*quoted [redacted] . I think that the article deals with models for instructional design and design methodology rather than web site design. What they're saying is that the model (or project methodology) used when creatin...*" [respond]

[redacted] wrote...

I agree and seem to think the model they are suggesting is that design methods should allow constructivist, cognitivist, and behaviourist learning principles while also being flexible and multilayered, but still enable educational interactive multimedia.

[created on: 2003-09-03 16:27:04]

"*quoted [redacted] .. I think that the article deals with models for instructional design and design methodology rather than web site design. What they're saying is that the model (or project methodology) used when creatin...*" [respond]

[redacted] wrote...

Indeed, the best instructional design is already a design that categorized as cognitive and contain constructivist learning ideas. Yeah, this writer is basically honest with his writing. Design context can affected the character of design,

[created on: 2003-09-03 16:41:57]

"*quoted [redacted] . I think that the article deals with models for instructional design and design methodology rather than web site design. What they're saying is* [respond]

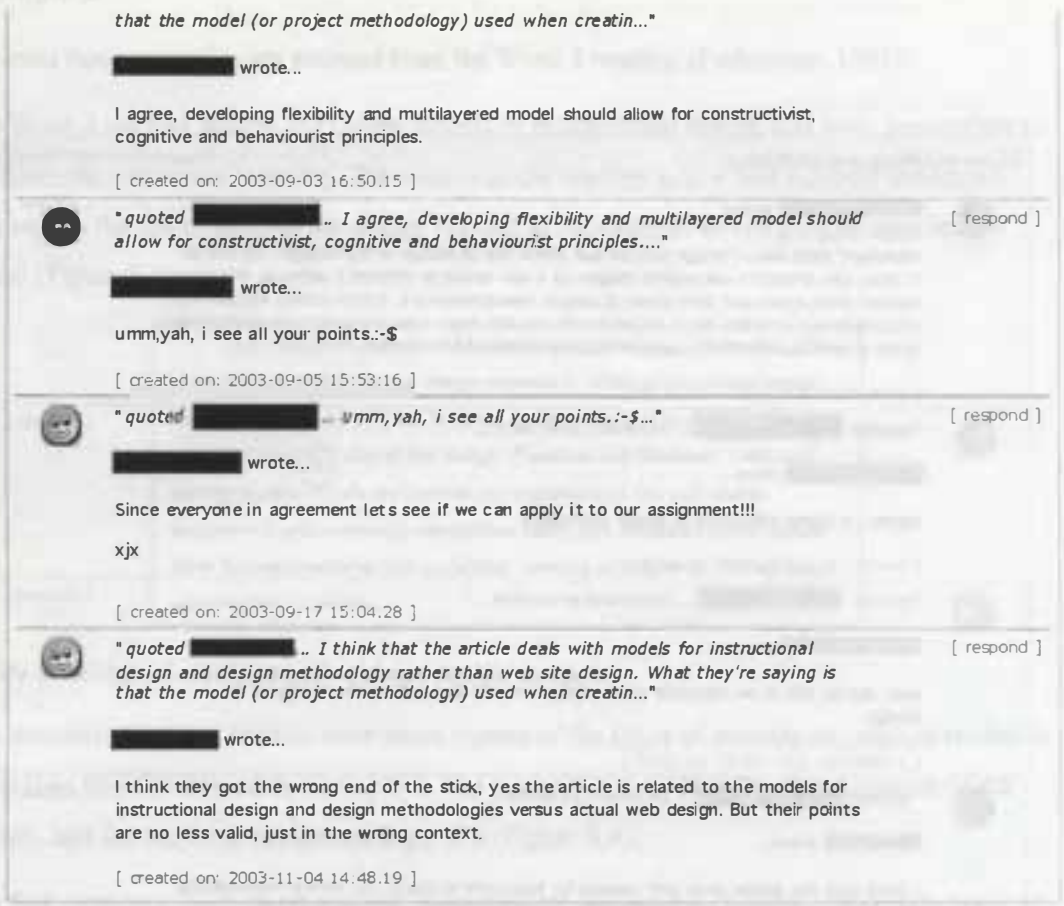


Figure 8.4: Student annotations about design context

Essentially there appeared to be two threads to these annotations. The first consisted of simply rephrasing or agreeing, and represented weaker evidence of monitoring than the second thread which demonstrated an attempt to clarify the concept of context in design models. Although the comment 'umm, yah, I see all your points.:-$' may have been evidence of that subject's developing understanding of the material through monitoring, the fact that it added little to the knowledge base about the role of context in design models suggested a more limited understanding.

Example 3

The examples discussed so far have predominantly evidenced monitoring in the forms of rephrasing the content of the section (in effect a brief summary) and of clarification of its main ideas. However these were not the only forms of monitoring that took place within the Annotation tool. Example 3 focused on the role of prior knowledge in cognitive learning (Figure 8.5) and along with Examples 2 and 4 was sourced from Fetherston (1997).

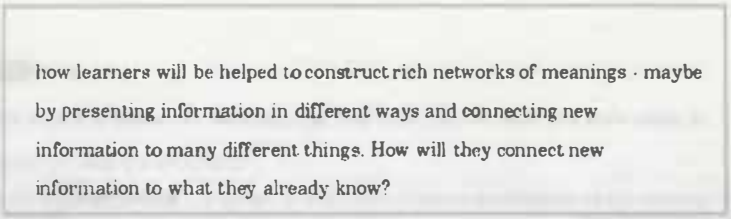


Figure 8.5: Original reading section about connecting to prior knowledge

This section of the reading created a number of annotations, most of which directly addressed the issue of how learning is enhanced by connecting existing understandings with new information. The first comment demonstrated information seeking as an approach to monitoring (Figure 8.6). By directly drawing an allusion to a previous reading, the subject was able to both emphasise and expand on the point made in Example 3. As well as information seeking, monitoring was also manifested in the questioning and answering that allowed subjects to identify and seek to address inadequacies in their understanding of the material. The questions 'how do you determine what the potential users already know?' and 'How do you build on their existing schemata, when they will differ from individual to individual?' both sought clarity about the issue as well as extended beyond the main concept to the practical implementation of those ideas.

This demonstrated monitoring at a high level and created a cumulative body of information that added to the value of the reading itself. It also evidenced an orientation to the transformation of understandings to a new setting, which was another type of monitoring. The strength of this series of annotations was that the environment promoted the articulation of potential answers to the questions posed. The comments that suggested an analysis of the backgrounds of the target audience, pointed to examples with teaching computer aided design to existing designers as opposed to bricklayers, or suggested under- rather than over-estimating the pre-existing skills of the user, all added a piece of information to the conversation to build up a more complete picture for learners.

View existing annotations: **Create new annotation**

[redacted] rote... [respond]

This refers back to the last reading about the Principles of IMM Design. Principle 2 - "New knowledge becomes increasingly meaningful when intergrated with existing knowledge".

The role of the designer is to connect their existing knowledge to the new knowledge that is being presented to them.

[created on: 2003-09-02 12:03:19]

"*quoted [redacted]..* [respond]

This refers back to the last reading about the Principles of IMM Design. Principle 2 -..."

[redacted] wrote...

I think this must be one of the most difficult steps in instructional design. How do you determine what the potential users already know? How do you build on their existing schemata, when they will differ from individual to individual?

[created on: 2003-09-03 12:38:09]

"*quoted [redacted].. I think this must be one of the most difficult steps in instructional design. How do you determine what the potential users already know? How do you build on their existing schemata, when they will di..."* [respond]

[redacted] wrote...

I agree. Is every user uniquely identifyable to the system so as to determine how much they already know?

[created on: 2003-09-03 16:56:18]

"*quoted [redacted].. I think this must be one of the most difficult steps in instructional design. How do you determine what the potential users already know? How do you build on their existing schemata, when they will di..."* [respond]

[redacted] wrote...

That is a very valid point. Learning is most effective when analogies can be drawn, or similar pre-existing knowledge of the user can be applied and related to.

[created on: 2003-09-04 01:36:34]

"*quoted [redacted]... That is a very valid point. Learning is most effective when analogies can be drawn, or similar pre-existing knowledge of the user can be applied and related to...."* [respond]

[redacted] wrote...

yep - i agree that it would be tough to pre-define what the end user knows. However, many multimedia-based products will have a target audience, and even if they have a variety of antipicated users, they will still be designed to cater for these groups of people. A website advertising hard-drives, for example, will assume that the browser will already have an initial idea about hardware, even though it could be at a basic level of knowledge for it.

[created on: 2003-09-04 17:17:56]

"*quoted [redacted].. I think this must be one of the most difficult steps in instructional design. How do you determine what the potential users already know? How do you build on their existing schemata, when they will di..."* [respond]

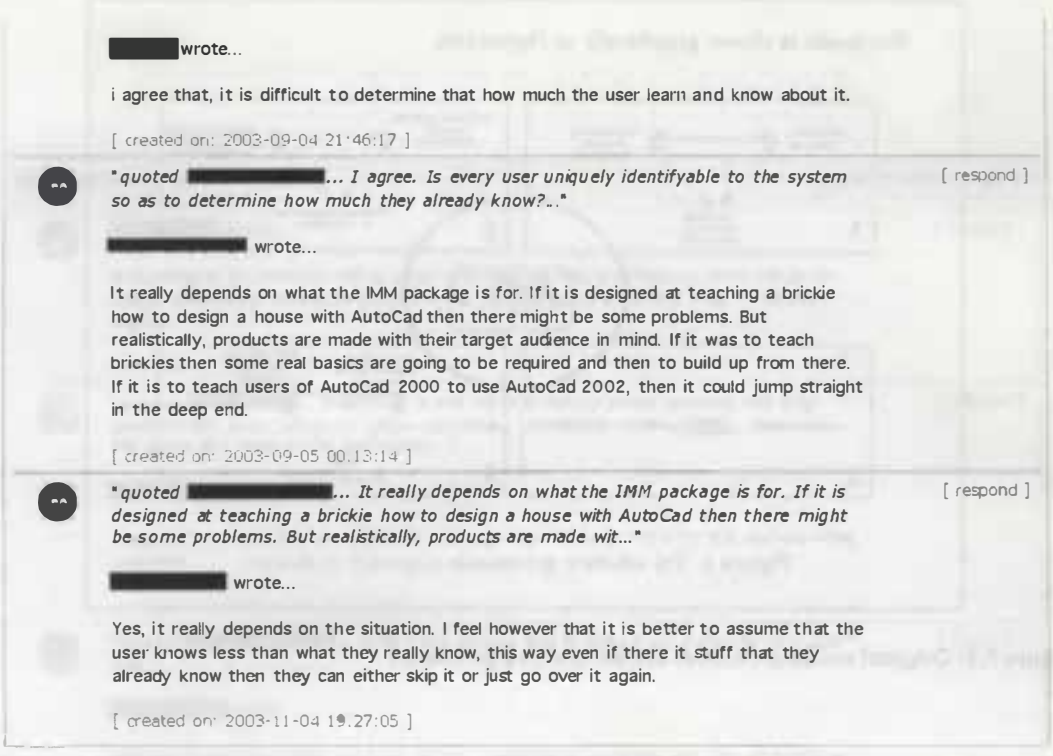


Figure 8.6: Student annotations about connecting to prior knowledge

Example 4

Example 4 was another set of annotations sourced from Fetherston (1997) and demonstrated how Mark-UP promoted monitoring through questioning and answering about a particular section of the reading. While this example came from the same reading as the two previous ones, it provided another form of monitoring. The section in question provided a diagram of a proposed model for instructional design (Figure 8.7) and manifested monitoring primarily in the forms of adding and rephrasing to build a discussion about the stages of design and the roles of evaluation (Figure 8.8).

The model is shown graphically in Figure one.

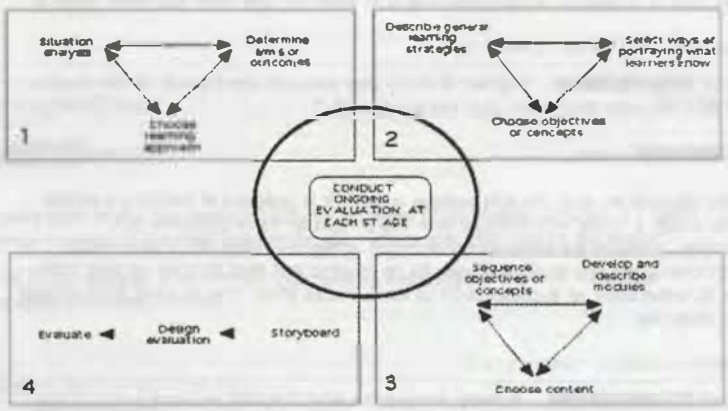


Figure 1: Yet another systematic approach to design.

Figure 8.7: Original reading section showing a design model

The first two comments added to this section were quite personal in nature and together formed a dialectic that framed the rest of the discussion – that of a systematic approach being a necessary evil in the design process. The discussion appeared to be triggered by the suggestion that it would be nice to 'just say "we'll try this and see what happens"'. This allowed ideas to be compared about how important a systematic approach is, with the contention 'by not evaluating or analysing one risks of having a poor product or a failed one'.

From that point monitoring was evident in the way in which the discussion evolved into a critique on the role of evaluation. In comparing their ideas, a focus was found that was obviously of relevance to the subjects who contributed, and this showed monitoring primarily through summarising and rephrasing ideas as well as adding to them. Statements such as summative evaluation being too late to inform design ('there's nothing worse to find out that you have missed out certain requirements') combined with claims about evaluation being integral to design, led to the final summative comment enforcing the iterative nature of design: 'you will need to go back and forth between deign and prototype via evaluation'.

View existing annotations: Create new annotation

[redacted] wrote... [respond]

everything in the world is talking about systems, not only professional, when we go to design something, we should analysis them, determine the goals and what would you expect

[created on: 2003-08-29 13:50:17]

"quoted [redacted] .. everything in the world is talking about systems, not only professional, when we go to design something, we should analysis them, determine the goals and what would you expect.." [respond]

[redacted] wrote...

Yeah... it'd be nice just to wing it for a change hey! Just say "we'll try this and see what happens".

[created on: 2003-09-04 23:55:44]

"quoted [redacted] .. Yeah... it'd be nice just to wing it for a change hey! Just say..." [respond]

[redacted] wrote...

But you forget one thing, the cost. By not evaluating or analysing one risks of having a poor end product or a failed one. Evaluation is important to check progress.

[created on: 2003-09-05 00:07:50]

"quoted [redacted] .. But you forget one thing, the cost. By not evaluating or analysing one risks of having a poor end product or a failed one. Evaluation is important to check progress...." [respond]

[redacted] wrote...

yea i agreed. without evaluation, you cannot gauge how well is the end product. There's nothing worse to find out that you have missed out certain requirements when you just declared the product completed!

[created on: 2003-09-05 12:33:21]

"quoted [redacted] .. yea i agreed. without evaluation, you cannot gauge how well is the end product. There's nothing worse to find out that you have missed out certain requirements when you just declared the product compl..." [respond]

[redacted] wrote...

Yeah I think evaluation is essential. You can't go through with a project only to find out at the end that its not a good product. Design flaws need to be discovered as early as possible.

[created on: 2003-09-09 23:08:52]

"quoted [redacted] .. Yeah I think evaluation is essential. You can't go through with a project only to find out at the end that its not a good product. Design flaws need to be discovered as early as possible...." [respond]

[redacted] wrote...

That is the reason way there is a design stage. To save time and plan out thoroughly what is to be expected and what problems may arise. It is all about working as efficiently and as effectively as possible to get the maximum and best result!!!

xjx

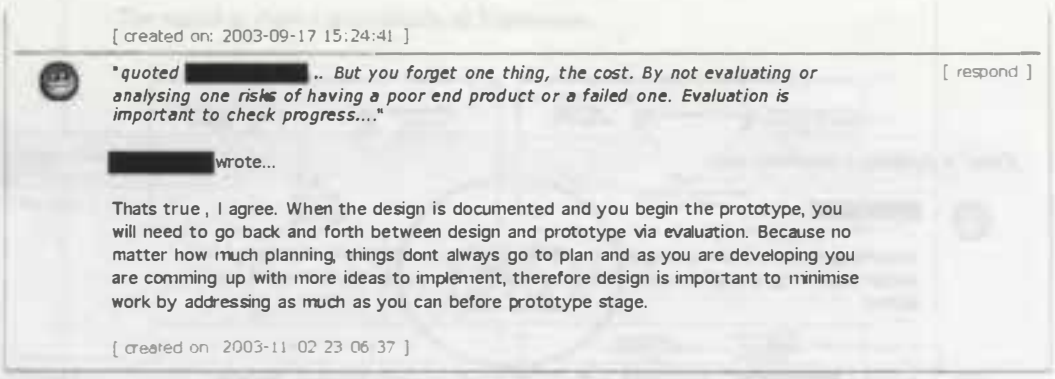


Figure 8.8: Student annotations about a design model

Example 5

This final set of annotations from Reading 5 (Fetherston, 1997) demonstrates another form of monitoring. This section of the reading discussed the role of learner attributes in informing design (Figure 8.9).

> *The attributes of the learner* such as age, gender, cultural background, prior learning, expectations of how they should be taught, special needs, reading ability, educational background, special interests, maturation level, the actual performance that has prompted the need for additional learning, what the learners already know, how the learners feel about the topic, how confident learners are about learning something new and amount and type of motivation, their stage of development; how learners feel about further learning on the topic and the time students have available for learning.

Figure 8.9: Original reading section about learner attributes

As Figure 8.10 shows, this section of the reading prompted a large number of annotations. What distinguished this sequence of annotations from the others previously examined was the use of the subjects' direct experience as a means of monitoring their understandings. While the first comment seemed somewhat unfinished, it prompted the question 'how do you create something that caters for everyone and at the same time maintaining the same standards?' As well as a good example of monitoring in the form of questioning itself, several subjects' responses to this annotation were able to use their own experiences to negotiate the issue in question. These related to the use of levels in gaming as a means of catering for individual differences, firstly in a general sense, then in one student's use of a specific example from a game to tie a concrete instantiation of the concept to the more general description.

View existing annotations: | **Create new annotation**

[redacted] wrote... [respond]

different people have different wants, that's something like the first years' economic.....

[created on: 2003-08-29 13:54:57]

"*quoted [redacted] .. different people have different wants, that's something like the first years' economic.....*" [respond]

[redacted] wrote...

So how then do you create something that caters for everyone and at the same time maintaining the same standards?

[created on: 2003-09-05 00:11:54]

"*quoted [redacted] .. So how then do you create something that caters for everyone and at the same time maintaining the same standards?...*" [respond]

[redacted] wrote...

I'm not quite sure if i understand what you are getting at but I have used different academic softwares as a child and have come across some that incorporate different levels for learners to go through. For instance, there could be beginner, intermediate, and advance levels, each with a slightly different interface to go with the difficulty level yet be in harmony with the design elements, eg. the color scheme.

[created on: 2003-09-05 11:13:01]

"*quoted [redacted] . I'm not quite sure if I understand what you are getting at but I have used different academic softwares as a child and have come across some that incorporate different levels for learners to go throug...*" [respond]

[redacted] wrote...

This is definately true with regards to having different levels, and especially if one were to start at easy and move on the the more difficult levels. But of course not to disorientate the user the design should remain the same.

[created on: 2003-09-05 11:27:10]

"*quoted [redacted] .. This is definately true with regards to having different levels, and especially if one were to start at easy and move on the the more difficult levels. But of course not to disorientate the user the d...*" [respond]

[redacted] wrote...

That's how some games are designed. In the fighting game *Soul Edge* for example, the beginner's stage has the same enemies as the Normal and Hard stages, but you do more damage and the enemies aren't that strong. There are extra rewards in progressing to harder stages.

[created on: 2003-09-05 11:55:10]

"*quoted [redacted] .. So how then do you create something that caters for everyone and at the same time maintaining the same standards?...*" [respond]

[redacted] wrote...

You have to compromise. You can't please everybody. thats why research into your target audience is essential before you start creating your product. you need to identify who you can target and who you can't.

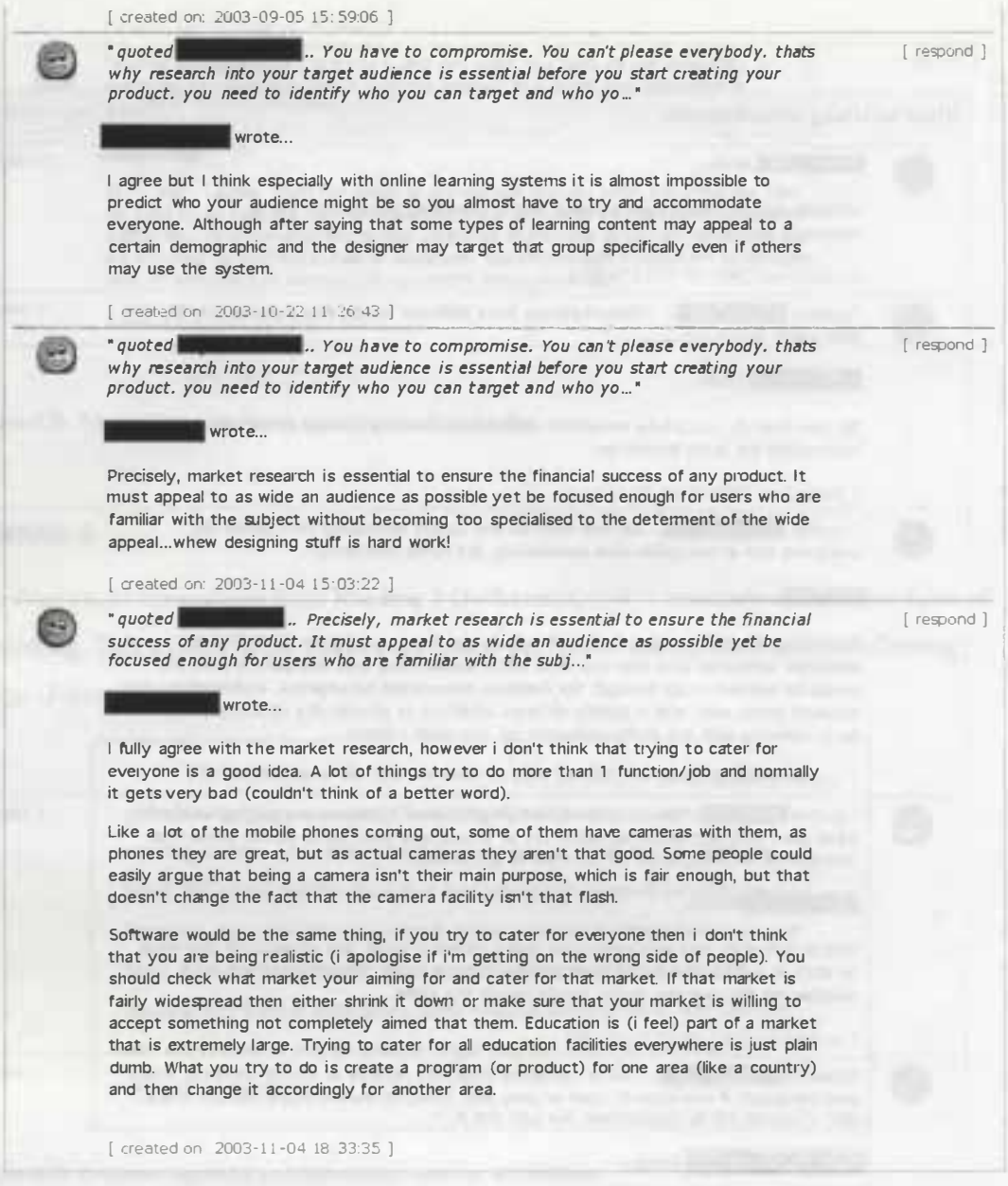


Figure 8.10: Student annotations about learner attributes

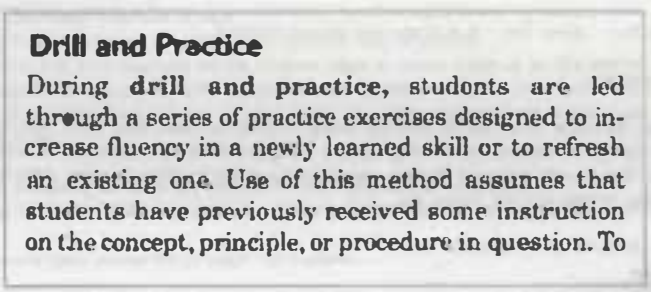
In fact, the Annotation tool promoted several forms of monitoring for this section of the reading. A parallel thread that was created was a discussion of whether in fact it was desirable to customise a product extensively. One subject warned that 'the design should remain the same' which evidenced monitoring through clarifying another subject's position, while a further annotation added to that in suggesting compromise. The understandings of this issue were then further modified by the following annotation which contended 'you almost have to try and accommodate everyone'. The final comments demonstrated each individual subject's monitoring in the way they summarised and tied the various threads together. While it could be argued the second to final annotation operated at the level of rephrasing rather than a

deeper reconfiguration of that person's understanding, the final annotation showed multiple forms of monitoring. The subject challenged a previous annotation ('I don't think trying to cater for everyone is a good idea'), drew on a direct example in comparing design to convergent devices such as phones, and then summarised many of the view points in the final paragraph: 'What you try to do is create a program (or product) for one area (like a country) and then change it accordingly.'

Therefore in this instance, Mark-UP's Annotation tool promoted multiple forms of monitoring that ultimately created a knowledge-base that added to the existing point, used examples from direct experience, provided multiple perspectives on the subject and then summarised and concluded at the end.

Example 6

This example was sourced from Newby et al. (2000). The paragraph that subjects annotated described drill and practice as a learning strategy (Figure 8.11). Although a different reading, this example demonstrated a similar pattern of monitoring to the previous one.



Drill and Practice

During **drill and practice,** students are led through a series of practice exercises designed to increase fluency in a newly learned skill or to refresh an existing one. Use of this method assumes that students have previously received some instruction on the concept, principle, or procedure in question. To

Figure 8.11: Original reading section about drill and practice

As Figure 8.12 shows, this section of the reading sparked a large number of comments, probably due at least in part to the fact that drill and practice was a familiar mode of learning for these subjects. It was not surprising, therefore, that this example also showed direct experience being one of the main referents against which subjects monitored their understandings. The first annotation evidenced monitoring in the forms of two examples. Firstly, the subject drew from personal experience in describing his mother's ability to rote learn and then broadened out into a practical example relating to interactive multimedia. This ability to transform from one domain to another is not something that was necessarily expected within the Annotation tool, since this aspect of Mark-UP was grounded in content rather than in a more general problem. Nevertheless, it appears that the Annotation tool certainly did not prohibit this kind of monitoring.

View existing annotations: **Create new annotation**

[redacted] wrote... [respond]

very behaviorist. excellent for long term memory, but what about understanding. knowledge without application is a bit of a waste i believe. my aged mother - bless her - is a proponent of this method. she after a good many years on this planet can still rattle off in an instant things that she learned many years ago in school. back then, D & P was all the rage.
moving to IMM, i have a (number of) applications designed to teach me to speak french. out of all of them, Think & Talk French is probably the best. it uses drill & practice - écouter, répété' - to encourage the user to speak the lingo. the lessons are situational, so that you learn by context. so teach you what le voiture means, you here the sound of a car.. it also has tests and little games to reinforce your learning.

[created on: 2003-09-17 12:38:45]

[redacted] wrote... [respond]

I always find practice is useful to remember some kind of knowledge. During the practice I will create mistake. After I solve the problem, I will memorize the concept better, and I will feel that the knowledge is really useful for my life. I also feel that solve a problem it is a challenge.

[created on: 2003-09-25 16:14:58]

"quoted [redacted] .. very behaviorist. excellent for long term memory, but what about understanding. knowledge without application is a bit of a waste i believe. my aged mother - bless her - is a proponent of this method...." [respond]

[redacted] wrote...

Yes but it has its place. When you're teaching young children to count, they don't have to ponder why we use the decimal numbering system - they just have to remember the order of the digits. This is only achieved thorugh repetition but it can be done in many different ways, including games, stories, songs etc.

[created on: 2003-09-26 12:58:24]

[redacted] wrote... [respond]

Practicing is a good way of remembering tasks because majority people tend to forget information given. It is a repetition of doing something and from there you'll get use to it. For example, driving a manual car. Each time you practice, the better you will improve your driving skill.

[created on: 2003-09-29 10:43:56]

"quoted [redacted] .. very behaviorist. excellent for long term memory, but what about understanding. knowledge without application is a bit of a waste i believe. my aged mother - bless her - is a proponent of this method...." [respond]

[redacted] wrote...

Drill and practice is a good way of teaching language. I remember doing Japanese, we had to engage in oral drills with the teacher as we walked into the class. It was almost a simulation, using the Japanese language in the real world.

[created on: 2003-10-02 16:24:04]

"quoted [redacted] .. Yes but it has its place. When you're teaching young children to count, they don't have to ponder why we use the decimal numbering system - they just have to remember the order of the digits. This is..." [respond]

[redacted] wrote...

[redacted] wrote...

I think that if you want to learn something it's best to understand it, this is because if you come across something similar then you will be able to problem solve it, since you understand the theories.

[created on: 2003-11-04 21:47:30]

[redacted] wrote... [respond]

In summary... some of the comments above and the reader leans towards it to. Suggest that Drill and Practise is an excellent tool for learning longterm bluk data. I disagree. It would be a good method if done properly but I doubt espcially in anyone under the age of probably 25 is serious about doing it properly. Number and Language learning is a mix between block learning and Practise/Demonstation. Initally its Drilled but its used in conversation so its continually practised and demontrated.

Drill and Practice is fine when it puts a theory into practice.

How ever if drill and practice is the method used to teach blocks of figures, dates, names, terms etc.
(Things that have no logical path. John Doe was born 1943. The battle for headstone occurred in bondcountry)
Drill and Practice is an appalling method for learning long term. It has the potential to allow us to retain long term but not in way most of us use drill and practice.

I read an article/study that said if the user retouches on the information two weeks after they finnish then that dramatically increases the long term retention of the content.

I know from experience that this is true.
Exams before holidays leaves me blank come the first day of school.
Mid term exams and then touching on the content once or twice again up to the end of year exams results in less painful drill and practice being needed before that final exams and because this is the second time I've used those memories they defiantly have stuck with me long term.

Assume your designing an learning program for a 20 year old uni student.
2 Weeks after his end of year exams he is unlikely to discipline him self to retouch on the information.
The problem only gets worse the younger the student.

Come the first week of uni and most of what was rope learned is fuzzy if there at all.
Theory is more readily retained because it is a series of thoughts and remembering just one part allows the user to unlock the chain back to the start.
Just like a story. We are naturally geared to remember stories because they are retained to help us navigate.
One journey into an unknown location with 30 turns and most people would be able to navigate you there and back even months afterwards.
10 lessons block learning the street names to get there and maybe you would get 30/30 if tested immediately. 4 months later you would be struggling to get any. Unless of course you used those roads or discussed them again with friends.

one more example for anyone that did/knows some basic geography.
Can you tell me 10 different names of geographical landforms unique to Australia?
(yes? tell me your secret to memorization!) (no. its fuzzy. Question:Did you drill and practice those terms before you exam?)
Now can you explain how those landforms (that you can't remember the names for where formed?)
(no? don't be difficult) (yes its common sense. this happened, then this, then this which creating that)
Final question. In preparation to the exam. Did you spend more time worrying about the remember the rainfall of costal forest to the nearest few mm or the concept behind why it rains over cost more than desert.
I spent 90% of my time Drill and Practicing the number of mm.
I can honestly say I have no idea now how many mm but i can tell you 10 reasons why it

I agree. When I first learned the multiplication table, I have no idea why I had to do it - only that the teacher gets really upset if you don't remember it. However, it does seem like a waste of time to do D&P at an age where you can do higher-level thinking.

[created on: 2003-10-02 20:41:43]

"quoted [redacted].. very behaviorist. excellent for long term memory, but what about understanding. knowledge without application is a bit of a waste i believe. my aged mother - bless her - is a proponent of this method...."

[redacted] wrote...

My grandmother did not know how to read and write, but she still knew how poems that she learn when she was little around the fireplace at night all the members of the family, and she wouldn't miss a word, but I don't believe it is the best learning approach, especially now that I am desperately trying to understand action scripts in flash I know that memorising script would not help me that much!

[created on: 2003-10-12 15:28:06]

[redacted] wrote...

More practice and that will stick in your head and you will not forget that so easy. As addressed by Andres,i remembered when i learned mandarin, my teacher only allowed me to speak in madarin. if he heard me speaking non-mandarin language,i would have to pay him! that way of learning helped me learning better and better

[created on: 2003-10-12 22:05:35]

"quoted [redacted].. very behaviorist. excellent for long term memory, but what about understanding. knowledge without application is a bit of a waste i believe. my aged mother - bless her - is a proponent of this method...."

[redacted] wrote...

Drill and Practice can also incorporate application. E.g: a series of math exercises that make you apply the same concepts for slightly different situations. In the math example, drill and practice actually teaches you understanding too. Recognition of patterns is part of how we understand things. Drill and practice also helps the learner to build up proficiency, speed, and confidence in a skill.

[created on: 2003-10-22 05:23:47]

"quoted [redacted].. Practicing is a good way of remembering tasks because majority people tend to forget information given. It is a repetition of doing something and from there you'll get use to it. For example, driving..."

[redacted] wrote...

Yes, practices make perfect!. It is good for memorisation and recall.

[created on: 2003-10-30 23:35:15]

"quoted [redacted].. Yes, practices make perfect!. It is good for memorisation and recall...."

[redacted] wrote...

Agree with Ervina. Practice, practice and practice one more time to get it PERFECT. If you dont practice how are you going to get good at it? Think about it, it's not hard to do.

xjx

[created on: 2003-11-01 14:43:16]

"quoted [redacted].. very behaviorist. excellent for long term memory, but what about understanding. knowledge without application is a bit of a waste i believe. my aged mother - bless her - is a proponent of this method...."

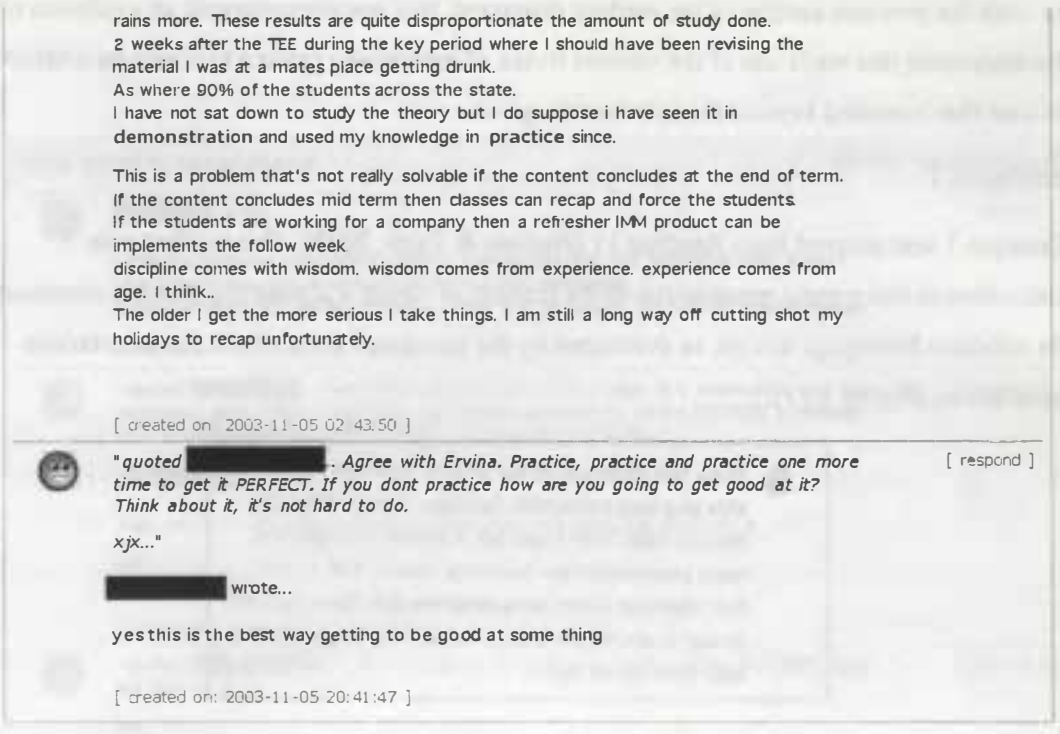


Figure 8.12: Student annotations about drill & practice

Annotations that were framed by direct experience however, still dominated this section of the reading. From subjects' personal experiences about how they best memorised concepts (including rehearsal) a strong picture of what characterises drill and practice was developed. This allowed a more critical form of monitoring also to be demonstrated. The comment 'when you're teaching young children to count, they don't have to ponder why we use the decimal numbering system – they just have to remember the order of the digits' presents a more complex and indirect means of drawing parallels than simply recounting experience and provided the basis from which understandings could be modified to form a consensus about the value of drill and practice rather than its basic characteristics. For example, comments such as 'it does seem like a wast of time to do D&P where you can do higher level thinking' and 'now that I am desperately trying to understand action scripts in flash I know that memorising script would not help me that much' provided a counter argument. Also, one student, in monitoring his understandings about Drill and Practice, was able to add the concept of *application* as a way of rounding off this form of learning. While towards the end of the series of annotations, some were quite trite in the way they rephrased existing propositions (eg 'practice makes perfect') one of the last comments constituted a sophisticated summing-up of all the positions, which included reference to the subjects' direct learning experiences, hypothetical examples, and information seeking by referring to an article that argued for revisiting content as a means of enhancing encoding into long-term memory.

As with the previous section of the reading discussed, this one demonstrated an evolution of the discussion that made use of the various forms of monitoring present to create an artefact of its own that extended beyond the information given.

Example 7

Example 7 was sourced from Reading 11 (Nielsen & Tahir, 2002). This reading was distinctive in being quite prescriptive in the manner in which it argued the features necessary for effective homepage design, as evidenced by the paragraph from which the annotations were drawn (Figure 8.13).

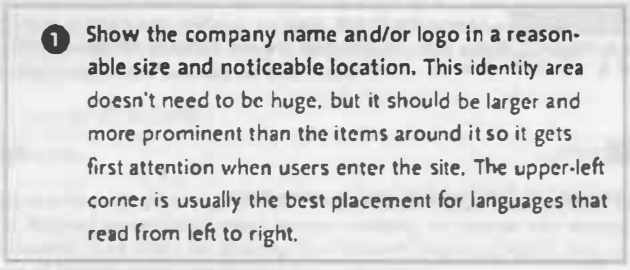


Figure 8.13: Original reading section about logos on homepages

As Figure 8.13 demonstrates, this section of the reading provided clear guidelines for how logos should be placed on a home page. Despite its brevity and 'literalness', it still created some discussion (Figure 8.14). On its own, the point raised could have been seen to be quite arbitrary in nature, and although it was tied to a specific visual example in the text, one of the ways in which subjects monitored their understanding of this point was to find another example, specifically the university web enrolment system home page. This provided a point from which others could comment, with the claim 'it's sick!!!' eliciting a more considered response that expanded on the issue of logos to identify the importance of a consistent theme with common features that communicate the brand identity of the organisation.

View existing annotations: **Create new annotation**

[redacted] wrote... [respond]

Show the company name and/or logo in a reasonable size and noticeable logo. When I read this criteria, this reminds me of the ECUWES homepage (http://www.ecu.edu.au/ssa/ecuwes). I think they should put the logo on the homepage.

[created on: 2003-11-03 11:44:24]

"*quoted [redacted] .. Show the company name and/or logo in a reasonable size and noticeable logo. When I read this criteria, this reminds me of the ECUWES homepage (http://www.ecu.edu.au/ssa/ecuwes). I think they should pu...*" [respond]

[redacted] wrote...

They should totally start anew with a better ECUWES page, it's SICK!!! O_o

xjx

[created on: 2003-11-03 14:26:41]

"*quoted [redacted] ... They should totally start anew with a better ECUWES page, it's SICK!!! O_o*

xjx..." [respond]

[redacted] wrote...

The ecuwes website certainly needs a redesign. Looking through the other websites related to ECU you'll notice a common theme, and consistency with common features. The ECU logo is one of these elements that 'connects' these websites together. Interestingly, it's not displayed in the top left corner for all the sites. The first thing that the ecuwes site needs though is definately an identifying element - the ECU logo would be a good place to start.

[created on: 2003-11-03 17:51:59]

[redacted] wrote... [respond]

A company logo is always what sells the site. It is an indicator of what the site is all about or who it is for.

[created on: 2003-11-03 20:31:21]

"*quoted [redacted] .. A company logo is always what sells the site. It is an indicator of what the site is all about or who it is for....*" [respond]

[redacted] wrote...

That's not necessarily true. It's nice to have a good logo, but it shouldn't impact the site's ability to convey information too much.

[created on: 2003-11-03 23:47:33]

[redacted] wrote... [respond]

I too think that it is very neccessary to show the company logo on the homepage. It reallt lloks weird when company does not have a logo on its site.

[created on: 2003-11-04 16:33:40]

[redacted] wrote... [respond]

I agree with this paragraph, all the sites I have visited have their company logo in the top left hand corner.

Figure 8.14: Student annotations about logos on homepages

This pattern of monitoring evidenced by adding information to the existing pool was one of the main characteristics of this sequence of annotations. Many of the subsequent annotations

contributed further perspectives on the issue regarding, for example, the size and location and design features of logos. One way in which these additions to the knowledge base were made could be in the form of contention of an existing point ('It's nice to have a good logo but it shouldn't impact the sites ability to convey information') but the main approach here was to monitor understandings by drawing parallels with other examples and seek information from other sources. One annotation, for example, directed readers to the 'Explain your site with a tagline' page, while another pointed to the author's personal experiences of company logos on buildings.

In the end, as this example shows, the monitoring evidenced in annotations had the effect of producing a series of comments that added to the artefact itself, and in this case the artefact probably had less information than the annotations themselves. This meant that the readings became somewhat secondary to the process. This allowed even broader scope for self-monitoring, since subjects could monitor their understandings of all of the information through the multiple perspectives that were available both from the reading and the annotations themselves.

8.1.2 Conclusions about monitoring in the Annotation tool

What these examples have shown is the range of artefacts and the annotations that they have engendered. An analysis of the annotations demonstrated monitoring in multiple forms, particularly in questioning, debating positions and comparing ideas by contributing direct and indirect experiences, as well as seeking alternative sources of information.

The fact that Mark-UP enabled such forms of monitoring to be demonstrated, however, does not mean that it guaranteed this type of cognitive processing, nor did it ensure that monitoring was always done the most effectively. One of the characteristics of early readings' annotations was a tendency for subjects to merely add comments such as 'I agree'. While this was not necessarily indicative of poor monitoring, such statements are obviously not so easily identified in terms of the form of monitoring that may have taken place. It is tempting to see the improvement in performance as an improvement in subjects' monitoring skills and these will be explored later. However, regardless of whether subjects improved in their monitoring skills, there certainly appeared to be a general improvement in monitoring behaviour and this may also have been a result of the tutor feedback identified in the section exploring planning, which specifically advised some subjects to explain their positions in more depth. These issues are explored later through an analysis of interview subjects' portfolios.

Nevertheless, many annotations did take the form of rephrasing existing comments, and student goals as well as the nature of the reading itself appeared to have some impact on the

quality. The example shown in Figure 8.15 addresses a reading dealing with storyboarding and concerns the role of storyboards in ensuring the successful design and development of multimedia products. It could certainly be argued that the annotations themselves do not add much to the discussion. There is no information seeking or genuine comparison of ideas within these comments. To write them off as inferior instances of monitoring, however, may be overstating their limitations. While it is true that they did not demonstrate the complexity of monitoring seen in some of the previous examples, it does not mean they did not actually involve complex monitoring on the part of the student.

Figure 8.15: Rephrasing in annotations

It would appear that these comments differ from some of the others in terms of their intended audience. The concept of personal annotations that were not designed to be viewed by others was not anticipated in the initial design of the product, but came up as a desirable design feature when exploring the useability of Mark-UP. These annotations could in fact be interpreted as personal 'mini-summaries' with the purpose of readers articulating concepts in their own words to assist monitoring of their understandings. The uncontentious nature of the

reading may also have had an impact here. One of the main foci of annotation was to express a point of view and this may not have been so necessary in a reading as uncontentious as this.

Beyond the Annotation tool's potential for personal notes and to express a point of view, such brief comments also demonstrated the potential to invite other users to correct any misapprehension or interpretation of a particular section of reading. Certainly they are still more effective than the comment 'I agree'. Not all annotations received follow-up responses – an inevitability in a flexible learning environment such as this. However, one feature that was certainly missing from all of the annotation sequences explored in this section was a second level of annotation, with subjects following up their own comments and those of others with respect to their annotations. This lack of a second level of reflection appeared to be a lost opportunity in this implementation. One of the limitations of Mark-UP that became evident during evaluation was its inability to advise students when they logged in of annotations that had been made in response to their own comments. Nor did the icons, when subjects viewed a reading, clearly identify where one of their own annotations was placed. This prevented subjects from easily accessing their previous annotations and considering any further perspectives or examples that may have been added by others.

This was a loss, as it would appear that the most manifest forms of monitoring took place where there were multiple forms evidenced in a particular sequence of annotations. Examples 5 to 7 in particular, demonstrated a cumulative growth in negotiated understandings, promoted through a mixture of questions, additions, experiences and alternative sources of information, that both stimulated and was stimulated by the internal feedback that guided subjects' monitoring. In not being able to clearly identify their own annotations, subjects were unable to review the progression of a discussion.

In exploring the types of readings that best lent themselves to monitoring within the annotation environment, it appeared that even the less popular readings in terms of annotation were still able to demonstrate a level of monitoring. Figure 5.2, for example, shows Reading 5 as one of the least annotated readings, yet the annotations in this reading provided some good examples of the types of monitoring subjects engaged in while annotating, and formed four of the artefacts that were discussed in this chapter.

A bigger issue in terms of the quality of annotation was the types of annotation and the monitoring that was evidenced by particular sections of readings. Lengthy and complicated sections such as that shown in Example 1, tended to promote monitoring in the form of annotations that questioned, and attempted to clarify concepts within it. Others, such as Example 6, which explored drill and practice as a learning strategy, and Example 7, which focused on the use of logos, promoted a different type of monitoring, where subjects related

experiences and sought extra information to build on the artefacts themselves. The value of the different types of monitoring as metacognitive activity will be explored in a later section of this chapter. One type of monitoring that the Annotation tool generally did not promote, however, was organisation and transformation of information. This form of monitoring, however, appeared evident in the Design Problem tool.

8.1.3 Exploring monitoring within the Design Problem tool

The Design Problem tool was the most widely used of all of the tools within Mark-UP. This was certainly a result of it being the only one that was mandated throughout the whole semester. Each week students had to discuss a design 'problem' using their understandings of the readings to provide innovative solutions to design issues they may face as a multimedia developer.

This provided a means for a deeper level of metacognitive monitoring than was available within the Annotation tool. While the Annotation tool primarily focused on the discussion of subjects' comprehension of specific reading sections, the Design Problem tool had subjects apply their understandings to a specific design-related problem. This meant that it promoted monitoring in the forms of organisation and transfer rather than questioning, information seeking, and comparing ideas. These forms, too, move beyond the specific domain of reading comprehension towards the application of metacognition to other areas, in this case problem solving.

To explore how subjects applied such forms of monitoring, two specific instances of responses were selected, which involved the application of understandings from two readings:

1. Week 12: Nielsen, J. & Tahir, M. (2002). *Homepage Useability: 50 Websites Deconstructed* (pp. 1-27). Indianapolis, Ill.: New Riders.
2. Week 13: Laurel, B. (1990). Interface Agents: Metaphors with Character. In B. Laurel (Ed.) *The Art of Human-Computer Interface Design* (pp. 355-365). Reading: Addison Wesley. Total Pages 523.

Obviously it would have been impractical to explore the responses to every design problem. These readings were selected because they represented two different styles of publication, that demonstrated a range of different response types. The first reading provided clear guidelines in point form about how businesses should construct and present their homepages. In this sense it was a more 'straight-forward' reading than the second, which was much less explicit in terms of the application of the reading to design. These therefore demonstrated design problems at two extremes. While both design problems dealt with the application of reading

concepts to practical design issues, in this case towards redesigning a homepage (Example 1) and proposing a replacement agent for the Microsoft paper clip (Example 2), they required different levels of abstraction to be able to do so. Since all subjects were required to complete the design activities, a full range of monitoring was evident from using only the two examples above. Each of these examples was examined in light of how subjects monitored their understandings of the reading to formulate responses to related design problems.

Example 1

In Week 12, subjects were presented with the following design problem attached to the above reading:

> *Letter to a webmaster – improving their homepage. There are a lot of bad web home pages out there, not all from small businesses or individuals. Your role in this task is to find one. Compose an imaginary e-mail that you would send to the webmaster about how the homepage could be improved, using this week's reading as a basis for your points.*

Since this task required subjects both to understand the reading then organise their understandings and transform them by applying them to the domain of problem solving, one might have expected the responses to be somewhat weaker than those tied more specifically to reading concepts.

This did prove to be the case for some subjects. Nevertheless, all appeared able to demonstrate monitoring of their understandings at one level or another. With Zimmerman and Martinez-Pons' (1988) monitoring categories of questioning, comparing, information seeking, and organisation and transfer in mind, monitoring appeared to take four main forms for this reading:

- explication of design suggestions that were relevant to the problem, but broad and only loosely tied to the reading concepts;
- re-iteration of reading concepts tied to the context of the problem but without uniquely customising the response to design issues within the website;
- application of reading concepts tied closely to the context of design issues with selected websites; and
- integration of personal comments, alternative examples or other forms of new information into responses which related strongly to both the reading and the problem.

The first two forms of monitoring were the weakest, mostly because they failed to engage both with the organisation of conceptual understandings and transfer to the problem at hand.

The first indicated adequate transformation, but weak organisation, while the second demonstrated an ability to organise reading concepts but inadequately apply them to the problem.

Examples of the former could be found in responses to the Design Problem tool, which tended to be somewhat vague in their description of specific concepts. These were quite few but stood out as weak, as in this particularly bad example:

> *To whom it may concern, What in the hell do you think you are doing!! I came across you're site looking for information and examples on storyboards and was annoyed with some aspects of your site. Please take these suggestions I have made for your home page into consideration and change it!! First of all to access your site we have to go through a splash screen. I, along with many others, believe it I a waist of time and just means more time is spent waiting for you're site to download. Not everyone is connected to ADSL or Broadband. What are you going to achieve with a splash screen anyway. Get rid of it! Then once your in the site that's another story. Don't get me wrong the information you have in your site is great but there is a better way to present it. The first thing that catches my eye is the animated fox above the navigation bar. It is disgusting and put me of your site straight away. Get rid of it and if you really want an animation there replace it with something more welcoming. The Navigation bar could be tidied up a bit by using maybe a pop out menu to show the extra links that belong with About Us and Samples. This groups them more effectively. Also what's up with all the scrolling!?! It's great that you have a lot to say but fragment it more by creating more links and storing the information in there or use tables more effectively. Better yet get rid of any irrelevant information, a lot of scrolling is a put for most people as they just want to get to the information quickly! For the time being that's all I have to say s take these considerations into account and redesign the site Yours sincerely... (Subject 55)*

One could argue that the tone of the letter was quite inappropriate, in itself evidence of weak monitoring with regard to language being used appropriately for a specific purpose. It also was also a weak example in its lack of direct reference to reading concepts. In fact, there were really four points made within this response: issues with download time through the use of a splash screen; inappropriate animation; a weak menu system; and scrolling. Of these, only one section of the reading was used to inform the response, specifically the section relating the graphics and animation, which claims in point 60: *Never animate critical elements of the page, such as the logo, tag line or main headline*; as well as point 62: *Let users choose whether they want to see an animated intro to your site – don't make it the default.*

Both of these points were applied somewhat loosely. The suggestion to get rid of the animation 'or replace it with something more welcoming' was quite vague, as was the comment, 'use tables more effectively'.

Fortunately this response was not indicative of the group as a whole and even here there was some evidence of deeper monitoring in the way in which the concept of bandwidth was mentioned as an issue with the splash screen. While not mentioned in the reading, the use of this issue to support the suggestion in the reading relating to annotation shows a clear use of monitoring by using other information to support a point. Another example of this was the comments about the re-organisation of links. While any understanding demonstrated of navigation as it was discussed in the reading is somewhat implicit rather than directly referred to, the comment relating to grouping links via a pop-up menu system had some value.

Nevertheless these appeared to be more aligned with received understandings of design rather than the organisation and transformation of the readings, and were therefore less indicative of monitoring than some of the others.

Such vagueness and lack of reference was inevitable to a certain extent. Several responses contained examples where arguments were made without support. Comments such as 'this is a bad choice of colour – not very professional' (Subject 118) and 'the navigation is very muddled up' (Subject 77) existed across the range of responses, and indicated issues that could be identified but were either not in the reading or were not understood in the reading, which suggested that monitoring was not consistent across all of the points raised by subjects.

As well as unsubstantiated claims, which indicated some transfer without any clear organisation of reading concepts, an equally problematic response was the type which evidenced an ability to restate the information in the reading, but a failure to apply it effectively to the problem.

As with the former type of response, these did not make up the bulk of examples. However several of the responses to the design problem read like a shopping list of ideas from the reading rather than a solution to the design issues in the chosen site:

> *10 October 1003 To whom it may concern. I recently visited your web site and I could not help but email you to tell you, it has to be improved if you want people to visit it. Here are some problems and improvements that should be considered: When you enter the site it's a bit hard to tell what it is about and the arrangement is not in any order of importance All the links should be in one place somewhere along the top in a neat manner not all cluttered together and all over the site There is no signs to show it's the home page and no company logos There should be less content and nicely presented instead of using point*

form The content on the home page should summarize what the site is about and not go into detail straight away Identify information that has been added recently Visited links should change colour and look different from the unvisited ones and there should be more than on the other pages The links should be clear so that the things that people are looking for should be easy and effective to find The information on the first page should be carefully selected and within the information it should have links to the page where there is more information about it The graphic should illustrate the content, and there should be graphics on the site The use of graphic design appropriately to fit the purpose of the site will attract users the site needs some graphic design desperately Drop down manus, text boxes and selection boxes should be used where necessary and because they increaser user interactivity they should be used Important information should be displayed in a headline Keep the pages as they are don't open them in a new window Keep the site updated with information that the user interested in. Have a search option within the site Hope you consider and follow my suggestions, if you find it hard to do yourself my telephone # is 9123 5678 call me and I will do it for you for a very affordable price Yours Sincerely... (Subject 99)

In reading this response, one can garner many recommendations for effective homepages; however, one does not get a strong sense of the site that was being critiqued. Subject 99 clearly showed an ability to monitor her understandings by organising and selecting appropriate recommendations from the reading. However, where she failed was in being able to apply those understandings to the problem itself. While the points made were relevant, the response was constructed in such a way that little reflection on how the points could be applied to improve the homepage was evident.

This type of response was more common than those where comments were applied more directly to the relevant site but were more ad hoc in nature. This suggested that most subjects did at least engage strongly in the process of monitoring through organisation of concepts. Subject 64 went so far as to quote the points from the text directly, as demonstrated in this excerpt:

This feedback is based on the publication Homepage Usability: 50 Websites deconstructed, written by Nielson and Tahir. I will follow the section headings that they use and highlight areas where opportunities exist. Communicating the sites purpose: They recommend to show the company logo in a reasonable size and noticeable location. I was unable to sight a logo. In fact, the usual place (top left corner) is blank. A logo gives your site an identity. Tags that explicitly

state the purpose of the site should be used. They are normally placed with the logo. There are a number of potential tags under the site title, which could confuse the viewer as to what purpose this site has. They suggest that you emphasize what is valuable about your site. Again, this could be any of three different items, as stated under the title - it is really not clear. High priority tasks should be emphasized. This site does not seem to have such an emphasis. It seems to offer a lot, but most of it is hidden from view owing to the size of the homepage. There is probably too much information on the homepage. It needs to be rationalized and condensed so that viewers know instantly what the site is about, what it offers and what task can be performed with it. (Subject 64).

What distinguishes this particular example from the previous one is that there was an attempt to direct the concepts more directly to the design problem. Comments on the lack of a logo and tag lines offer little beyond what the reading says; however, the subject does identify tags which could be used, and emphasises the role of a logo in promoting identity.

Most subjects were able to demonstrate some ability to transfer reading concepts to the design problem. While the above example was somewhat limited, others were more specific in their reference to the web page they were critiquing. Rather than simply stating 'there is irrelevant information on this site', Subject 126 argued, 'I see that your website designer, **** **** (you just had to give him credit didn't you, do you think that I care?) did an excellent job.' Subject 101 did not refer specifically to sections of the reading, but was able to apply her understandings of the recommendations regarding 'Communicating Information about your Company' directly to the her chosen website:

The first words in your window title should be "Chicken Treat" rather than "welcome" because this can appear in people's search engines and people who are browsing the web have no patience. Also your customers have no way of contacting you other than a link which opens their mail client. A phone number and address would be very helpful on your site. I thought perhaps in the store locations section of your site there would be a list of addresses, but there is just a picture of Australia with a couple of chickens on it. This misleads the user into thinking you only have ten stores when that is clearly not correct. (Subject 101)

The reading argued '"Welcome" or "Homepage" ... might look okay in isolation but convey no differentiating information in the first word' as well as contending, 'Include a "Contact Us" link on the homepage that goes to a page with all contact information for your company.'

Rather than refer directly to the reading, Subject 101 was able to both organise the concepts then transform them in a manner that was more relevant to the design problem.

Such stronger evidence of monitoring could be found interspersed with more direct reiteration of the points in the reading and it appeared that most students were able to engage in both forms of monitoring, though this was not consistently applied across the whole design problem. Subject 126 argued 'You have managed to include a tag line which names your company and identifies you as being possibly different from your competitors with the word "Superstore"', but he was also able to go beyond simply rephrasing the recommendation about tag lines, combining it with the recommendation regarding an 'About Us' link to suggest:

> *Did you think about having an "About Us" link to tell users why you think you're a Superstore and to give us an insight into your business model, company values and who makes up your business? (Subject 126)*

Such synthesis of several points reorganised and then transformed into recommendations that could be directly applied to the design problem indicated a strong level of monitoring. However, the strongest evidence of monitoring appeared when subjects were able to do all of the above as well as integrate concepts that were new, existing beyond the points made within reading. This was different from the ad hoc responses discussed previously. Instead of applying received notions of good design to the design problem, some subjects were able to contextualise alternate design strategies to both the reading and their chosen website. As such, there were several points of reference being used within the monitoring process. Monitoring took place in the form of organisation of both reading concepts and existing understandings, which were then transferred across the domain of conceptual understanding to be applied to a specific instance.

Subject 128 picked up on two recommendations in the reading regarding links, but extended beyond the basic comments about showing visited and unvisited states and making sure they explicitly state what happens:

> *The links have different size and colour for each different section and the only indication they are links is that the cursor changes shape into hand shape when it rollover the links. Other than that, they are not detectable as links. The most obvious example is on "Gift & Bridal" section. The links on that section are as grey as the text on it and the buttons are as plain as a table with a text in it. If not because the rollover cursor effect, I won't realize they are clickable. Good links are supposed to change colour or shape when we rollover and click on them. They also show us which section we have visited and which one haven't*

by changing their colours. Your main navigation buttons doesn't give us such information [and that if not for] the cascading menu and the title you have below the navigation buttons, I would be lost within the site. (Subject 128)

Two subjects went so far as to integrate concepts covered in other parts of the course, going beyond the recommendation for alt tags to argue their role for accessibility. One argued, '[The graphic] does not contain an ALT tag that could be useful for people with visual disabilities' (Subject 56), with another subject claiming, 'where you have used pictures, you haven't included a description in the "alt" tag which lets visually impaired users hear a description of the picture' (Subject 50). Another example is Subject 84, who, while acknowledging the point about a need for a "Contact Us" link on the homepage with contact information on it (Recommendation 12), was also able to extend beyond that point:

I would also place a line of text describing who answers e-mails. Is it the police, the webmaster, the government? Or will the webmaster refer these queries to the right body of people to get the correct answer? (Subject 84)

While such additions to the reading concepts were not as common as more direct application of the recommendations, they occurred frequently enough to suggest that a further level of monitoring was taking place in many students, where the organisation and transfer of reading concepts was being mediated by existing understandings.

Example 2

This reading differed from the previous one in that it was more general in its discussion. While Reading 13 provided discrete recommendations, the text chapter on Interface Agents was more theoretical in exploring the concept rather than trying to define guidelines for their design. Thus while one might expect students to be able to organise the concepts within the chapter, the gap between the idea of agents and their transfer to a design problem was greater and would have involved a higher level of monitoring to broach.

The design problem stated:

Redesign the MS Office Paper Clip. We have come a long way in our understandings of what makes for a good interface agent since the MS Office paper clip was created. You need to redesign it. Consider the functionality and character with which you want to imbue your agent and how end users may best interact with it, using your understanding of the reading to inform your design.

The above reading contained some general features of effective interface agents. These included features such as agency, competence, responsiveness and accessibility, as well as arguments in favour of and against attributing human attributes to such guides.

The four main forms of monitoring demonstrated in the previous design problem were also apparent with this one. Specifically, responses tended to demonstrate application to the problem with little relevance to the reading; reiteration of reading concepts without application to the problem; application to the problem tied directly to reading concepts; or the integration of personal comments and other forms of new information to responses that relate strongly to both the reading and problem.

What tended to differentiate responses to this reading and problem was the greater division between the reading concepts and the problem itself. This resulted in responses that were somewhat weaker on the whole than for the previous problem, although all forms of monitoring were still present.

Overall, this weakness showed itself as a tendency to not integrate reading concepts into the problem solution. Most subjects could identify issues with the Microsoft Paperclip, but these tended to focus primarily on its irritating mannerisms rather than its value as an agent. For example, Subject 7 complained, 'basically he distracts you, much like an animated GIF on a website', while Subject 52 stated, 'personally I do not use the paperclip helper as I find it very annoying'. The following example was typical of responses that were informed more by personal experience than by any reading content:

> *Although the Microsoft office agent has the ability to provide help in almost all situations, but it can be quite annoying that the agent keeps popping up to offer their assistance to the users. It may prove to be very useful for novice users because they agent will provide them with all the help and guide them through the whole working process. It's amazing how these agents can analyze the situation and offer the most appropriate help to its users. As for expert users, I believe these agents are the annoying factor that can frustrates a user. Having the agents popping up every now and then on the screen will only hinder the process of their work rather then helping them. So having this kind of agent may be a good or bad thing. The most important point is that they are used correctly at the right time. (Subject 118).*

Such a response demonstrated some relevance to the section in the reading covering objections to agents, particularly the 'agents as virus' problem. However, by not drawing directly from the reading, there is little evidence of monitoring beyond applying received notions to the problem. In fact, it could be argued this student did not tackle the design

problem at all. The final sentence was a telling one. The concepts of correct and timely use of agents was covered within the reading but this response only mentioned these as a problem rather than using reading concepts to identify what exactly are correct uses of agents and when they are most useful.

Where reference to the reading was made, several of the responses showed an ability to organise concepts by providing brief summaries of the relevant aspects of the reading. However, the transfer of these concepts was more problematic. Subject 45 attempted to tackle both the reading and problem, but these were not fully integrated:

> *This readings mainly focus on Interface Agents, which comprises the key characteristics of resposiveness, competene, accessibility and the capability to perform action and the objections to Agents. The interface agent is commonly used and recognized in Microsoft office, which is called paperclips. It is considered a useful tool to let user know their situation and it also provides help and feedback. If the paperclip is to redesigned, it should offer a choice for users' such as creating their own image or downloading any kind of image (photos, creations, other characters) to make it more interesting and unique as their paperclip. This would enhance users' motivation and engagement to use the program. A function of activate or inactivate the interface agent is a useful feature. It gives users a choice, as some user's might be distracted and get frustrated because of the interface agent. The agent must be useful to provide users' quick respond to user's needs and goals. Normally the agents appears at the corner as long as it is noticable, which I think it is a good spot so that it would not interfere user's work while using the program. (Subject 45)*

It can be seen that this subject began with a summary of the reading, but this was not carried through to the actual response to the problem. While issues such as responsiveness and competence were broached, they were not used as a basis for the discussion that followed. Few reasons were given for the design choices proposed by this subject, which made it a poor solution to the problem and a weak example of monitoring beyond the ability to rephrase concepts within the reading.

Several other responses showed difficulty in applying monitoring by transforming the reading concepts to the problem. Even where one subject could clearly show the use of monitoring through rephrasing concepts into her own words, adding new ideas to the reading concepts, this still did not mean she could directly transform her understanding of these concepts into a problem solution:

A good interface agent is where user can turn on or off the agent because not every user likes to use an agent. For those who want to use an agent, they should be allowed to choose a certain character to pose as their agent and decide what basic characteristics the agent has so users will feel at ease with the agent. User can also choose whether to interact verbally or using written text both. As an agent, it has the knowledge of MS Office, knows how to perform certain actions to reach user's goal, and represent the goal in a form that user can understand. They also have to be able explain the action steps to the user who requests the tutorial instead of asking the agent to do it. Every user has different need so an agent has to be able to distinguish the needs of each user. The agent will be able to detect what user wants to do when user performs a sequence of actions and offers to do it in a better way or give a quick tutorial for user. The agent also should adapt to user's improved ability where if user has learned the way to reach certain goal, the agent won't keep insisting offering the same way over and over. This feature is important and must be accurate so that user won't feel like the agent hiding some information from them. And also the agent must be reliable. The developer has to ensure that an agent never makes any mistake or give user wrong information because once user find out about agent's flaw, they will hardly believe in agents anymore. (Subject 128)

There was a strong implicit understanding of reading concepts in the above example. The issue of the agent understanding the user's goal and being able to perform actions relates directly to the reading concepts of agency and competency. The idea of the product developing a user model in order to provide implicit as well as explicit response too was an important concept in the reading. What this example lacked, however, was a strong reference to the Microsoft Office paper clip as an example of a weak agent or how it could be improved.

Despite generally weaker transformation of reading concepts than was evidenced in the previous reading, many subjects were still able to demonstrate this form of monitoring. Some of the stronger responses showed clear organisation by articulating reading concepts and then actually applying them to the problem. Subject 64 for example was precise in his use of the reading:

...Based on the reading the following points should be observed for redesign: agency, responsiveness, competence and accessibility. with that in mind - the user must be able to control it. if they do not want it, then it should never appear again until invited. if an icon is to be used, it should have a character associated with it that is user configurable. one that means something and

denotes its purpose. it must be smart enough to understand the users goals. clippy certainly knew when you were trying to write a letters, but that is not all users do. this would probably require a bit of time to configure properly. it must adapt to the user. as the user grows, so must the agent. it must be unobtrusive. clippy had a tendancy to get in the users way... (Subject 64)

This example is markedly different to the response from Subject 45 in the way in which the critique of the paperclip agent was tied to the reading concepts rather than simply being an addendum to them. The issue of the control over the agent is tied directly to the concept of implicit versus explicit responsiveness, for example. Other responses were able to quote the reading about how agents could be perceived as 'whining chatting little irritants' and suggest ways that this could be reduced (Subject 9), or pick up on the issue of bad behaviour towards 'digital' agents being transferred towards 'real' agents by suggesting filters to prevent the use of inappropriate language when interacting with them (Subject 115).

This direct use of reading concepts to solve design problems provide strong evidence of the ability of Mark-UP to support monitoring through transfer. The strongest responses within this example went further, actually adding to the material through further forms of monitoring.

Information seeking for example was evident in several responses. One subject directed users to the site for 'Bonzi Buddy'; an agent that assists users in managing downloads (Subject 10). Another drew parallels between the issue of agents and the value of natural language interfaces that was discussed in a previous reading (Subject 42). Overall, there were few examples of responses that fully combined the monitoring processes of organisation and transformation within this reading and problem. Nevertheless, there was still some evidence of them. Subject 50 was able to adopt many of the themes of the reading and address them directly to the problem. The inability of the paperclip to 'do any useful tasks for the user', for example, related directly to agency, and the need for the Word agent to be an expert on grammar and literacy was a good example of competence, as was her discussion of contextual help:

Competency: When you ask the assistant for help, it just provides you with a choice of help topics, and the user has to make the decision about what topic is most likely to contain the information you need. Often the information presented is just not relevant to the search. The agent should be "smart" enough to retrieve highly relevant information and to recommend which help topic is most likely to contain the answer to your question.. (Subject 50)

Issues with responsiveness were also discussed in a manner that was related to the reading but applied to the problem:

The MS Office Assistant currently doesn't rate very highly on responsiveness. You have to communicate with it using terms dictated by the computer. It would be far more effective if you could describe the problem with which you need help in layman's terms, instead of having to know the system term for the problem.

This was also true with regard to the issues of accessibility and design:

The agent's character can be selected by users who can choose from the paperclip, a bouncing dot, genius (Einstein lookalike), William Shakespeare, dog, cat, mother nature, the Office logo or a robot. Of these selections, only Einstein, Shakespeare, the dog and the cat have a character to which users would attribute certain traits. For example, Einstein would be a good design for the Excel agent, because he was a brilliant mathematician and physicist. Shakespeare would be an appropriate character for the Word agent because of his mastery of the written language. A dog represents someone who's not too bright but will willingly carry out mundane tasks and fetch things for you all day long. The cat is an interesting choice of character, totally inappropriate for an agent. When was the last time a cat did anything useful for anyone? Microsoft should continue to offer users a choice of characters to represent the agent, but the characters' 'personality' should accurately represent the skills of the agent. (Subject 50)

Ultimately it appears that similar forms of monitoring were demonstrated in this example to the Reading 12 example. However, the gap between the theoretical reading and the complexity of the problem was a greater one to bridge this time. The result was more responses attempting to address the problem without reference to the reading, as well as responses that, while reiterating the reading points, were then not transformed effectively into problem solutions. Nevertheless, as the above example shows, several subjects were able to use Mark-UP to monitor their understandings effectively to develop ownership of the reading concepts, then apply them effectively to the design problem.

8.1.4 Conclusions about monitoring in the Design Problem tool

As one would expect, the further level of monitoring required to organise and transform reading concepts beyond their initial contexts was challenging for many students. This created a diversity of responses in terms of the types of monitoring evidenced. Most subjects appeared able to engage in monitoring at some level, whether this meant they could reorganise the reading concepts in a way that was personally relevant to them, or they could transform

previously formed ideas rather than the reading concepts to tackle the design problem. Most students were able to engage in organisation and transformation at some level. However, it appeared that they were more able to do this when the immediacy of the reading to the design problem was clearer, as was found in the first example compared to the second. In the latter, a division between the monitoring activities of organisation and transformation was evident in a tendency for subjects to restate reading concepts in their own words and select appropriate ones, but then only to transform those concepts in a limited way, either by writing in generalities or relying more heavily on previously understood concepts. Nevertheless, even Example 2 allowed for a breadth and depth of monitoring that could be strongly allied to cognitive self-regulation. As well as being able to show organisation and transformation, the fact that subjects were also able to seek information from other sources to support their responses suggested a strong sense of metacognitive monitoring, supported by the use of the Design Problem tool.

8.1.5 Exploring monitoring within the other tools

While the Annotation and the Design Problem tools were the most widely used of the tools within Mark-UP and facilitated the broadest range of monitoring activity, the other tools were also found to have contributed to activating monitoring processes within subjects. Following initial scaffolding of the use of each tool, from Week 7 of the semester, subjects were instructed to make use of all the tools in the ways that best supported their learning and in ways that most assisted them in solving the design problem. Week 7's reading discussed techniques for ensuring motivational multimedia software, synthesising two theories of motivation into the categories of immersion, reflection, transfer, collaboration, learner control, curiosity, fantasy and challenge:

- Wynn, S. (1995). Interactive Multimedia: Ensuring Motivation of the Learner. Edith Cowan University: Perth

Students were required to 'mark up' the reading in the following way:

> *Use the tools available to develop your understandings of the topics covered in this week's reading. This will assist you in responding to this week's problem.*
>
> *1. Annotate this reading*
>
> *2. Summarise this reading*
>
> *3. Discuss this reading*
>
> *4. Find an URL to shed light on this reading*

The choices of tools used reflected to a certain extent the nature of the monitoring in which they were engaging. Annotation was the most broadly used tool and provided examples of the widest range in terms of monitoring forms. Since the Summary tool, Forum Discussion tool and Post URL tool were more clearly defined in the nature of the activities, they tended to focus more on a limited subset of monitoring activities. Each of the three tools was examined to identify the nature of the monitoring evidenced by their use.

8.1.6 Monitoring in the Summary tool

Consisting of 37,196 words once collated, made up from 89 individual students' responses, the Summary tool was the most widely used of the other tools. Summary itself is directly tied to reading comprehension as a regulatory strategy. This suggested that it had value for subjects, enabling them to monitor their comprehension of the reading. In terms of the types of monitoring evidenced, one would expect it to demonstrate a somewhat limited range, given its focus on reorganisation of concepts rather than transfer, comparing ideas and so on. Some opportunity for questioning would also be expected, although the lack of feedback would have made such questions predominantly rhetorical in nature.

In fact, these forms of monitoring did dominate the responses. Such organisation generally took one of two forms: summaries that were brief and more personal, being written in the language of the subject; and summaries that were more direct in the manner in which they condensed the ideas within the reading. The latter summaries tended to follow the structure of the reading more closely and were generally longer.

Subject 38's response was typical of the former type of summary:

> *This reading presented some similar points to last weeks reading as it was talking about the motivation of learners with regard, in some parts, to the different ways in which people learn effectively (the topic of last week's reading). The reading, along with the comments provided by other students, presented arguements for and against the effectiveness of different types of learning, with respect to the ways in which they motivated the learners. The article concluded that it was more difficult to produce a piece of interactive multimedia which was "motivating and engaging", but worth the extra time as, in the long term, a "point and click" interface would be a waste of resources. This opinion was formed as a "point and click" interface has a lack of affective appeal and therefore learners are going to get bored quickly, and simply discard the program and move on to something more enjoyable.*

Such a response demonstrates the best and the worst aspects of such summaries. On one hand one could argue that a strong level of monitoring was evidenced in the above response. The subject drew parallels with other readings, demonstrating information-seeking activity, and the personal language style also indicated the subject was working at a reasonably high level of abstraction. This would appear to be more indicative of metacognitive activity, since a level of reflection and identification of personal value would have been placed on the points selected for inclusion within the summary. It would appear that this subject was quite selective in the points he found valuable.

The flipside of such a contention is that in operating at a high level of abstraction there is little evidence that the subject was engaging fully in the reading concepts. The other dominant form of summary was where subjects took each section of the reading, which generally focused on eight criteria for motivating software, and summarised each one in their own words. The monitoring evidenced in these responses was in the selection and statement of ideas within the reading. However, to a certain extent the organisation of the summary was a received one, relying heavily on the reading's own organisation rather than a subject's personally developed hierarchy of importance.

There were a few responses which tended to manifest both techniques. Subject 45's response was less balanced in terms of the weighting placed on each concept compared to many of the responses that kept close to the original reading. The section on fantasy was summed up in a single line with the statement, 'Fantasy is important to make the learner imagine that they are in the situation', whereas the section on learner engagement was much deeper:

> *Learner's needs to be engage so they feel as though they are part of the program both physically and psychologically. Situated cognition gives learning a context similar to that of the real world and therefore provides an authenticity to learning. (Wynn, 1995, p.2). The process of engagement leads to reflection as to make decisions when exploring the environment. This experiential technique can lead to high order thinking and problem solving but also an encouragement for learners to construct their own learning.*

This response appeared to be more selective about the information included in the summary. While it demonstrated all of the techniques of the summary strategy modelled in previous weeks, there appeared to be another level of critique operating where the subject was selective about the information presented, discounting concepts that were well understood, such as fantasy, and including reference to new concepts such as, in this case, situated cognition.

Another extension on organisation as monitoring was where information was re-organised rather than simply summarised. Subject 8 organised his response according to design

strategies rather than motivational categories, integrating the two into a more synthesised form of summary:

> *This article shows that making an effective IMM learning tool should be:*
>
> - *Realistic and relevant to real life situations. (Immersion)*
> - *Intuitive and Interactive Interface. (Reflection)*
> - *Situated learning (real life situations) improve transfer of learning in new situations. (Transfer)*
> - *Having some form of media (eg. Video) to allow the user to have expert opinions. (Collaboration)*
> - *Have a help tool so that the user can go to it if they are stuck. (Learner Control)*
> - *Have some variety in scenarios to engage curiosity. (Curiosity)*
> - *Intrinsic fantasy, believable and meaningful (Fantasy)*
> - *Allow the user to repeat the step as neccessary and have some form of a test at the end. (Challenge)*

In this case, it appeared that monitoring was stronger than the previous examples. The focus on design approaches demonstrated some transformation of reading concepts. One subject went further, using the Summary tool to critique the reading. Subject 7 began by arguing the value of the reading:

> *A good reading that covers the most important aspect of IMM learning. IMM has the problem of not being able to tell when a user is getting bored or distracted. IMM can't take a different approach or adjust itself like a human teacher could. (Subject 7)*

However, he then went on to suggest how the reading could have been better:

> *Such a document could probably be much better written in a practical manner. One which includes examples to further the understanding of the reader. I feel that such an important issue should be written in a much more untheoretical manner, and done so that it maximises reader knowledge. (Subject 7)*

While certainly evidence of a higher order thinking, with monitoring demonstrated in the ability of the subject to frame the ideas in the reading in terms of personal values, such types of responses were rare. This may have been simply because of the nature of the tool itself. The Annotation or Forum Discussion tools would seem to be more appropriate since they would have allowed debate. Such a response raised the question of whom the response was for. The closed nature of the Summary tool (students needed to post their own summary before seeing others') would have predicated it as a tool for personal reflection and to emphasise key points

for further study, rather than to engage in any form of dialogue. Such motivations in the use of the tool are reported later, in discussing how the interview subjects used Mark-UP as an environment for monitoring their learning.

8.1.7 Monitoring in the Post URL tool

69 students posted a website to the system, producing 4,035 words in total. As such, the Post URL tool was also widely used by students. The nature of the activity of finding and posting websites that were relevant to the reading sat squarely within the monitoring process of seeking alternative forms of information. However, many of the responses implicitly involved monitoring in other forms. The very selection of sites provided some indication of the ways in which subjects monitored their understandings; however the comments that subjects added provided evidence of other forms of monitoring too.

One site posted, for example, was not a site about motivation but a site that the subject found motivating:

> *URL: http://www.neostream.com*
>
> *Comment: WARNING THE SITE ABOVE TAKES AGES TO LOAD :P*
>
> *I find this site really interesting... although it is not an educational site, but it uses the learning aspect of Control, Curiosity and Challenge. The user have control of when and where to go, as in most websites. The curiosity i think is the greatest factor in this site, because of the mouse interaction with the character, which is different in each zones of the character.. and the most intriguing thing is the character also reacts to different speed of the mouse passing by... each of the links also have different animations that leads into the sub-pages and also different animations when returning to the main menu, which attract my curiosity. Challenge is only applicable with some of the pages, where you have to drag a link for the character to smash with an anvil (which is not so obvious). This site succeded in maintaining my interest at the site, so thus i think that the learning aspects is well placed within this site. (Subject 37).*

In this case, monitoring in the form of information seeking was supplemented by transfer to a practical application and critique of that. As such, it represented a deeper level of monitoring processes than those that simply posted alternative sites.

For the most part, subjects posted sites that either focused on a particular theory within the reading (for example, Subjects 98 and 129 identified sites that explored the ARCS model of motivation in more depth than the original article) or added a dimension to the reading in

some way. For example, Subject 74 identified a site that explored gender bias as a motivational factor, Subject 13 posted an URL that dealt with the relationship between motivation and culture, and Subject 22's site focused specifically on adult learning.

Not all posted sites were well chosen and some of these choices demonstrated weak monitoring. One particular site was posted no less than 4 times by different subjects. This indicated that while they may have been monitoring their own understandings in selecting sites, it would appear they weren't necessarily engaging in the other available sites posted within the Mark-UP system; otherwise they may have noticed the duplication. Two of the subjects noted that the site specifically mentioned the reading as a reference. This suggested that a somewhat unsophisticated approach to information seeking was evident, with subjects keying in parts of the reading title and author into a web search engine rather than exploring the key ideas within the reading further.

Nevertheless, nearly all of the sites were relevant to the chosen reading. Whether they related directly to motivation as was the case with most of the sites posted, or demonstrated subjects' deeper level of monitoring by being selected for demonstrating motivational concepts for multimedia in more applied way (eg Subject 49 identifying and critiquing the site for the 'eye toy' product as a means of enhancing motivation), sites generally added value to the reading itself.

One notable exception was the subject that posted an URL for a site that dealt with personal motivation and enhancement rather than motivational design (Subject 62). Another, while less strident an example, was more general in the way it identified a range of criteria for evaluating websites with 'engagement' as only one of those criteria (Subject 5).

The comments attached to the readings themselves also showed varying levels and forms of monitoring. A common approach was to summarise the sites, organising the concepts into a more condensed and personal form, in similar ways to the following example:

> *URL: http://www.ualberta.ca/~sdowie/Motivation/motivation_index.htm#top*
>
> *Comment: Motivation is Important Even on the Web*
>
> *This site looks at how to motivate adult learners to use web-based education systems. The site uses Raymond Wlodkowskiis Time Continuum Model of Motivation to base it's strategy on.*
>
> *The site lists six important aspects of encouraging learner motivation and suggests that they be implemented at different stages of the learning process.*

Initially the point when a user first begins to use a product is discussed and the strategies suggested at this point are creating positive attitudes towards learning and understanding the needs of your learner.

Next the phase where the user is interacting with the product is explored. Creating a stimulating and positive atmosphere are highlighted as key strategies at this point of learning.

Finally the completion of the learning package is discussed. Learners will wish to feel as though they have mastered the concepts presented in the package and therefore affirming learner competence is important at this stage. Reinforcement is the final strategy discussed by this site and is considered important as it is the "reward" a learner receives at the completion of a product. (Subject 101)

Others were much simpler, being one line synopses of sites along the lines of 'principles in designing for IMM products which have PBL – problem based learning' (Subject 89) or 'This site expands on the ideas mentioned in this week's reading, particularly with regard to motivating learners in an on-line environment' (Subject 38).

While one example of a good critique has already been shown, not all critiques were of such a high standard. In a few cases, simple summaries of the sites were accompanied by brief personal reflections, such as 'I found this site very interesting' (Subject 85). Others provided a little more evidence of monitoring by drawing direct comparisons between the site and the reading itself:

Clear and simple points to figure out the learner motivation. But compare to this week reading, the site is not going as deep as the reading. They using different model for this writing. (Subject 11)

One way in which the Post URL tool was able to extend on monitoring processes was by adding another level of critique in the form of rating URLs that had been posted. For example, one URL received the following replies:

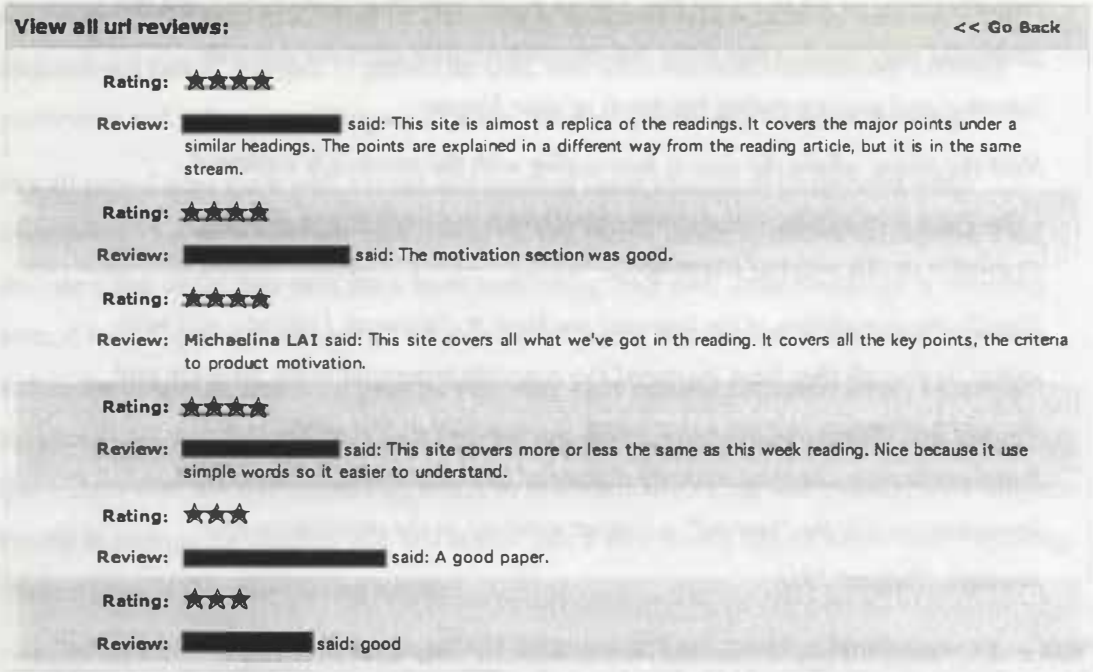


Figure 8.16: Ratings in the Post URL tool

As Figure 8.16 shows, most responses were somewhat brief, particularly the final two, which contributed little to the overall discussion. Some monitoring was evident in the first few responses which, while repetitive, attempted to draw comparisons between the two websites. The act of rating itself would have necessitated monitoring in the form of evaluating the website, the comparison coming from matching expectations and existing understandings to the new URL and then applying a sense of value to it.

Ultimately, the Post URL tool appeared to elicit a broader range of monitoring processes than were expected. While primarily a tool for information seeking, the use some subjects made of the tool to summarise sites and rate those posted by others also meant that it was an effective means of comparing ideas and organisational monitoring, albeit in a more limited mode than was achievable in a more broadly defined tool such as annotation.

8.1.8 Monitoring in the Discussion Tool

In Week 7, this tool generated 2,200 words from 29 individual submissions. As such it was the least used of the tools. It was also the most similar in terms of the cognitive activity it elicited to the Annotation tool, which was the most widely used. As a forum for sharing ideas in a global sense rather than relating to a specific point in the text, one might have expected responses to be more general in nature, although with more room for opinion and the opportunity to integrate concepts beyond the specific concepts within the reading.

Certainly, many of the comments were quite general in nature. Several failed to integrate specific concepts into their discussion, as was the case with Subject 108:

> *I do agree that it is important to follow guidelines such as the ones shown in this weeks reading but I also feel that if we do not experiement and think outside the square we live in we will not grow. And IMM is growing at an amazing speed.*

Such platitudinous comments do not demonstrate any clear metacognitive monitoring. While the point made is valid enough, a lack of any rationale, or reference to specific examples, dilutes its value both as an example of monitoring and as a contribution to the reading content.

It appeared that many of the responses were written without a clear sense of audience. While discussion forums typically provide a means for people to share ideas and opinions, and answer each other's questions, 14 of the responses could be defined as a summary. These responses were frequently similar in style to those actually posted in the Summary tool:

> *This article discusses about developing IMM into education. Obviously, the eight elements mentioned are very important because those elements made learners want to learn efficiently and effectively. Learners definitely want to learn which gives benefits to them and worth doing. For example, with reflection, learners definitely want to know where the links will bring them. Majority of learners would not want to waste time to figure out how the site works. (Subject 32)*

The above example was quite typical of the responses, with summaries being similar in nature to those in the Summary tool, although much briefer. It would appear that many subjects were using the discussion tool, more as a means to make brief personal summaries to assist in later review than to create a strong discussion.

Of the other responses, a number of subjects did provide evidence of monitoring of their understandings by generating discussion through posing questions:

> *Besides the eight learner effects (immersion, reflection, transfer, collaboration, learner control, curiosity, fantasy, challenge) mentioned in the reading, what other important criteria do you think can be added to produce an effective IMM product? It is time consuming to produce a high quality IMM product that contains these eight learner effects but I believe there are more to these eight learner effects. Personally, I think getting users of the public to give feedback and ideas of their own can be brought into consideration. (participation learner effect?) Just a thought, any suggestions? (Subject 74)*

The paucity of replies to the above example, however, suggested that either the question was framed in such a way as to inhibit discussion or, more likely, other subjects simply did not wish to engage in a debate. One subject did pick up on the above example and emphasised aspects of it, stating:

> *I think what **** suggests about 'participation learner effect' can be brought into consideration. By allowing them to participate or give the opinion on their own can increase their motivation to learn more. (Subject 114)*

In effect, the above subject was simply emphasising a point made previously, in her own words. While the selection and emphasis on specific items showed some organisational monitoring, it did not really extend beyond the reading, as was the case in Subject 130, who wrote:

> *Generally, the better ways to maintain learners' comfort, learners' interests, and to improve transfer of learning, the teaching content in the IMM programs should be designed with realistic situation, realistic activities, and realistic experiences. The teaching elements, such as guidance, surprising elements, elements with diversity of choices and paths, and learners' freedom to choose their own learning, are the basic elements to build motivating and engaging IMM. (Subject 130)*

While not particularly detailed in terms of examples provided, or reference to personal experience, at least this subject did attempt to add new information to the reading. Again, however, in titling her response 'general points' the subject appeared to be using this opportunity for brief personal reflection rather than to engage in more complex forms of monitoring.

Ultimately, while the Discussion tool had the potential to engage subjects in a variety of forms of monitoring, this tool was less popular than the others, and tended to elicit monitoring in the most limited ways. This could possibly have been a result of the Annotation tool, which was much more widely used, and whose focus on contextual content as the basis for discussion promoted a wider range of monitoring processes than the more general discussion and summaries evidenced here.

8.1.9 Conclusions about types of monitoring within Mark-UP's Tools

All of the tools offered affordances and limitations in the types of monitoring that they promoted. The Forum Discussion tool certainly appeared weakest both in the variety of monitoring and depth of monitoring evidenced. Of the others, a range of processes was

manifest. The Summary tool tended to emphasise monitoring in the form of organising ideas, but also supported transformation of the reading concepts into more complex forms. The strongest summaries also evidenced an ability to critique the ideas and find applications for them. The same was true for the Post URL tool which, beyond the monitoring process of information seeking, also demonstrated some critique in the ratings of the URLs, albeit in a briefer and more limited manner than was evidenced in the Summary tool.

By far the most complex forms of monitoring appeared to take place within the Annotation and Design Problem tools. The Annotation tool supported multiple forms of monitoring such as questioning, comparing ideas and information seeking. In some cases, the sequences of annotation generated a body of knowledge that went well beyond the artefacts that were actually being annotated. The actual depth of monitoring evidenced in annotation was very varied, however. This may have been partly due to some subjects using annotation as a means of emphasis of important points rather than further exploration, in itself a legitimate regulatory strategy for reading comprehension. Nevertheless, further exploration of how different subjects used different monitoring processes to support the metacognitive regulation of their learning was required.

This was also true of the Design Problem tool, which exhibited the most powerful forms of monitoring in subjects' transformation of reading concepts to solving complex design problems. As was the case with the Annotation tool, the selection of readings and problems appeared to have some impact on the quality of monitoring demonstrated within the tool. Also similar to the Annotation tool, it appeared that a range of forms of monitoring and depth of monitoring took place within each example.

To explore this aspect further, with a view to shedding light on the impact of individuals' existing cognitive and affective attributes in their use of Mark-UP and the value they found in it as an environment for supporting monitoring, the twelve interview subjects' portfolios and comments in interviews were analysed.

The next section reports how Mark-UP supported monitoring across a range of existing psychological attributes by examining the interviews and portfolios of the twelve interview subjects in the light of the types of monitoring which have been shown above.

8.2 Exploration of Mark-UP as an environment for supporting monitoring across the range of Interview Subjects.

Interview subjects' interpreted approaches to and levels of planning and evaluating their learning processes were discussed in the previous chapter. This section explores how they

used the tools to monitor their understandings throughout the implementation of Mark-UP. To conduct this exploration, the interview subjects' portfolios were examined to define the extent to which they used the various tools provided. They were also analysed to determine the level of monitoring demonstrated in the use of the tools in the light of the findings in the previous section about which types of responses best demonstrated metacognitive activity. Their statements in interview about their preferences for tools within Mark-UP, their use of reading concepts to solve problems, and the value of the problems to frame their exploration of the readings were also used, along with their reflections on the quality of their work throughout the semester. The results of this analysis are collated in Table 8.1.

Table 8.1: Interview subjects' monitoring in their use of Mark-UP

	Interpreted Level	Monitoring		
Name	of Metacognition	Pref Tool	Portfolio Qual	Interpreted Level
Dean	Low	Annotation	Medium	Medium
Yvette	Low	Annotation	Low	Low
Frances	Low	Annotation	Low	Low
Brian	Low	Annotation	Medium	Medium
Craig	Medium	Summary	Medium	Medium
Sylvia	Medium	Mixed	Medium	Medium
Jake	Medium	Annotation	Medium	Medium
Duncan	Medium	Annotation	Medium	Medium
Claire	High	Design Problems	High	High
Belinda	High	None	High	High
Debbie	High	None	High	High
Alan	High	Annotation	Medium	Medium/High

Each subject is discussed individually in the following section, and conclusions are then provided as to the relationship between the role of the tools in promoting metacognitive regulation, and subjects' existing metacognitive levels and learning preferences. Suggestions are then made about how the tools may be improved.

8.2.1 Claire

Claire was one of the interview subjects who were identified as metacognitively strong (Table 8.1). As such, it was not surprising that she displayed an ability to monitor her understandings both in interview and in her portfolio. While she was somewhat neutral overall in her attitude towards Mark-UP, she could explain the value of the tools available, although she may not have found value in them herself. When it came to marking up the readings in general Claire argued:

The [design problem] questions they were good because that meant that you actually had to read it, you had to understand it, and then you had to apply it to a situation so it wasn't... because a lot of markup I found is almost like a manual, its just there, everything is there all you need to do is read it.

This awareness of the division between activity around the reading and the use of the reading to solve problems was one of the characteristics of those subjects who were interpreted as displaying a high level of metacognition. Claire's preference was for learning activities that required transfer of principles to unfamiliar situations rather than focusing on the artefact itself, and this transfer could be seen as requiring a greater depth of monitoring than a more situated activity such as summary.

While Claire did one summary after the tools had been introduced, it was not her preferred mode of working with the readings. Instead she preferred tools that involved a greater level of reflection. In describing her approach to the Forum Discussion tool she stated:

Yeah, that's one I liked as well because the thing with markup was that you didn't get to talk to other people directly, you had to wait and then come back, it was a bit like e-mailing. You know you have to wait to see the responses. But that one... you could write your response and what you thought about it and THEN you could see what other people thought.

This prompted her to identify a weakness in the Annotation tool as a means of monitoring activity:

Annotations were a pain in the arse. You just... if you would just go right in annotation and then you'd have to wait for the whole process to go through and then if you were writing a question then you'd have to come back in a couple of days, if someone had written that and if they hadn't written it then you would have to keep coming back and forth.

It is evident from both of these interview comments that Claire actively monitored her understandings by seeking feedback on the ideas she proposed using the tools. The ones that were of least value to her were the ones that did not prompt that level of monitoring. Overall, her preference for the tools was mixed. She did not post URLs very much although she actively researched around topics ('I kept forgetting to put it down for other students to look at').

Many of Claire's comments particularly focused on the value of Mark-UP as a tool for monitoring. As well as the issue of not knowing when annotations had been added to her own comments, she also identified a weakness in the portfolio as a reflective tool, claiming 'when

you look at what you've written, if you disagree with what the person before you said, you can only see their last two lines'.

Claire's portfolio reflected this focus on monitoring. Her annotations displayed a variety of monitoring techniques. For example, in responding to a question asking for an example of intrinsic fantasy, she demonstrated information seeking through identifying an alternate source of information:

> *Learning in Cyberspace: Shaping the Future provides a good explanation supporting the view that effective learning can not take place without motivation. It also states "Sue Wynn ... extends the importance of motivation even further, concluding that ongoing motivation leads to lifelong learning".*

She also used annotation to address what she perceived to be misapprehensions in other people's comments:

> *I disagree. I think what they are referring to with Natural Language is the concept of Artificial Intelligent systems being able to effectively "understand" humans through speech and written text. That is, if I were in a wheelchair, by saying "open door", a robotic computer would recognise the speech and open the door.*

The overall quality of her portfolio was high (Table 8.1), but not the strongest. Claire found towards the end of the semester that her performance deteriorated ('that's when I was flat out, that's when I was not at my house, I was at my boss's house at the time'). This was reflected in some of the later design problems in her portfolio. Her response to the Week 12 design problem that required her to write a letter to a webmaster to suggest improvements was somewhat perfunctory, although she did directly refer to concepts in the reading such as including dates when pages were updated. The nature of the reading itself appeared to have some influence in this. Claire claimed in interview:

> *It was discussing it, but it wasn't really adding to stuff, it was like 'yeah'. I suppose it was just a whole lot of points so you didn't add, or you didn't contradict it, you just accepted it.*

More complex readings, however, such as Reading 4, prompted greater monitoring:

> *That was when you know what you did know and what you didn't know. If you didn't understand it then you had to go and find out and if you had to find out, maybe find your own reading.*

The Week 11 reading was a storyboard example. In this case, Claire appeared able to effectively transfer her understanding of the example to her own design, identifying similarities and differences based upon her specific needs:

> *Since the prototype we are designing was based around a linear functionality it is not necessary for us to detail each and every page as there were template designs used and called upon for, say, the questions. Where the only part that changed was the actual question text and answer text.*

In conclusion, monitoring was most evident in Claire's work where she was reconciling multiple perspectives or working with readings that she perceived as challenging. Others that were more straightforward did not require as strong a level:

> *If it's all in front of me I don't do it. It's just a book it's just a manual ... and if I get to go out and find it for myself then I'm learning.*

For subjects like Claire, Mark-UP was most valuable as a tool for metacognitive monitoring when it provided the means for a deeper form of monitoring. While the design problems afforded this, much of the activity that centred purely on the reading concepts was unnecessary.

8.2.2 Craig

Table 8.1 shows Craig's interpreted metacognitive level as medium. While he showed a clear approach to planning that was based upon learning goals, there was less evidence of metacognition in his approach to evaluation. This may partly have been because of his low level of motivation. Describing himself as having 'an irresponsible habit' he did not find it easy to maintain effort in his studies. Nevertheless, he could explain the choices he made in his use of tools. When asked about Forum Discussion tool, he complained:

> *I'm not a big net person. I don't like chat rooms; I don't like forums and on to the whole anonymous voices... just putting this on a screen.. urrghh.*

He preferred the Summary tool:

> *I think it just really helps you sort of remember something that you read, then kind of have to condense it down to I suppose the key points, it really just helps it to sink in.*

While this statement did not indicate any sense of questioning of his understandings or comparing them to other concepts, he did acknowledge the role of summary as a tool to distil concepts. Craig was less enthusiastic about the Annotation tool:

I suppose I thought it was a good idea to get you to actually read the readings and actively go through and actually analyze them. The annotation system... who knows just you read a lot of annotations and you just get the idea that they're put in there for the sake of the fact they have to put annotations there.

This was ironic, since in his portfolio, Craig made little use of summary, only completing the compulsory summary activity when the tool was initially introduced. At all other times, he tended to use the Annotation tool. From Week 5, once all of the tools had been introduced, Craig exclusively used the Annotation tool to 'mark up' the readings.

These responses tended to be somewhat brief and cursory in their approach. In replying to a post about the value of windows, his response was quite dismissive:

Pah! Windows, Shmindows! Bring back the DOS Shell! I loved that interface! So simple, yet so effective!

The above comment actually had some potential to be useful, and certainly did not suggest there was a lack of metacognitive monitoring. However, the brevity of the response prevented readers from understanding exactly why the simplicity of a command line interface had some benefits over a graphical user interface such as Windows.

Other comments were equally brief. In responding to a comment about the value of interface agents, Craig argued:

I couldn't agree more! I find them incredibly distracting and generally view them as being elements of poor design! On top of the information that they provide could easily be dug out of a help file if you were so inclined.

Once again, this was a valid comment. In failing to explain his response in any depth, the annotation indicated more of a lost opportunity to provide a rationale for his beliefs than a specific lack of monitoring per se.

Ultimately it appeared Craig's general lack of motivation had some bearing on the quality of his portfolio. His response to the Week 12 design problem regarding improving a site's homepage (Design Problem Example 1 above) showed a clear ability to transform his understandings from the reading towards the domain of design:

As far as you can see in the page there is no statement of purpose as to what the site is about or what information one might find on the page. This would be one of the easiest things to change by simply providing a brief summary of what the pages purpose is at the top. Although this page presents a face to the viewer (quite literally,) it does not provide any information about Gabhar or provide any means of contacting him. This could be better improved by providing a

simple email link on the page. The page has absolutely no means of feedback whatsoever and as far as I can tell is not intended to make money so I don't think that providing information on how it makes money is really relevant. To his credit, Gabhar does not have any glaring problems with his use of text but having said that he could have perhaps used a better colour scheme. The few links that there are on the page are easy enough to follow and provide adequate descriptions as to where they go but perhaps some better explanation as to what the links are there for would be nice. Having said all that there are many aspects of this site which could be changed in order to make it more appealing to users.

His acknowledgement of design requirements such as an articulated purpose, means of feedback and so on, tended to make up for the broad comments on issues such as the need for 'a better colour scheme'. In being drawn directly from the reading, yet showing clear application to his chosen site, the points made were indicative of a strong level of reflection. His annotation for that week too, was a little longer and added to the discussion, by identifying issues where sites capturing user information can be used for spamming and other unethical business activities.

Therefore, in being able to clearly explain a position and defend it in discussion, Craig appeared not so much to lack self-monitoring skills as to fail to show them at detailed enough level. It is reasonable to conclude that he did not have major difficulties with the reading content, and although he showed a clear preference for some readings over others in interview, he did not note any issues with them. In fact, all of his annotations were responses to others. It appeared instead that his neutral response to Mark-UP was a result of generally poor motivation, as well as his use of annotation purely to articulate a position in response to others rather than use the tool to negotiate his understandings of the topic. Therefore he can be classified as showing a medium level of metacognitive activity and an equally mediocre overall portfolio quality as a result of this tendency to apply himself only loosely to the Mark-UP activities.

8.2.3 Dean

Dean's background suggested an overall low level of metacognition and that was borne out by his approach to planning in terms of performance objectives and a tendency not to engage in self-evaluation. In interview he stated, 'I never liked reflection to tell the truth because generally it makes me think about what I did wrong more than what I did right.' In terms of his use of Mark-UP, product, Dean's pattern was to focus on annotation as his preferred tool,

despite showing no preference for it over the other tools when questioned in interview. One point he did make was that he valued the interactions with other students available in the annotation and discussion forum tools:

> *I like forums generally because you can say stuff and then people reply and then you can say stuff back. It's just like a nice place to get stuff out.*

While not very articulate, the above comment did indicate a level of perceived value from the tools. In fact, given Dean's overall low interpreted metacognitive level, his portfolio showed several forms of monitoring. Each week's submissions contained at least three annotations and these took the forms of questioning, where he asked about how far back web archives should be kept on-line for example, as well as more complex forms of monitoring. On several occasions he took issue with a previous annotation, as in this response to one student who argued menus were much more effective than command line interfaces:

> *I can't say that i agree with this. Menu's are easier, but that doesn't mean that they are better. I loved the old DOS days and while i didn't know much i knew enough to get what i needed to get done, and this wasn't a lot of commands, probably about 5 or so. While there is a lot to learn if you want to learn all of the commands there is nothing saying that you need to use all of them or anything close to all of them. Also since they are all words or abbreviations of words, there isn't much effort required.*

Such contention clearly demonstrates a level of monitoring in the form of comparing two positions. Not all of his annotations were of a high quality; several took the form of general agreements rather than adding to the body of information ('Yes, pop-ups are bad'; 'agreed: the microsoft office help agents (personally) are very well designed and organised'). Nevertheless, Dean appeared to show a definite improvement in the quality of his annotations throughout the semester, stating in interview:

> *I tried giving... I normally like to say why I think something, I tried saying it a bit more as to why and try and find a few other reasons as to why after as well.*

This was in contrast to his innate tendency to 'just write things, check if its good and then forget it after I paste it'. Dean also showed an ability to make use of the readings in his design problem responses, stating:

> *I always did the reading first so I would know what to say ... my memory is not that flash, but yeah.. I as far as I remember they were fairly well interrelated.*

While Dean did not complete the Week 12 design problem, his response to Week 6's problem, which concerned the application of a design strategy to a learning need, showed clear evidence of transfer of the reading materials to the problem itself:

> *A possible form of learning strategy could be to create a simulation. The user chooses how they want to build their house. Factors could be included being cost, time, area and location. After they choose how to build the house the simulation shows how energy efficient the house is, based on a scoring system. All parts of the house is customisable, that is the ventilation, the windows, the walls and all other parts. The user is effectively a house designer/builder. The simulation could be free form where the user chooses the variables (time, cost, etc), static where the user is given the variables and has to build above a certain level of effeciency or it could be both.*

As well as being a highly appropriate approach to the design task, the above response indicated a clear understanding of controlling and managing variables within a simulation using real time feedback as a learning mechanism, that was clearly drawn from the reading.

It would appear, therefore, that despite being interpreted as exhibiting an overall low level of metacognition, Mark-UP provided Dean with an effective means to monitor his understandings, particularly through annotation, which allowed him to ask questions and provide alternative points of view. His understandings of the readings were then able to be transferred to the design problem, suggesting an ability to cross the domain of reading comprehension to apply metacognition to the application of his understandings.

8.2.4 Belinda

Having been interpreted as highly metacognitive (Table 8.1), Belinda generally showed strong evidence of planning, monitoring, and evaluation throughout her interview and portfolio. This did not mean, however, that she always engaged formally with the process. While motivation was not an issue for her, her failure to engage in formal self-evaluation, and her acknowledged deterioration in the quality of her submissions to Mark-UP throughout the semester, were clear indications of her negative perception of the product.

In interview, she was cogent in her critique of Mark-UP. She did not see herself as operating at the same metacognitive level as other students and she felt Mark-UP was patronising in its approach to facilitating reading comprehension:

> *It's almost like junior high school – read this, give me a book report, I want to see that you've read it and that you understand it.*

For some of the stronger students, value may have been found in the tool by helping others out, but Belinda did not feel a sense of responsibility towards others, arguing, 'because school is so expensive in America you don't get kids there that are killing time or they're there 'cause Mummy and Daddy or HECS are paying for it'. She cited a previous unit and group assignment as an example:

> *I tried to do the mother's thing with project management and I actually did mine and a little bit of their work. I used it as a learning exercise for them because I wasn't going to carry them. They weren't going to learn anything. They're in their third year and I wasn't going to carry them all the way through the unit, but when I saw what it did to my grade point average it hurt me more than it hurt them. They benefited and I hurted.*

While the above statement suggests a focus on performance rather than learning goals, Belinda ended up withdrawing effort from Mark-UP since she felt she was 'doubling up' on her own study practices. In fact, she was quite positive about the strategies of annotation and problem solving themselves. In her own work she described how she would highlight and add comments to her own work, and while she found the problems onerous, it was more a result of her high expectations of herself than the nature of tasks. She certainly did not find the work difficult:

> *Not difficult, no. I didn't – everyone loves critiquing websites, so that's fine, although I actually critiqued it against a different set of standards than the week 12 - I used AQIS as an example, and my biggest downfall is that I probably put too much effort into it ... which adds to the complexity of the exercise.*

Such a statement shows a strong level of self-awareness, and an ability to select what she felt were appropriate resources to complete tasks, that went beyond those suggested. This high level of metacognition meant that she found summary somewhat limiting as a strategy:

> *I would prefer to read through something and give my opinion and then give it some context and maybe have to – and often I did put hyperlinks there and say I believe this, it may be a dissenting opinion or off on a tangent but read this and read this – two other completely different viewpoints and tell me what you think because you've only gone one viewpoint here.*

In effect, Belinda engaged in all of the metacognitive processes that Mark-UP promoted. She simply did not value having to do them in Mark-UP for others to benefit from. Her annotations in her portfolio were strong, as in this example where she discussed constructivism:

I disagree totally....

Not being a big fan of Constructivist theory (though it DOES have some merit with regards to the concept of scaffolding) I can see I am going to have major problems agreeing with this reading and what it proposes.

Firstly, the statement: "...to deal with these advanced then traditional models just need to be enhanced or modified as they provide a well grounded and validated beginning."

Says who? ... Not everyone, I assure you! Have a look at: "OLD WINE IN NEW BOTTLES: A PROBLEM WITH CONSTRUCTIVIST EPISTEMOLOGY" [http://www.ed.uiuc.edu/EPS/PES-Yearbook/92_docs/Matthews.HTM] for starters.

I am sure there is some merit in, and valid usage of, every learning model - -to some degree (depending on the learning situation)- but, to make sweeping statements like the one above is simplistic in the extreem! (And, in my opinion, borders on being ethically irresponsible.)

And further to the argument of modeling media after the Constructivist Model (without really understanding the full implications of that act and what ancillary outcomes of this approach may arise - primarily due to lack of understanding the theory -holistically)

See also: Summary of Proposed Research Program for Doctor of Philosophy from Curtin Uni. It brings up some very valid points that bear consideration. Especially in cultures with diverse religious beliefs, such as Australia. The fundamental right of a parent (or student) to not have his religious beliefs undermined by a system of education - regardless of intent - should not be violated.

Skim down (if you don't want to read all of it) to the paragraph begining:

Postmodernism is characterised by "Foundationlessness, Fragmentariness, Constructivism and Neopragmatism" (Polkinghorne, in Kvale, 1992). Postmodernism celebrates the diverse and the chaotic (Harvey, 1989) and is significant by its lack of absolutes and uncertainty (Eckersley, 1996; Giroux, 1992)

The lengthy annotation above demonstrates many of the monitoring characteristics identified in the previous section, including information seeking and comparing multiple perspectives. For Belinda, monitoring was integral to her life, and Mark-UP simply replicated the process for her:

Yeah, it's a check and I do those kind of checks on myself regularly. One if the things I do on the way home is unwind before I get home, is the half hour drive to the vines and it allows you to change gears and reflect on things and if not reflect on things then maybe sort through things and file them away – just part of how I operate.

While Belinda did engage in the types of monitoring that Mark-UP promoted, and could see the value of the readings and problems ('I enjoyed the actual readings and they usually pointed at the task or were useful in doing the task') ultimately it appeared that Mark-UP created an administrative layer on top of those processes, that inhibited her study style.

8.2.5 Yvette

Yvette was one of the weaker students in terms of her interpreted level of metacognition, and interpretation of Yvette's interview and portfolio was also made difficult by the fact that her actual experience with Mark-UP was very limited. In fact, her portfolio consisted of responses to the design problems that were generated exclusively within a word processor. Her stated reason for this was log-in difficulties that prevented her from successfully accessing the product. Nevertheless she felt she had had adequate experience with the product's tools over the first few weeks to comment, claiming, 'I found it very intuitive, I found it very interesting that I could post up responses and read other people's during the first few weeks.' Yvette was actually one of the most vociferous of the interview subjects in support of Mark-UP's Annotation tool. Like some of the other students who had been interpreted as metacognitively weak, she found value in others' comments:

If I didn't understand the reading what ... other people's comments would help me understand it and how they grasped it and how it's different from my perception of the reading.

This focus on differences in perceptions did suggest some monitoring was taking place on Yvette's part. It appeared her relationship with the tool was viewed by her as a transactional one, and she admitted to a certain defensiveness when it came to sharing ideas:

I prefer reading other people's than re-editing mine but I don't like giving out my ideas 'cause they might take it.

While she engaged in off-line summary, Yvette did not like or use other discussion forums or post URLs for the reasons stated above. Nevertheless she could see the benefits of the strategies integrated within the tools, acknowledging that if they were not implemented, 'I would just read, just read, just goes past my head, in and out'.

Ultimately however, Yvette demonstrated little evidence of monitoring in this unit during her interview. When it came to using the readings she felt, 'I didn't know what I was reading for until I read the response.. I mean the questions', and even then she had some difficulty drawing the connection between the two. When asked if reflection was something she engaged in as a matter of course, she stated:

> *Reflect on my own work? No but if other people like if a tutor reflected on my own work, gave me comments, I would respond to it but I wouldn't reflect on my work, no.*

Yvette's portfolio supported many of the findings from the interview, particularly with regard to this lack of reflection or use of the readings to solve the problems. Her response to the Week 12 design problem requiring her to draft a letter to a webmaster contained little that was not standard received notions of web design. Once she had provided a preliminary introductory paragraph her suggestions for improvement merely consisted of a list of faults:

- *No menus*
- *Images are not effective*
- *Not hierarchical in structure. This is a linear site*
- *Each page is not consistent in structure and colour*
- *Font used for text is too big*
- *No homepage*
- *No way of getting back to the 1st page*
- *No sufficient links*
- *No icons or buttons*
- *No graphic component besides .gif image at the top of the page*

This 'shopping list' of design issues lacked direct reference to the purpose of the site, or the concepts in the reading. The lack of synthesis did not suggest a strong level of metacognitive transfer.

It was difficult to ascertain any impact that Mark-UP had on Yvette's self-monitoring since, by her own admission, she did not use it. If the reasoning for this related to her existing cognitive regulatory skills, as was the case with Belinda or Claire, then some negative conclusions could be drawn about the usefulness of the product. However, her positive attitude towards annotation yet the lack of actual annotation artefacts to analyse made this subject an example of a student who did NOT use the product effectively for her learning. As such, the poor quality of her design problem responses suggested a need for the strategies promoted in Mark-UP rather than providing evidence of its effectiveness in providing a solution for that need.

8.2.6 Sylvia

Sylvia's level of metacognition was interpreted as medium. Her focus on learning goals was an indicator of the value she placed on her own learning processes, and this was reflected in her interview. She described an approach to improving her learning involving concept mapping based upon a book which she had recently read. It was evident that Sylvia reflected on her learning and sought to improve.

Sylvia claimed that all of the tools in Mark-UP had some value for her. She made use of the Annotation tool because 'it made me come to argue with myself' and 'kept me thinking about why this person said this thing he did'. While not very well explained, it was clear that Sylvia took advantage of it to monitor her own understandings. She claimed:

> *I think I learn a lot from the other students by reading what they said because to be honest some things are I don't really agree.*

The Summary tool was also useful to Sylvia, but she used it as an adjunct to concept mapping. After initially concept mapping a reading, she would then write a summary. Again, this was described in terms of monitoring, although once again, it was not very eloquently expressed:

> *I do concept mapping, so I don't summarise first. I go concept map and then at the end I will write it out for myself and then I just think wither it should be right or should I change and then I'll just paste it in.*

Sylvia's first language was not English and this did not allow her to explain the concept very efficiently but it was clear that the summary provided a further point for self-reflection. Nevertheless, she was less able to describe how she would compare ideas internally than use other external perspectives as a means of monitoring. With the Post URL tool, as with the Annotation tool, she described her approach in terms of the value she obtained from other people's ideas:

> *I think a lot of students wen in to practice something and putting some URLs so some of them were really useful, some are really good and a lot you might not actually look at all URLs.*

It would appear that Sylvia was in many ways quite a different student from Belinda, who found no value from others' perspectives, using her own understandings as a basis for her monitoring. Rather than describe monitoring in terms of actually seeking out new information through URLs and having to explain their value in the tool, she thought more about what information she gleaned from others' and how that impacted on her own thinking.

Her portfolio reflected this. While she used all of the tools each week, from Week 5 after they had all been introduced, there was a tendency for her annotations and summaries to be the most dominant. Week 9's Mark-UP activities, for example, consisted of six separate annotations of brief paragraphs and a summary of approximately 300 words. Her forum discussion post was a single comment about WIMP interfaces (windows, icons, mice & pointers), stating, 'I think WIMPs were a bit step in systems. Kudos!!' Sylvia's URL post, while an effectively chosen site, did not contain any discussion, other than, 'This URL speaks a lot on speech interfaces'.

It would appear that she felt more comfortable in responding to others, as this appeared to stimulate her reflection. Sylvia did not demonstrate a lot of variety in her annotations in terms of monitoring – while there were some examples of information seeking and bringing in her own experiences, many of her responses took either of two forms. Firstly she often disagreed with a concept proposed by other students. In discussing e-learning strategies involving group work, she argued:

> *I think that it is not very fair to say that students wallow in mutual ignorance. Usually, in groups, students will discuss with their group members how best to do something. In getting opinions and information from their group members, they will assess it themselves to see if it fits in with the logic of the entire project.*

This comment was selected both because it was typical of the way Sylvia monitored her understandings by agreeing or disagreeing with a point, as well as it being indicative of her own orientation to using the group knowledge as a measure for her monitoring. The second dominant form of monitoring in her annotations was a tendency to clarify concepts by stating them in her own words. In her annotation on storyboarding, Sylvia wrote:

> *A storyboard organises your thoughts for you, the order of flow, helps you to double check that your objectives are fulfilled, much like the foundations of building a house.*

On a section of a reading dealing with cognitive engagement:

> *My tutor told me though that technology has changed much, people have not. Their learning methods are still the same principles of learning have applied from 2000 years ago until now. And will do for the next thousand years Where 'the amount of effort = amount user learns' applies everywhere.*

It appears Sylvia certainly engaged in monitoring, but not perhaps at the same depth as those students perceived as metacognitively strong, such as Belinda.

One definite weakness in Sylvia's monitoring was a gap between reading content and solving the weekly design problem. While subjects such as Belinda could apply their reading understandings to the Week 12 problem involving critiquing a homepage, Sylvia's response made little direct reference to the reading.

> *Dear Sir/Madam I am a Mass Communication and multimedia student from the Edith Cowan University. I went to the excite site today and after evaluation, thought up some factors that could help to improve this site. Please do kindly look through. The site interface has not changed much in the last 5 years. This does not increase or encourage traffic to your site as people would not be interested to see the same thing over and again. The company logo, though very prominent, does not fit in too well with the interface. The banners beside it was very distracting, as they are animated gif banners. I would recommend coming up with a tag line, as it tells customers what your company does, your objectives are clear. There are too many table of contents on the homepage of excite.com. Although I understand it is to be a portal, it still is too cluttered with information such that it becomes overwhelming. I would suggest only having the links for the categories on the homepage and put their related sub categories as a link. The colors on this website are not well coordinated as it is not aesthtically pleasing to the eyes. Black, yellow, grey and light yellow are not good color combinations. If yellow is to be used at all, I would suggest it to be a gold and white scheme to be used for the site. Hyperlinks could be changed to gold and scrollbars could be gold too. Clicking on a link on the homepage brings the user to sites that have different interfaces, they can be green, yellow or black. This is not good for a website as it makes the user feel as though it is not uniform or the user might think that they have landed at another page. New and exciting contents should be thought up, as your esteemed company's name does dictate that it should be really innovative. Lastly, I think there should be a hierachical navigational structure in place so that it will not be so overwhelmingly full of information. Major categories shoul be drawn up into a menu. Related information can be grouped together and users will be able to find information easily.*

There is obvious synthesis in the above example. She was able to draw upon many design issues. Nevertheless, there was little direct reference to reading concepts, and in interview, Sylvia claimed:

> *The readings were only needed for the summary. And the tasks are based on what I know. Then you will critique it based upon your own skilling usually.*

Given the fact that nearly all students could identify the strong relationship between the reading and the problem, Sylvia's response stood out. She appeared to be engaging in monitoring within Mark-UP in a variety of ways, but possibly with less depth, and with a more limited sense of transfer than other students. While her response to the problem included information garnered from other readings (such as hierarchical site structures, use of colour and so on), the synthesis and transfer of reading concepts did not appear to be happening at such a conscious level.

Sylvia valued Mark-UP as a tool for monitoring her understandings because other students' responses gave her a basis for her cognition. She argued Mark-UP was a way 'of checking that we'd actually covered everything' and claimed the interaction 'gave me a kind of bonding with the school system because school systems are usually very cold'. This focus on community and external forms of feedback for monitoring suggested Sylvia made limited, albeit successful, use of Mark-UP as a tool for self-monitoring, where it was done within the framework of other people's points of view and where transfer took place in a heuristic rather than metacognitively manifest way.

8.2.7 Frances

Frances was one of the weaker interview subjects in terms of her interpreted metacognitive level (Table 8.1). In her interview she tended to lack insight about her own learning processes, although when situated specifically within the context of Mark-UP she was able to identify issues that had bearing on her ability to monitor her understandings of the readings. Frances could perceive the role of multiple perspectives in helping to monitor her understandings but claimed, 'it's difficult to align my thinking to other students'. Nevertheless she was a keen user of the Annotation tool:

> *Some students are smarter so I get to summarise and I get to make other annotations like they... I don't know one of the students but I think he always makes a very good comment so I generally try to find him.. and then see what he think about it and then I'll go back and read the markup and say maybe he's wrong but he makes me .. the way he puts his words makes me understand the markup more.*

This approach was useful for her in that it formed external feedback, without which she had little reference from which to monitor her understandings. She admitted that in a previous unit she never touched the book of readings but that Mark-UP assisted in engaging her with the content. Firstly it appeared to have a volitional aspect ('it makes me do the reading and it makes me do the activities whether I like it or not', but it also had a benefit in giving her an

opportunity to monitor herself claiming, 'you get go know what .. how your ... how do I say? How you're moving along like whether you're doing well or not.'

Without an external prompt, Frances did not appear able to able generate internal feedback to guide her learning, admitting, 'if I don't get any feedback I don't think I would go on ... I like to see what other people said for my comments or my discussion ... I get excited to read what other people say'.

With this in mind it was understandable that annotation was her preferred tool, specifically for this ability to use external feedback as a means of activating her own monitoring, although she was not able to express it effectively as such:

> *It kind of makes it interesting 'cause you get to see how other people react to the article like some of them may say they don't agree with the articles and they say they don't agree I like to see why they don't agree and maybe add on that says this is correct actually.*

The Summary tool was a support to the Annotation tool as far as Frances was concerned. Its role was not so much to monitor her understandings by expressing them in familiar terms as to organise her understandings after having used the other tools:

> *I get to compile what I learn from the articles so it really helped like when I went through the exam, I studied for the exam, I read the summary like what I did for the summary and then just go ahead and read the readings.*

This use of revision suggested that Frances was using summary as another external base from which to monitor her understandings, and feedback was also her stated reason for using the Post URL tool rather than the actual monitoring inherent in finding other sources of information for herself:

> *It helps me understand more like some of them I can accept like after a while I came and read what other people say ... this is a good one, site for this and then I go ... jump [to] websites .... So I just read whatever they posted and then it helps me understand.*

The Discussion tool had less appeal to Frances, mainly because she found the lack of threading made it more difficult for her to follow the discussions themselves, but the portfolio tool was valuable. While she found the formatting of it somewhat awkward, she enjoyed the facility of reviewing her comments and those of others, reinforcing her statement about summary as a tool for distilling a lot of the ideas gathered through annotation.

Frances' portfolio, as could be expected showed, monitoring at a somewhat crude level. Use of the Annotation tool dominated in her portfolio, and many of these annotations did show

basic monitoring. This appeared to develop as she progressed through the unit. Many of her early annotations showed little evidence of true reflection. Statements like 'I agree .. it totally depends on what kind of product is being designed' and 'this is a very useful checklist when it comes to interactive design' may have been valid comments but indicated little monitoring.

Her annotations did improve, however. After the first part of the semester, Frances started asking some rhetorical questions:

> *Why do we really need forced justification? If it is forced then what happens to the lines with the least amount of words? It will then stretch and then look vary ugly*

In another case she was able to agree with a comment based upon her own experiences:

> *Yep, I agree with guideline 4. I hate reading any kind of long articles may it be a textbook or something like this, but with questions I am forced to read the article so I can locate the answer. With this I am learning other things as well.*

While she was not able to articulate the secondary learning that resulted in the process of questioning a reading's contents, she did at least appear to be aware that *something* was going on. In interview, Frances herself noted an improvement in her annotations, admitting, 'the first few markup activity was quite low' but 'I saw how other people how they do it', and acknowledged that her understanding of readings improved as she went along.

Nevertheless, the majority of her annotations relied on personal experience rather than broader reading or examples as the basis for her monitoring, which did not suggest an ability to abstract her understandings and apply them to broader contexts beyond her own personal one.

Frances argued for the value of Mark-UP as a means for solving the design problems:

> *If you don't read the readings you can't do the activity like in my point of view like I tried to tackle it the other way round like try to cheat a bit but I can't 'cause I don't understand what they want so I had to go and read the readings first then do the activities.*

However, her actual design problem solutions were not particularly strong. Her response to the Week 12 problem was somewhat brief:

> *I am writing to you in reference to your rubber stamping website. I really think you should consider redesigning it if you want to get a good market for selling your rubber stamp.*
>
> *First of all, the main page is unorganized. I would suggest that you lay out the main page correctly. The menu should be on the left and goes downwards*

instead of just being at the top or no where. Buttons should be personalized to suit the theme of your page.

Might I suggest a color scheme to your page as well. A great webpage to see if your colours match is at www.colormatch.dk . This is a useful online tool to see if some of the color match your theme.

I would also suggest that your contact details be put in a "Contact Me" page so that you can put more information at the main page about current stamps on sale.

anohter thing i want to point out is your new designs page. I suggest that you put those pictures in thumbnails and in a table so that it will look organized and makes it easier for users to find.

for the calender, you should try to put those states into sub catagories so that the user would just have to find what state he/she wishes to find and not be bombared with all the information.

I really hope my suggestions would be able to help you redesign as i can see huge potential in it.

While there was some evidence of information seeking in identifying a useful website, this was identified as a resource rather than used as corollary to an idea or means to justify a particular position. Little direct reference is made to the reading although Frances did use some received notions about homepage design to critique points such as the need for sub-categories in tables.

Ultimately it appeared the Mark-UP was a useful tool for Frances, and certainly one she enjoyed. While her low interpreted level of metacognition appeared to impact greatly on the overall quality of her portfolio and she was not able to express her understandings as effectively as some others, the Annotation tool seemed to provide her with the external feedback necessary to prompt her own internal reflection.

8.2.8 Jake

Jake's experience with Mark-UP was somewhat similar to that of Frances. Like Frances, his favourite tool was annotation. While his portfolio demonstrated some use of the Post URL and Forum Discussion tools, these were used mainly for the purposes of reviewing others' work rather than expressing his own ideas. Jake argued, 'I don't have time to go and find all these things on the Internet [but] it's good to see what other people have found on there and how they have used it'. Likewise, the Forum Discussion tool was mainly used to see others'

general comments about the reading. While he used the Summary tool when it was required, he did not do so later in the semester, simply stating that the Annotation tool was 'easier' for him.

It appeared that his use of annotation was primarily as a tool to support the monitoring of his own understandings:

> *I preferred doing annotation. I found that easy to... as I was going through... to reflect on what other people were saying.*

This concept of reflection is one that Jake stated repeatedly in his interview. When asked whether he gave much consideration to his learning processes, he admitted, 'probably not, I probably just go through and as I finish a unit don't really reflect on what I've done to that point'. This was not surprising given his overall medium level of interpreted metacognition. However, it was clear by the end of the semester that he had given some thought to how he learned. He admitted, for instance, that the problems provided a means for him to focus on the readings, stating, 'you're doing the design and you have to reflect on the readings as you're doing it'. This conscious reflection with a view to transferring knowledge suggested that Mark-UP was effectively engaging Jake in monitoring.

Jake's portfolio provides evidence of the domination of Annotation as his preferred tool, with only four other instances of other tools used, specifically the Forum Discussion and Post URL tools. Jake's annotations provided support for the level of reflection he mentioned in interview. While the nature of the annotations themselves did not show as strong a level of synthesis as that of Belinda, for example, there was evidence that he was engaging in monitoring, particularly with regard to the range of monitoring techniques shown.

While Jake himself acknowledged, 'I tend to just respond to current annotations instead of starting new topics', his own annotations did demonstrate forms of information seeking, making contentions and integrating his own personal experiences. For example, he used a specific instance of where a friend received little feedback in an automated assessment activity as an argument to reinforce the importance of remediation:

> *The only level provided was a 0 for question, there were no explanations as to what the mistake was or how to avoid it in the future. This quickly leads to frustration, believe me, as I had to try and help her to figure out why the seemingly perfect answer was being marked incorrect.*

While further discussion of the issue could have provided a more detailed exploration of the role of remediation as a learning support, it did demonstrate a clear sense of monitoring, with Jake framing the information in light of his own experiences. This integration of external

examples also came through when Jake commented on the value of microworlds as a learning approach:

> *I don't know how successful Mario word was at teaching me anything. I recall using it as an alternative to the learning I was supposed to be doing. But I agree with the learning aspects being present in games such as Sim City which require skills such as resource management and infrastructure planning etc*

Again, this response could have been enhanced by a discussion of just how such environments promoted the secondary learning outcomes he mentioned. Nevertheless it was clear he was monitoring his own understanding of the value of microworlds by distinguishing between a successful and unsuccessful example. Such monitoring was also evident in the ways in which he disagreed with some posts. In one annotation, for example, Jake took issue with the concept that learning should be fun, arguing a need for discipline, while still admitting, 'I agree to an extent that fun can improve learning'. He was equally guarded in his discussion of the popularity of text-based adventure games, claiming that while such games were very valuable, we had become 'spoiled', arguing, 'we now expect a higher level of interactivity and engagement,' qualifying the argument with the comment, 'we are spoiled and I feel our imagination and creativity are suffering.' This even-handedness suggested that Jake's monitoring could allow him to selectively accommodate aspects of a point of view while contending other perspectives. Such complexity was also evident in the ways he integrated other sources of information, for example referring to Sony's robotic dog, *Aibo*, as a means of debunking the Matrix 'myth' of intelligent computers as potentially malevolent. So while Jake's use of the Annotation tool in Mark-UP did not demonstrate the depth of synthesis possible, the variety of forms of monitoring and the balanced approach to discussion provided clear evidence of the product's value in stimulating Jake's monitoring.

Unfortunately, however, these processes did not necessarily transfer across to the Design Problem tool. His response to the Week 12 Letter to a Webmaster activity was quite brief:

> *To whom it may concern, I couldn't help noticing when I visited your site today that your site is rather poorly designed. It lacks an intuitive menu structure, constancy in its layout, an attractive design, suitable colour scheme and pretty much anything that resembles what could be classified as style. I recommend starting from scratch with a fresh design that reflects the image you client would like to portray. The major issue to address is the currents sites poor navigation menu. Using hidden buttons that only appear on roll-over is bad design practice and totally confusing for new visitors. This does improve further into the site but the idea of a homepage is to allow "easy" access to the*

rest of the content. A simple and clearly grouped navigation bar positioned either across the top or down the side of the page would be much more suitable. Attractiveness can be achieved through simplicity and consistency, your current site is much cluttered in its layout and the large graphics dominating the homepage don't give any balance or symmetry to the site. I hope you take my advice into consideration in order to improve the useability of you site Regards...

The brevity is exacerbated by the fact that any reference to reading concepts is implicit rather than demonstrating any direct relation between the concepts and the site analysed. Comments such as 'it lacks an intuitive menu structure, constancy in its layout, an attractive design', and so on are too vague to tie directly to the reading, and his recommendations for improvement warranted further detail.

It appeared therefore that Jake found value in Mark-UP primarily through the Annotation tool as a means of monitoring his understandings. He could clearly engage directly with concepts in the text and was capable of drawing in personal experiences and other information as well, applying a reasonably high level of synthesis when it came to agreeing or disagreeing with reading concepts. The greater difficulty in transferring across to actual design was probably symptomatic of his only moderately interpreted level of metacognition. This leads to the conclusion that while Mark-UP appeared to support Jake well in engaging in monitoring around the text it did not so easily support transfer across the domain of reading comprehension to solving design problems.

8.2.9 Debbie

Debbie's high interpreted level of metacognition was evident in the ways in which she monitored her understandings while using Mark-UP and in the ways in which she critiqued her own performance in interview. On the whole, Debbie did not like Mark-UP. While she found the activities 'useful', she claimed, 'I feel I could have achieved the same thing by doing my own study.' At the same time, she admitted its value for other students, stating:

I can see how it could benefit others, though... because if they are not familiar with or they don't understand what the paragraph's talking about they can go in and find out what others had to say about all that information

This was not the way Debbie preferred to work. Her use of the Annotation tool was guided by the requirements of the course, but when given the choice, her preference was for the Summary tool. This seemed somewhat contradictory to the concept of monitoring. As has

been shown, the Summary tool typically demonstrated a subset of the types of responses found in annotation, but such responses were typically more 'neutral' in terms of critical thinking and the monitoring that was demonstrated involved rephrasing concepts rather than adding to them.

It appeared that Debbie's preference for the Summary tool was underpinned by a lack of confidence. Previous experiences had impacted negatively on her evaluation of herself:

> *Yes I enjoyed the summary. I found it for me because when I was studying in High School and English wasn't one of my stronger points so if I can go through and reword that paragraph that was beneficial because I understood what that paragraph was talking about.*

This led to a reluctance to express an opinion:

> *When I had to read something again and put my opinion I was a bit hesitant I guess because I was concerned about 'Oh well I've got a crap mark over here, what's going to happen with this one'.*

However, this improved as she went along:

> *Finding that I actually understood what I was reading and I was concerned what mark I was going to get for the first half so getting my result and feedback it was like 'oh' and it really boosted my confidence.*

This initial lack of confidence did not appear to be tied to a lack of monitoring. In her approach to readings, her preference was for challenging ones rather than those which provided information with which she was already familiar since 'it wasn't stimulating enough'. Like Claire, she enjoyed the design problems, stating, 'the activities were designed well', but even then commented that in some of the later ones, 'I felt I was repeating a few techniques and skills'. This constant comparison was a positive indication of Debbie's continuous monitoring of her learning. In using the Design Problem tool, she made use of her Mark-UP around the reading:

> *I felt they were designed to use the readings, I couldn't have solved the problems without it [but] I also felt they worked and in hand also... I also read what I had to do first and kept that in mind while I was doing the reading.*

Therefore, while most of Debbie's Mark-UP in her portfolios consisted of summaries which demonstrated monitoring through more basic forms of rephrasing existing content rather than questioning, information seeking and so on, she was certainly more adept than Jake when it came to applying this knowledge across domains. Debbie did not actually summarise, annotate, discuss or post URLs around the Week 12 reading, perhaps because its nature as a

set of recommendations made it more 'obvious' than some of the others. Nevertheless, her comments demonstrated specific knowledge about the reading, including layout, colour and information architecture, which were transferred into detailed advice:

> *Lets pick a colour scheme of no more than three colours and stick to. Divide the page into sections, toward the top have a strong heading/title so people know what you are and provide an intuitive noticeable menu structure along one of the other surrounding borders this will assist users to know how to find desired information. You can have a news section simply section it apart from any common navigation and content, apply a differentiating colour or create a news icon to save on real estate. I'm assuming your site is designed for a recreational browse so make it easy for users to skim through information, so format your paragraphs of information with appropriate line spacing, indentations and left alignment. Don't let the txt run from one side to the other and make sure the content is up to date, easy and interesting to read.*

Debbie's portfolio was somewhat contradictory in terms of her monitoring. Low-level summaries gave way to complex solutions to design problems that clearly demonstrated an ability to monitor her understandings by synthesising the information into a practical form. In fact, her initial lack of self-confidence may have contributed partly to this. While she felt 'comfortable' in her reading skills, she was reluctant to use the Annotation tool because she felt a need to work out the meaning of a reading for herself. Therefore, most of her monitoring appeared to be internal.

Nevertheless, this approach appeared to produce some benefits and she noticed an improvement in both her confidence and skills:

> *My skills have developed, I think they came hand in hand. My skills came first because of the practicing. I spent hours... perhaps too much attention for the first four or five ... now I'll read and instead of doubting myself, I will just keep going. Before, I would doubt my comprehension.*

In Debbie's case, her use of Mark-UP appeared to involve monitoring that integrated a complex set of affective and cognitive components. Her actual pattern of use was somewhat similar to that of both Claire and Belinda, both interpreted as highly metacognitive, and like Debbie valuing the tool in somewhat limited ways. In Debbie's case, however, self-concept issues appear to have been resolved in part through her use of Mark-UP, even if only as a result of the rewards of perseverance. Ultimately, the product proved to be an effective environment in allowing her to transfer her learning across the domain of reading comprehension to being able to approach design problems.

8.2.10 Brian

Brian was interpreted as exhibiting an overall low level of metacognition, primarily as a result of self-perceptions that proved somewhat inaccurate and a tendency to think of his study in terms of purely external and volitional measures. In interview, however, he did manage to provide descriptions of how he used the tools within Mark-UP and his rationale for doing so.

Annotation was his preferred tool. Like Yvette, Sylvia and Frances, who were all interpreted as metacognitively low or moderate, Brian valued the opportunity to see other people's points of view:

> *I guess I like the annotations, like you're able to see what others are writing, what they're thinking, you know whether you base yourself on what they're writing about.*

He did not restrict himself to the Annotation tool, however. Summary was used as 'it's good to base, get your base points down and then expand' and he also valued the Post URL tool 'because then you have a comparison for the reading'. All of these approaches implied monitoring in the way he described them, using either others' perspectives, alternate readings, or his own summaries as the basis for reflection. Brian even mentioned the portfolio in terms of its ability to support exam revision, and was one of the few students who actually used it:

> *I'd just go through and have a quick skim of the readings see how things match, if they don't match I added a few things into my summaries yep. So yes like maybe Tuesday I'll print it all out and just do all of that and rereading the readings, go through my summaries and getting the main bits.*

It appeared as though the structure of Mark-UP provided a means and focus for monitoring in which he would normally not have engaged. The only negative comment Brian made about the toolset in Mark-UP regarded the Forum Discussion tool where he didn't 'think of forum as really of much importance' because 'it's more like annotating, annotation being in the broader sense'. For Brian it seemed that the structure provided by the Mark-UP toolset provided a framework for learning; hence the Forum Discussion tool, which did not specify topics and was not based around a particular region of the reading, was too unfocused for him.

When questioned about the Design Problem tool he was equally enthusiastic, claiming 'The activities besides the markup they're quite enjoyable like writing letters to the webmasters', and pointing to their role motivationally ('the fun activities kept me interested in the readings') as well as in learning. He was not able to explain his use of readings for solving the problems, however, beyond their ability to 'provide a structure'.

Brian's portfolio reflected his varied use of Mark-UP. While the Annotation tool was the most widely used, he also engaged in forum discussions, and posted several URLs. The level of monitoring shown in these forms was more consistent of his overall low interpreted metacognition. While the sites themselves were often quite valuable (for example a site on learner control to support a reading on motivation) his accompanying comments tended to be quite cursory, stating in this instance, 'this is the reading in practice. Talks about how the learner takes charge of their own learning.' His use of the Forum Discussion tool was similar:

> *Good point: I agree with what you have said. Everything seems to evolve as time goes on, this is no different with learning.*

Not all of Brian's work was of such brevity or superficiality. In his use of the Annotation tool on one section of a reading he commented:

> *Yep, good point. Students do need to get feedback quickly for them to take on board what is being said. The same applies for assignments, when we get them back weeks after we submitted them, we don't care about the assignment.*

The integration of such personal experiences could not be classified as highly in terms of monitoring evidenced as those for example of Belinda, who integrated new information and added significantly to the ideas in the reading. Nevertheless, it did show Brian was considering the ideas of the reading in terms of his own understandings, and was certainly an improvement on annotations in his portfolio such as 'yep very true, it is always important to know where you are' and 'I agree with this'.

Brian's response to the Week 12 Letter to a Webmaster design problem was a little better:

> *Dear Mr Webmaster, I wish to address the nature of your website. I have enclosed some ways for you to improve the nature of your site, perhaps make it look a bit more like a professional bank. Although you logo is an orange blob with text in it, i think that it would be best if it did not throb. I understand that this is just an internet bank, however there is no need to turn it into a site that looks like side show ally. You should include how the website makes money because it is not self evident. There is to many navigational strutures and links throughout the pages, it is just an inundation of information and options that is not necessary. You use the company logo for other things not just to go to the home page, which is what it should be primarely used for, but also to go to other links for example the Internet Banking Demo. That will just confuse users. Use graphics that show real content not just decorate your homepage in other words loose the colour scheme. Try not to animate your logo or anything else*

for that matter with the soul purpose of drawing atention to it. And do not have your logo throbbing. I hope this has helped.

Like Debbie, Brian managed to integrate reading concepts into his response, although it was a little weaker in terms of the monitoring demonstrated. While Debbie's response to the design problem modified the information to provide detailed advice, this response was a little less specific, showing monitoring in the form of selecting reading concepts rather than critically applying them to the website itself.

The relatively weak monitoring apparent in Brian's portfolio was not surprising given his low interpreted level of metacognition. Nevertheless, it did seem that in interview at least Brian could articulate a position on the toolset in Mark-UP based upon their potential for assisting him in monitoring his learning. In this sense it appeared the product was successful, albeit in a way that operated within his limited range of metacognitive skills.

8.2.11 Alan

Alan's age, experience, assertions about his level of self-awareness, and ability to accurately predict his performance in the unit suggested a high level of metacognitive ability. In interview he was clearly able to explain the reasoning behind his use of Mark-UP, although much of this was framed in terms of motivation rather than learning.

His preferred tool was the Annotation tool which, like Brian, he valued for the opportunity to review others' ideas:

It allowed me to gauge myself and read the other responses and just make sure that I was on the right track. And it was good to read other comments about... that didn't relate to the reading.. people would fill in comments about other aspects.

In this sense he was quite similar to Claire in the way he valued the Annotation tool, rather than Belinda and Debbie, the other subjects identified as having a high level of metacognitive awareness , who found little value in others' comments.

Nevertheless, Alan did find Mark-UP inhibited existing reading strategies. For example he did not use the Summary tool unless required to because he preferred to identify key ideas by highlighting them on paper. While he recognized the Portfolio tool as a useful one in being able to review the amount of work done and to be completed, he did not describe it in terms of learning.

The design problems themselves were 'good' and he acknowledged the value of the readings, saying, 'you basically had to do the readings to know how to answer the questions.' However he was not able to describe in any way exactly how he transferred the reading concepts in his use of the Design Problem tool.

It appeared, then, that despite his strong background, he was less able to articulate his level of metacognition than the other students interpreted as working at a high level of metacognition. This may have been partly due to cultural differences, being of Malaysian background, although he had lived in Australia for several years.

In any case, it was not surprising that the level of monitoring demonstrated within his portfolio was a little weaker than that of some of the other highly metacognitive subjects. Annotations were quite lucid, and demonstrated monitoring through the integration of personal experiences or through comments and contentions that did not draw heavily on detailed understandings but added to the discussion. In one example, Alan was able to frame his ideas about the impact of artificial intelligence on work life around his own experiences with industrial robots:

> *The company I work for has introduced a robot which moves stock from one area to another, this has taken the role of one persons job and with what ******* has said it does sometimes creates another job as you still need a human to key in instructions and manage that equipment. The benefits are to the company which has cheaper and faster production of goods and services as jobs are made redundant and processes are streamline.*

In another instance, his response to a comment about the inadequacies of interface agents was to suggest that they should only be available when deliberately accessed by the user:

> *Having an agent that uses meta knowledge to retrieve information on a subject it was designed for as well as bring in information and tie it all up together for the user to be able to read the information logically and clearly would be a much better role for the future of agents.*

Such strong evidence of monitoring was less evident in Alan's use of other tools. One Forum Discussion post added little to the existing comments:

> *I agree, the most easiest interaction interface would be WIMPS type. It is easy to use, graphically pleasing and icons and so fort allow first time users to grasps the concepts involved in using a computer much easier and therefore reducing the time to learn and minimises the difficulty.*

This response showed that Alan was able to rephrase and summarise existing comments but demonstrated little evidence of synthesis into something new.

Ultimately the same could be said of Alan's response to the Week 12 Letter to a Webmaster design problem:

> *Dear Webmaster(Alex Kramer), I have just visited your site and would like to make some suggestions in regards to improving your website. Please review the following criticism:*
>
> *1. Navigation needs improvement, Centered links going down the page could be improved by listing them horizontally.*
>
> *2. Use of bright colours as background colour is not apealing to some users and it would be advisiable to maintain a consistent layout and colour scheme throughout your site.*
>
> *3. Pages are very long and require the user to scroll down for longer than is acceptable.*
>
> *4. Images shown throughout the pages would be best served using thumbnails. this would allow users to preview all of the photos on the one screen and will allow for faster downloads.*
>
> *5. pages from the home page have no navigation or even a home or back button. Users have to use the browser back button to return to the homepage to find access anotherpage. It would be ideal to put all these links onto all apages.*

It is clear that Alan was able to show monitoring in the form of identifying key ideas and applying them to the problem. What made his response a little less cogent than those of other subjects interpreted as highly metacognitive was the level of higher order thinking shown. For example, Debbie's response to the same problem involved inference about the target audience and customised the information in the reading accordingly, while this one was more formalistic in nature.

Mark-UP did appear to provide an effective medium for Alan's monitoring although he did not demonstrate the range and depth of some other students. His neutral attitude to Mark-UP was no doubt informed by his existing approaches to learning, which the product tended at times to replicate and at others confound (as in the lack of an ability to simply highlight key phrases). The product seemed to be most effective in the opportunity it gave Alan to view other's comments which lead to a deeper level of monitoring demonstrated in the Annotation tool.

8.2.12 Duncan

As the highest performing student of the group, one would have expected Duncan's level of Metacognition to be equally high. In fact, his interpreted level was more moderate, given his apparent inability to describe the strategies he used for reading and study in interview. His description of how used the tools within Mark-UP to monitor his learning were equally vague.

Like most of the other subjects, his preference was for the Annotation tool, although his portfolio demonstrated a range of tools used, and he admitted that he was not aware he could choose which tools to use. Duncan said:

> *The annotation was good because it was specific on the actual bit like you're reading over it and then the annotation is right there.. that's what made it useful.*

As well as the proximity of the annotations to the artefact enhancing their relevance, it was also the views of other people too, that he found valuable:

> *Sometimes you wouldn't understand a point like someone would put, someone would say this means this or whatever or someone would ask you a question and someone would answer it, and that was quite good actually.*

It appeared that like many of the subjects interpreted as metacognitively moderate, monitoring was best activated for Duncan when spurred by an external stimulus rather than taking place through a process of internal negotiation.

He found the Forum Discussion tool less valuable, as it was more general in nature, and therefore 'kind of a bit redundant' and made little comment on the Portfolio tool and Post URL tools other than they were 'OK'. Duncan was more expressive about the value of the Design Problem tool. In interview he stated:

> *They were pretty good... I could see where they were coming from. It wasn't that they were just random things. They made sense with what they were getting at.*

When asked specifically about the relationship between the design problems and the readings, Duncan could explain some connectedness between them:

> *It makes you think about you know if you have to relate the reading to the problem, then you have to think about reading a bit and analysing... you've got to relate it somehow so you probably got to understand it a bit better.*

It appeared therefore that if monitoring was something that he did as a matter of course during his study it was not something that had been abstracted to the level of being a metacognitively

conscious activity. The reliance on external feedback was a feature that could be seen in his portfolio.

While Duncan used a range of tools, it was with the Annotation tool that he best demonstrated monitoring activity. In one annotation about complex interfaces he was able to relate the content to a specific example:

> *"Learners become disoriented when procedure are complex, insufficient or inconsistent." A good example of a disorientating interface is the command line interface for operating systems. The complexity involved is high, so that many users will just give up without knowing where to start. This does not mean the command line is not useful, just not intuitive for a new user. The command line can be very powerful if used correctly.*

In another, Duncan disagreed with an annotation about the commercial nature of the World Wide Web driving eye-catching design:

> *I think they were refering to "information sites", like you look up info on physics theories or whatever. But from a commercial POV, then yea you need something that catches the eye. But I wouldn't go so far as to say "Most websites these days are commercial, either selling a service or endorsing a product"... there's a lot of stuff out there that's not for commercial purposes. Again, depends what you use the web for though.*

While it appeared that the nature of Duncan's uses of Mark-UP demonstrated an implicit monitoring, this did not always appear to be a formalised process. As the annotation above demonstrates, Duncan's posts tended to be less specific than some of the others and draw less directly on experience and other readings, although obviously spurred by the external stimulus of a previous post. His use of the Forum Discussion tool to respond to a storyboard example was equally cursory:

> *You have to be able to give [a storyboard] to a programmer, and they should be able to create that product exactly how you want it. There is no owhter way than to include a lot of detail.*

His response to the Week 12 Letter to a Webmaster design problem therefore was unsurprisingly vague in its relationship to the reading:

> *Webmaster, I visited your site looking for information on basketball rules, and I found it quite difficult to find what I was looking for. The links on your site are difficult to see, I didn't know they were links at first. I think maybe the primary navigation of the of the site could be more obvious, and seen immediately on*

the front page, rather than having to scroll down to see it. I also feel that the fonts and colours used on the site hinder the legibility of the page. There also isn't a consistent structure between the different sections on the page. Hope this criticism helps you improve your site!

Such responses were typical of his responses in the Design Problem tool. Duncan himself admitted he was 'lazy' and it appeared that a slightly inflated assessment of his Mark-UP portfolio, combined with a high quality group submission for his major assignment, contributed to his overall high mark in the unit. Duncan also displayed a clear sense of inquiry and intelligence in interview. However, the actual nature of his posts within Mark-UP demonstrated a level of monitoring more consistent with his moderate interpreted level of metacognition.

It appeared that Mark-UP was most effective for Duncan when he used the Annotation tool to respond to others' comments rather than the reading, and the lack of detail when responding directly to a reading or applying understandings to a design problem suggested he was less able to monitor internally or transfer across domains.

8.2.13 Conclusions about monitoring demonstrated within the interview group.

One of the strongest findings in this exploration of the interview subjects' use of Mark-UP to monitor their understandings was the perceived strength of the Annotation tool for this purpose. Being one of the more unique aspects of the product, it was gratifying to find that the majority of students found value in it.

This was not true for everybody however. As Table 8.1 shows, Annotation was more popular with subjects who were identified as metacognitively weak or moderate than with those who were interpreted as operating at a high level of metacognition. While Alan's preference for annotation seemed to be in contrast to this, it was interesting that his overall portfolio displayed a lower level of monitoring than some of the others. While the emphasis that annotation placed on external references for monitoring meant that it was very accessible to weak or moderately metacognitive students, it did not always promote the deepest level of monitoring. Nevertheless, as Table 8.1 shows, nearly all subjects were able to demonstrate a medium level of monitoring within Mark-UP, and the Annotation tool appeared to be the dominant medium for this.

For the metacognitively strongest students, the Design Problem tool was found to enable a deep level of monitoring and demonstrated their ability to actively monitor their understandings to apply reading concepts to new and unfamiliar tasks. Claire, for example,

noted the value of this above all other tools. This was not always true for the metacognitively weak or moderate students however. While Jake could argue strongly around a specific point in a reading, he was less able to transfer this knowledge across to practical application.

In this sense, it appeared that Mark-UP supported subjects in operating at a level of monitoring commensurate with their interpreted level of metacognition. Where there were exceptions to this, subjects nearly always displayed a deeper level of monitoring than their metacognitive level would have suggested. As Table 8.1 shows, only Yvette's level of monitoring was interpreted as low, and she was also the subject who made least use of the product. Dean, Frances and Brian were all capable of demonstrating monitoring when tied to an external form of feedback.

A big issue in the way subjects monitored was the impact of affective components on the ways in which they used the Mark-UP. Duncan's self-proclaimed 'laziness' undoubtedly impacted on his performance within the product. Equally, Debbie's choice of summary restricted the range of monitoring she was able to demonstrate compared to her use of annotations. The fact that this choice was guided by a lack of confidence and the overall high quality of other forms of monitoring demonstrated suggested that the cognitive aspects of self-monitoring could be greatly impacted upon by issues such as self-concept and motivation.

In the end, it appeared that the metacognitively strong subjects were the ones who were least well serviced by the product. Alan's slightly lower performance compared to his high interpreted level of metacognition provided a reminder that monitoring was only one aspect of metacognition. Other aspects such as his emotional maturity and ability to regulate most aspects of his life were not necessarily captured in his use of the tool. The positive value he placed on the product also gave some confidence in the worth of the product. Unfortunately this was not true for Debbie, Belinda and, to a lesser extent, Claire. While some value was found in the Design Problem tool's ability to act as a medium to transfer learning concepts to a practical outcome, the fact that Mark-UP tended to replicate what were already well established cognitive strategies for these subjects made it more of a hindrance than a help. Nevertheless, all three students were able to demonstrate a high level of monitoring in their use of the product.

8.3 Conclusions about the role of Mark-UP in supporting monitoring as a component of self-monitoring

The aggregated findings of the interview subjects' backgrounds, interpreted levels of metacognition and their experiences with Mark-UP for planning, monitoring and evaluating

their learning processes are summarised in Table 8.2. From this and the findings from the broader subject group, it is evident that Mark-UP provided a means for the majority of subjects to develop and articulate their understandings of reading concepts and apply them through the metacognitive processes of planning, monitoring and evaluation. The analysis of data produced within Mark-UP and by subjects as they used the product led to the following conclusions:

- subjects demonstrated a range of goal orientations and approaches to planning;
- Mark-UP provided a means to assist subjects in developing plans that were both process/learning oriented;
- subjects demonstrated evaluation within Mark-UP at both object level (eg reading skills) and process level (learning strategies);
- annotation was the most widely used tool in Mark-UP and demonstrated the broadest range of monitoring processes;
- the Design Problem tool provided the most complex form of monitoring in its ability to promote abstraction from a specific form (the text) to be applied to a practical problem;
- the other tools (Summary, Post URL, and Portfolio) were less popular, promoted more limited forms of monitoring, and were valued as an accessory to learning rather than central to subjects' strategies;
- the majority of subjects could articulate the ways in which they used the tools within Mark-UP to monitor their understandings;
- subjects interpreted as metacognitively strong tended to demonstrate stronger monitoring in their use of the Design Problem tool than moderate or weak students; and
- subjects interpreted as metacognitively weak and moderate were able to demonstrate monitoring primarily through the Annotation tool as well as summaries in the forms of contention, questioning, information seeking, and drawing on personal experiences.

However, these findings also raise a number of issues that need to be addressed in future instantiations:

- the design of activities within Mark-UP did not provide an adequate level of feedback for weaker students to assist them in developing plans;
- the formal nature of planning within Mark-UP was counter-intuitive for stronger students, who found it an artificial approach to a natural, implicit process;
- the majority of planning was described by subjects in terms of effort rather than learning, the latter being more closely associated with metacognition;

Table 8.2: Aggregated findings of interview subjects' self-monitoring in their use of Mark-UP

	Name	Dean	Yvette	Frances	Brian	Craig	Sylvia	Jake	Duncan	Claire	Belinda	Debbie	Alan
Subjects' Backgrounds	Age	20	22	23	19	19	20	21	22	23	48	23	32
	Gender	M	F	F	M	M	F	M	M	F	F	F	M
	Degree	BSc Soft Eng	BSc C & IT	BSc C & IT	BSc Soft Eng	B Comms	B Comms	BSc Int Comp	BSc Soft Eng	B Comms	B Comms	BSc Int Comp	B Comms
Subjects' Interpreted Levels of...	Metacognition	Low	Low	Low	Low	Medium	Medium	Medium	Medium	High	High	High	High
	Reading skills	Low	Low	Low	Low	Medium	Medium	Medium	Medium	Medium	High	Medium	Medium
	Technology skills	High	Medium	Medium	High	High	High	Medium	High	Medium	High	High	High
	Motivation	Low	Medium	Medium	Low	Low	Medium	Low	Medium	High	High	High	Medium
Attitude	Attitude to Mark-UP	Positive	Positive	Positive	Positive	Neutral	Positive	Neutral	Positive	Neutral	Negative	Neutral	Neutral
Performance	Intended Result	Pass	Distinction	Distinction	Pass	Credit	Distinction	Distinction	Distinction	Distinction	Distinction	Distinction	Distinction
	Actual Result	53 Pass	62 Credit	60 Credit	62 Credit	63 Credit	64 Credit	64 Credit	84 High Distinction	68 Credit	74 Distinction	74 Distinction	69 Credit
Planning	Goal Orient.	Performance	Performance	Mixed	Performance	Learning	Learning	Mixed	Performance	Mixed	Learning	Mixed	Performance
	Type	None	None	None	Effort	Effort	Learning	Learning	Effort	N/A	Effort	N/A	Effort
	Interpreted Level	Medium	Low	Low	Medium	High	Medium	High	Medium	High	High	High	Medium
Initial Evaluation	Reading	N/A	N/A	Low	Medium	N/A	High	High	Medium	High	High	N/A	Medium
	Strategy	N/A	N/A	Medium	Medium	N/A	Medium	Medium	Medium	High	High	N/A	Medium
	Self	N/A	N/A	Low	Low	N/A	Medium	Low	Low	High	Medium	N/A	Medium
Final Evaluation	Perceived Improvement	Low	Low (int)	High	Medium	Low (int)	High	Low (int)	Low	Medium	None	None	Low
	Focus	Plans	strategy	Mixed	Plans	Strategy	Mixed	Strategy	Strategy	Strategy			Mixed
Overall Evaluation	Overall Interpreted Level	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium	High	High	High	Medium
Monitoring	Preferred Tool	Annotation	Annotation	Annotation	Annotation	Summary	Mixed	Annotation	Annotation	Design Problem	None	None	Annotation
	Portfolio Quality	Medium	Low	Low	Medium	Medium	Medium	Medium	Medium	High	High	High	Medium
	Interpreted Level	Medium	Low	Low	Medium	Medium	Medium	Medium	Medium	High	High	High	Medium/ High

- both planning and evaluation are implicit processes of self-monitoring and difficult to treat as discrete processes;
- subjects interpreted as metacognitively weaker were less able to evaluate their learning than moderate or strong students, while subjects who were highly metacognitive derived little value from the process, suggesting a 'sweet spot' in Mark-UP's value as an evaluation tool mainly for metacognitively moderate students;
- subjects with a high interpreted level of metacognition tended to resist the monitoring processes in Mark-UP as they replicated existing strategies;
- subjects with a low interpreted level of metacognition tended not to be able to apply their monitoring to transfer their understandings from reading comprehension to design; and
- self-concept, motivation and the level of subjects' volitional control were strongly related to the quality of subjects' work in Mark-UP, suggesting such attributes needed to be taken into account when constructing activities for students.

The above findings provide a strong basis for confirming the effectiveness of Mark-UP for promoting the self-monitoring activity inherent in the development of cognitive self-regulation, while at the same time highlighting aspects of its design where opportunities were lost and changes needed to be implemented to make the best use of the product.

The next chapter concludes this thesis and addresses the above issues with a view to providing suggestions for the next iteration of Mark-UP within this study's framework of design-based research.

9 Summary and Conclusions

This thesis has documented the design-based research of an on-line environment designed to support the processes inherent in metacognitive regulation of learning. Findings have been discussed that relate both to the useability of the product and its value as an instantiation of the cognitive self-regulatory design model. This chapter concludes the study and, in the spirit of design-based research, proposes a further iteration of refinement to the product and summarises the findings of the research as a whole.

The basis for the inquiry was the Instructional Model for Metacognitive Development proposed in Chapter 2, and which is represented in Figure 9.1.

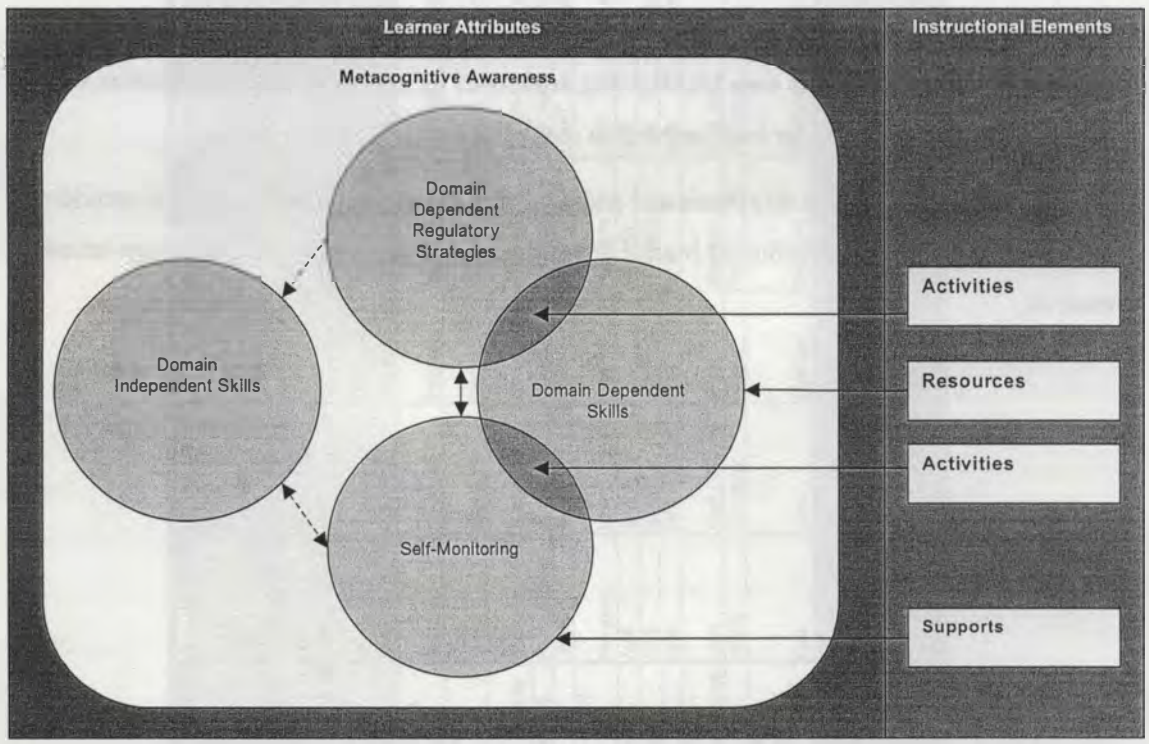


Figure 9.1: The Instructional Model for Metacognitive Development

The IMMD provides the psychological foundations of metacognitive development in the form of domain dependent and independent skills, regulatory strategies and the self-monitoring process that underpins the development and application of these. Outside of the learner,

instructional components in the form of activities, supports and resources provide the means of engaging self-monitoring and strategy use.

The chapter reports on the conclusions developed through the implementation of Mark-UP as an instantiation of the IMMD within the domain of reading comprehension. The chapter takes the form of two main sections in line with the two main aims of the research, relating to an exploration of the product itself, and its value in supporting metacognitive processes. This chapter therefore is framed around: a summary of the design and implementation issues with the product and suggestions for improvements; and conclusions about the product's value as an environment to support metacognitive regulation and suggestions for how these processes can best be promoted.

9.1 The design and implementation of Mark-UP and suggestions for improvement

The first research aim was based around how subjects used Mark-UP to assess the intrinsic value of product as a useable e-learning environment:

Explore how students use an on-line learning environment designed as an instantiation of a model for facilitating cognitive self-regulation of reading comprehension

The research demonstrated that the majority of subjects found Mark-UP to be a valuable and easy to use environment to support their learning. Its workflow and structure appeared to be logical and readily manifest to the subjects, with many of the findings emphasising its simplicity and self-evident functionality. Nevertheless, in conducting the study a number of issues were raised with the design and implementation that should be considered for future iterations of the product. These appeared to fall into three main categories:

- aspects of the user interface;
- the provision of help and subjects' confidence in the product; and
- instructional design of activities and workload.

Each of these aspects is discussed in turn with suggestions as to how they can be improved in future versions of the product.

9.1.1 Enhancing Mark-UP's user interface

While the general perception of the interface was that its lean and uncluttered look made it amenable to subjects' learning, some issues were found with the use of icons, the tendency for

the product to spawn multiple windows and a tendency for some functions to not be immediately apparent.

Improving icon use

Icons were used to indicate the types of annotations that subjects made, with different facial expressions representing the annotation types of *agree, disagree, summary, general,* and *question.* A yellow 'post-it' style note was used with a number reflecting the number annotations where there were multiple comments on a single section of the reading. While most of the subjects were happy with the use of these icons, particularly with the ability to view the number of annotations on a single section of the reading, many students found the *question, disagree,* and *general* icons confusing. This was a reasonable response given the neutrality of an annotation type such as *general* and the difficulty in rendering a response type such as a question, as a facial expression. During the prototyping phase of developing Mark-UP, icons were used that had a visual style reminiscent of tribal masks, which were even more arbitrary in nature. Since this proved problematic for subjects too, a solution would appear to be the use of icons that are more representative of the types of the annotation made. One way of doing this, rather than using facial expressions, would be to use hand signs and symbols. A 'thumbs up' signal could represent an *agree* response, 'thumbs down' would then represent a *disagree* response, and a *question* could simply be represented as a stylised question mark. While a *general* response is obviously the most vague of the annotation types, this may be shown as a finger with a knot tied round it to demonstrate its role as a general reminder of some aspect of the reading.

There was also some confusion over the use of icons for the page navigator and the task list. Arrow shapes were used for both of these although they represented different functions. In fact, this issue was related to more than just the visual appearance of the interface elements. Issues relating to their tendency to add an extra level of physical interaction to the use of the product are discussed later in this section. However, the use of similar icons for different purposes was obviously problematic. Simply changing the style of arrow to differentiate between the two functions would have simply resolved this issue.

Reducing pop-up windows

The use of pop-up windows, while common to many web environments, proved to be a problem in Mark-UP purely because of the number of them. Figure 5.10 demonstrates that in some instances, subjects could have had four windows open at any one time. This problem may be overcome in two ways. The first involves integrating Mark-UP more closely with the Learning Management System, to alleviate the need for an index of readings (readings could then be integrated directly into the LMS schedule with a script directing the user to the

appropriate Mark-UP page). Another way of minimising the number of windows would be to use a technique supported by browsers such as Safari and Firefox, which both use tabs as a means of multiplexing the information areas. The familiarity of this paradigm as well as the value of tabs in providing instant visual cues as to the availability of tools or sections of the product would enhance both the visual economy of the environment, as well lessen the cognitive load required when switching between multiple windows.

Avoiding hidden tasks

When confronted with the reading page for the first time, many subjects had difficulty with knowing exactly how to use the interface. This problem related both to the task and page navigators.

The page navigator required subjects to use arrow icons to select a page number and then click on *Load* to access the specific reading page. This required at least two clicks, even if subjects only wanted to visit the next or previous page. The page navigator was already a minor refinement of the prototype where all page numbers were presented as a list down the side of the reading page. While easier and more intuitive than the page navigator that was used in the version of Mark-UP implemented in the research, this approach caused problems when there were many pages to a reading requiring a commensurately large number of options for navigation.

There are two potential solutions to this. The first would be to simply modify the page navigator by incorporating the navigation arrows directly in line with the page number and maintaining the Load function, while adding extra icons underneath for *Next* and *Previous* that would automatically load the page immediately before or after the current one.

A slightly more complicated but perhaps more appropriate solution would be to borrow aspects of the original design where specific hyperlinked page numbers are presented to the user. This would allow direct links without the need of a Load button. Where there would be a large number of pages, the complexity could be minimised by using a subset of those pages. For example, a status bar to the side of the reading could list the current page, the three or four pages either side of it, a next and previous link, and a link to the four previous pages, and a link to the four next pages. Accompanying this would be an indicator of the total number of pages. In most instances, users would be able to navigate directly to their chosen page. If they wanted to jump to a page more deep in the structure, then they would be able to load the next list of pages and select the page directly from there.

While the design of the page navigator was necessarily complicated by the large number of pages potentially in any reading, the task navigator, however was more complicated than it needed to be. Originally, concerns about the availability of screen space to define multiple

tasks led to the inclusion of a drop-down menu represented by the arrow icon to reduce the amount of screen space occupied by the icon. In fact, this concern proved to be unnecessary. The ability of adding full descriptions to activities tied to tasks meant that the drop-down menu was not necessary. By simply removing the task description, the problem of users not recognizing the arrow's role as a drop-down menu is resolved. Users would then be able to access activities directly from the page, receiving a full description of the activity when it loaded.

9.1.2 Improving user confidence in Mark-UP

While most students felt comfortable with the stability and 'fairness' of the Mark-UP environment with regard to the product behaving as expected when users interact with it, some subjects during the study felt a resistance to it that was related primarily to some early bugs the system and difficulty in using the product in ways that were consistent with their need for a responsive and flexible workspace. Addressing these would enable greater confidence in its use.

Improving stability

There were no times during the research project when Mark-UP was unavailable to students. However during the first week of the semester, some subjects experienced problems where a design problem response was overwriting all of the other subjects' responses to that design problem. This instantly caused a lack of confidence in the system. The problem was the result of an error in defining the database field to be updated which occurred during the migration of the product from one version of PHP to another. It was unfortunate that this error was not identified before the implementation of Mark-UP, and emphasises that any future versions of Mark-UP would need to be fully tested before implementation to avoid this issue.

Care would need to be taken in any learning environment to maintain an adequate session length to allow users to make considered responses, while maintaining the security of the environment. Initially, when Mark-UP was implemented, a 'time-out' was in place where users would be logged out if they were inactive for 15 minutes. For some subjects this was too brief and at least one subject lost work when coming to submit his response, only to be told that he was logged out of the system. This issue was resolved with the first few weeks, but may still be problematic if integrated to a learning management system that did not provide adequate time for users to consider and write their responses before posting.

Enhancing responsiveness

A minor but intractable issue with Mark-UP during the implementation phase of this research was its speed when subjects attempted to access the product from home using dial-up connections. While the majority of students agreed that the screens loaded quickly enough, it was an issue, at least for some.

In some respects this problem is irrevocable, and in others it is an issue that will solve itself over time. On the one hand, the ability to collate a number of responses and present them on a page meant significant processing on the server, and the size of graphical pages needed to be balanced to ensure that they downloaded quickly enough for the user, while at the same time were large enough to be readable directly from the screen. Efforts were made at the prototype stage to limit the bandwidth and server requirements of Mark-UP to maximise the performance of product, and it is unlikely further enhancements would be possible. On the other hand, the rapid move towards broadband technologies for home Internet access and the continuous enhancements of operating systems and chip processors ensures the gradually diminishing impact of this issue for end users.

It would appear, however, that users would need to be made aware of requirements of the system before using it. Just as many students' complaints about reading off the screen was an issue related to their ignorance of the availability of a printable version of the readings, an awareness of the limitations of the product across low bandwidth environments and the need for patience may alleviate much of the frustration that this issue engendered.

Providing a greater level of user support

While subjects generally did not have difficulty with Mark-UP's useability, some initial discomfort prompted some subjects to suggest the need for a help system. This would be particularly useful in orienting the user when accessing the system for the first time. An 'about this product' page that explained the value of the product as a learning tool, brief descriptions of the tools, the navigation system, and the way in which responses are stored, would be an extra benefit for those who felt initially disoriented or insecure about why the product has been integrated into their learning and how it may best be used. This facility could also address some of the intractable issues with the product, such as the bandwidth, and suggest useful strategies for how to make the most of the system. Such assistance may help tip the balance of power and control, which is suggested by Laurel (1990) as an important factor in useability, more in the direction of the end user than the environment itself.

Another issue that proved to be empowering to subjects was the ability to format their responses using HTML tags. This powerful feature was somewhat invisible to end-users. Unless they were aware of it, they may not have made use of it. Also, not everyone is familiar

with HTML tags or comfortable writing their responses using a page description language. Since nearly all Mark-UP submissions made use of standard text box interactions, this aspect of the product could be greatly enhanced by incorporating a WYSIWYG text editor as a series of tools accompanying the text box. The technology to develop such word processing style tools is not insurmountable. Indeed, there are a number of off-the-shelf packages that already exist to add such functionality to database driven environments such as PHP, ASP, ColdFusion and so on. Most of these, such as Sitepoint's Editize (Sitepoint, 2005) and Pintexx's pinEdit (Pintexx, 2005) are easily installable and configurable Java-based utilities designed to integrate into web browsers and operate in all well known database-enabled environments.

9.1.3 Developing an appropriate model of implementation

The flexibility of Mark-UP as a suite of tools that could be integrated into multiple approaches to instructional design has been mentioned several times throughout this thesis. The approach that was developed to support the teaching and learning aims of the research is discussed later in this chapter. Beyond the learning approach taken, however, there were issues relating to how the product was implemented with regard to the sequencing, frequency and scale of learning activities that impacted on subjects' experiences with the product. These are issues that need to be borne in mind when the product is used in future learning settings.

Chief among these issues was the perception of the level of work required when using the product. This issue proved to be a difficult one to reconcile. The truism that the value of a learning experience is commensurate with the effort expended in that learning experience provides an uncomfortable dynamic with regard to workload. While learners would need to be actively engaged to derive benefit from using Mark-UP there is obviously a point at which this workload becomes unmanageable. It would appear that Mark-UP reached this point in this project. In fact the statement indicating an excessive workload in using Mark-UP received the strongest level of agreement of all of the statements in the questionnaire conducted among subjects. This was not initially anticipated by the researcher, as the unit of study traditionally had readings each week which students needed to complete before attending workshop sessions. Also, design problems were often posed as activities for learners. What was different in Mark-UP was the fact that rather than discussing the comprehension of readings informally in class, subjects in this study were required to complete regular activity which was much more formal in nature.

Because of this, the boundaries of what was expected were probably not clear enough at times. Some subjects went above and beyond what was expected. For those that didn't there

was a tacit admission among some interview subjects that they rarely completed readings in previous units, and so having to actually write about issues in readings on a weekly basis was something of a shock for them.

While this can be seen as a good thing in that it ensured a level of activity from all users, a balance would need to be struck in future implementations of Mark-UP to maintain a consistent level of manageable activity. The impact of affective components of self-regulation on the cognitive processes that were explored in this study are discussed towards the end of the chapter; however it would be a reasonable expectation that students should not feel overwhelmed by the work involved.

As well as the frequency and scope of the activity within Mark-UP, the nature and scope of the readings themselves often impacted on the workload of students. Ensuring that readings are kept to a manageable size and taking into account the amount of new information within readings would be an obvious improvement to future implementations of the product.

Finally, the structure and sequencing of activities, as well as impacting on the value of the product in promoting metacognitive regulation, had a strong effect on subjects' acceptance of the product. The approach of providing an initially highly scaffolded structure which faded to a much more flexible approach elicited mixed feedback from subjects. While many valued the strong initial support, others found it constraining. Also, weekly design problem and Mark-UP activities were not always available until one or two weeks before that week, which prevented some students from making an early start on their work. Maintaining the structure of scaffolded tool use and strategy instruction, while still allowing users to choose which tools they wished to use from the beginning, would have enhanced the flexibility of the product while maintaining learning support.

In terms of the implementation of Mark-UP, therefore, a number of recommendations for the future can be made that would enhance users' acceptance of the product with regard to the content, structure and workload involved in using it. They are:

- limit the number of mandated activities to every other week to relieve some of the workload in using Mark-UP;
- provide clearer indications of expectations with regard to workload and the nature of activity to be performed;
- ensure readings are relevant to the design problem and take care to ensure the language and size of the readings are still accessible to a range of users; and
- provide greater choice of Mark-UP activity during the first few weeks of implementation, to enhance the flexibility of the product while still maintaining a

suggested pattern of use to provide adequate support for learners who are initially less self-regulating.

9.2 Conclusions about Mark-UP as an environment to promote the processing inherent in metacognitive regulation

The second broader aim of the research was related to the self-monitoring that took place as subjects used Mark-UP:

Explore the forms of self-monitoring when students use Mark-UP as an environment to support cognitive self-regulation

The self-monitoring was analysed through answering three research questions that examined subjects' planning, evaluation and monitoring. This was conducted by an analysis of the monitoring evident in subjects' use of the tools within Mark-UP and the reflections of the whole group at specific points of the semester in their Mark-UP portfolios, as well as interview subjects' descriptions of their cognitions, attitudes and patterns of use of Mark-UP as they took part in the study.

The findings provided strong support for the role of Mark-UP as an environment to support self-monitoring processes. The product appeared to effectively support subjects' engagement in all of the processes of planning, monitoring and evaluation. What the study did find, however, was that Mark-UP did not create the same experience for all users. Some subjects derived more benefit from its use and some tools and activities seemed better suited to developing self-monitoring than others. This section summarises the issues with regard to how Mark-UP engaged subjects in metacognitive regulatory processes, and makes suggestions as to how its value as a cognitive tool may be enhanced. In particular, this section addresses concerns with:

- finding ways to address the implicitness of metacognition and difficulties measuring it;
- addressing individual differences in individuals' developing regulatory skills;
- enhancing the level of feedback to promote monitoring; and
- accommodating the affective dimensions of self-regulation.

9.2.1 The implicitness of metacognition and difficulties in measuring it.

One of the most difficult aspects of this research was the process of trying to expose an implicit cognitive state and make it amenable to measurement and instructional intervention. Chapter 4 has already discussed how the methodology required the development of an

instrument to elicit subjects' assertions of their perceptions of themselves as demonstrating metacognition. This, like many other studies, was prone to the dangers of subjectivity in making claims about subjects' understandings of themselves as learners. As Nicholls (2003) points out, 'It is extremely difficult to get information from "inside people's heads" and make claims that any single interpretation has truly empirical statistical validity and reliability' (Nicholls, 2003). This was accommodated in this research by reviewing a variety of self-reporting instruments, and synthesising elements that were relevant to the model of learning that underpinned the theoretical framework into statements that were validated by experts in the area of educational technology. Most importantly, however, these self-perceptions were countered with a more objective form of data, which was the portfolios created within Mark-UP. Even then, the complexity of the research setting and the interpretive nature of analysis still raised issues with the ability to draw tangible conclusions about Mark-UP as an environment to promote metacognitive processing.

Given the complexity of these dimensions, the relevance of making conclusions related directly to the capacity of Mark-UP to 'make' people metacognitive is questionable. Self-perceptions may not always supported by external evidence, which suggests that, at best, the two components may be different lenses on the same concept and, at worst, provide evidence of different constructs. Similar studies have attempted to explore metacognitive regulation by examining the evidence of metacognitive processing rather than learners' self-perceptions (Schraw et al., 1995; Markman & Gentner, 2001). This contention is supported by this research in the ways in which some subjects' assertions of their understandings of themselves and their study patterns did not always match their output and portfolios. On the one hand, there were issues with the nature of self-reporting as an accurate reflection of self-awareness, while on the other one can question the value of an external artefact such as a portfolio of design solutions and comments on readings as a true depiction of an internal state. Ultimately, just because subjects may claim to understand themselves as learners does not mean that they do. At the same time, an annotation such as 'I agree' to a paragraph in a reading does not provide evidence of monitoring, but nor does it provide evidence of a lack of it.

This paradox was reconciled within this study by using a constant comparative approach to analysis in which findings were grounded in both self-reporting and external evidence, and where care was taken in claiming causal relationships. It was not the purpose of this study to specifically identify improvements in metacognition, but rather find evidence of the processes that are known to be related to it, and explore the role of the product in supporting those.

Future studies into metacognitive regulation should extend on this methodology to gather a broad range of data and use deep approaches to analysis that reflect the richness of the concept and the ways in which it can be demonstrated. At the same time, research into better methods

of measuring the underlying psychological bases for self-regulation, may assist future projects such as this that attempt to explore the concept. The development of better questionnaires than the one used in this study may assist future studies.

9.2.2 Addressing individual differences in individuals' developing regulatory skills

While issues with metacognition as a construct amenable to research itself have been discussed, there appeared in this research to be a strong link between subjects' perceived metacognition and their use of Mark-UP. These manifested themselves as differences in the ways subjects planned, monitored and evaluated their learning.

For example, subjects interpreted as *metacognitively strong* created plans that were more closely aligned with process-oriented learning goals than outcome-oriented performance goals, and on the whole were able to explain their plans effectively and show a commensurate level of metacognition in the ways that they evaluated those plans. At the same time, Mark-UP was generally less valued by those students than by those interpreted as *metacognitively moderate* or *weak*. This also tended to show itself in an unwillingness to engage in all aspects of the product; therefore, while such subjects often demonstrated a high level of metacognition in their design problems, they may not have put the same level into using Mark-UP's annotation, summary, forum discussion tools and so on as they already felt comfortable in their regulatory strategy use.

Subjects who were categorised as *metacognitively weak* on the other hand, did not appear to demonstrate the full range of evaluation and planning types, and in particular when it came to monitoring their learning, their responses often failed to demonstrate a deep level of metacognitive reflection. The prevalence of plans that were performance-oriented and evaluations that failed to extend beyond evaluating an external artefact, such as a reading or problem, to self-evaluation combined with responses using Mark-UP's reading tools that were somewhat cursory to suggest that this implementation of the product failed to engage both the strongest and weakest students fully in the self-monitoring process.

Ultimately there appeared to be a 'sweet spot' for Mark-UP where subjects interpreted as *metacognitively moderate* could extend beyond initial plans and evaluations that were performance-based and grounded in external evidence to a more reflective approach to self-monitoring; where subjects seemed better able to consider the influence of the product on themselves as learners; and where the tools were used for information seeking, questioning, making contentions and so on, which all indicated the monitoring related to metacognitive processing.

In order to broaden the value of Mark-UP to a greater audience it would be necessary for care be taken in any future iteration of the product to ensure that the widest possible group of learners are benefiting from it. That inevitably means that students with different levels of existing metacognitive regulation would be using the product in different ways.

Those subjects perceived as *metacognitively strong*, for example, seemed better able to transfer concepts from the domain of reading comprehension to the active use of reading concepts to solve problems. The 'force feeding' of regulatory strategies appears unnecessary for this group of learners and in fact the study did show that some of the subjects interpreted as having a high level of metacognitive awareness were resistant to the concept of engaging in the processes of summary, annotation and so on. They appeared to have well developed strategies and in fact perceived the formal process of engaging in the reading strategies promoted within Mark-UP as artificial.

Those subjects perceived as *metacognitively weak,* on the other hand, sometimes failed to show a broad range of monitoring use of reading strategies. For these subjects a higher level of direct strategy instruction, and more explicit scaffolding of the regulatory strategies themselves, would have been beneficial.

This finding therefore echoes the need discussed in the previous section for promoting more flexibility in the implementation of Mark-UP. Stronger students would be able to engage fully in the design problems posed within Mark-UP, while weaker students could conduct activities that would be more grounded directly within the reading and would be initially more structured and supported. It is not a perfect solution in terms of managing a unit of learning – the ability to demonstrate content comprehension and knowledge through strategies such as summary is a lower order outcome when compared to the synthesis involved in solving design problems. Nevertheless, even in the most basic tools offered by Mark-UP there would be potential for users to demonstrate outcomes closely related to course requirements. For example, a summary may involve critique, annotations may make suggestions as to how to overcome stated problems and so on. Scaffolding such higher-order thinking while maintaining a focus on the development of specific regulatory strategies would appear to be a realistic aim for learners perceived as metacognitively weaker. While there are significant issues with regard to assessment when learners conduct different activities at different levels, these are not new problems, and may be balanced by the potential benefits of such a flexible student-centred approach.

9.2.3 Enhancing the level of feedback to promote monitoring

If the improved flexibility of Mark-UP to support the needs of both stronger and weaker students in their development of metacognitive regulatory processes is to be adopted as a realistic goal, then mechanisms need to be in place that enhance the potential of the environment with particular regard to the metacognitively weaker students who may have difficulty in developing independent strategy use.

Future iterations of Mark-UP should enhance the support provided within the environment to promote self-monitoring. This would involve the development of extra means of providing the external tutor feedback to prompt learner's reflection and the internal peer feedback generated within the product when learners annotate, post URLs, participate in forum discussions and summarise.

At a number of points within this study subjects were required to make plans and evaluate those plans. Those processes were mediated primarily by the feedback received from tutors about their partly completed portfolios. During the study, this part submission took place once, however in doing this it could be argued that extra opportunities for expert feedback were lost. For example, subjects' plans for their learning were not reviewed by tutors until subjects had already had one attempt at evaluating them. This meant that plans that were focused on narrow performance goals were not remediated and it was hardly surprising, therefore, that subjects evaluated themselves in the light of these narrow goals. Explicit instruction regarding the nature of goal setting, combined with an earlier evaluation of plans, may have enabled subjects who were not operating at that level to start using evaluation strategies that were more closely aligned with metacognitive processes.

As well as external feedback too, it would appear that there are opportunities in enhancing the peer feedback within Mark-UP to help promote monitoring and the development of personal strategies. More opportunity for reviewing model answers in summaries, for example, combined with discussions of the differences between the different types of summary would have enabled a greater level of abstraction beyond what the text means towards an understanding of what is an effective summary for the purposes of developing an understanding of a reading. The Annotation tool, in particular, while widely used and by far the most popular of the reading tools within Mark-UP, had a limitation in that when logging into Mark-UP subjects were not able to quickly identify their own annotations. While they could review them in the portfolio, a useful tool would have been some notification of when an annotation had been responded too, with a direct link to relevant point in the reading and the evolving discussion around it. This would also help remove the perception that some subjects had of annotation as a somewhat fatuous activity, since the lack of clear cues for

where their own annotations were meant they could never follow a discussion fully. It would also emphasise the centrality of annotation to the Mark-UP system as the tool that captured the largest range of monitoring activity associated with metacognitive processes.

These recommendations to add further iterations of review and feedback into the system reflect the cyclical nature of the planning, monitoring and evaluation process. One notable finding over the course of conducting this research was that subjects' evaluations generally appeared to evolve over time from evaluation of external entities, such as readings and tools, to evaluations of learning strategies and themselves as learners. This suggested that the cyclical nature of self-monitoring could lead to not only a process of continuous improvement with regard to self-understanding but also the metacognitive application of appropriate strategies. It also appeared that this cycle took place not only at the explicit planning and evaluation phases of the implementation but was an ongoing result of subjects' use of the tools within Mark-UP to monitor their understandings. Therefore, ensuring that these tools provided the easiest access to a wide variety of prompts, questions, and ideas to stimulate monitoring would appear to be the main crux of the value of Mark-UP as an environment to engage learners in metacognitive regulatory processes.

9.2.4 Accommodating the non-cognitive dimensions of self-regulation

This research focused on the cognitive aspects of self-regulation, specifically engaging learners in self-monitoring to promote metacognitive regulatory processes. Ultimately, however, the acknowledgement of self-regulation as a complex web of interrelated variables that can loosely be described as the fusion of skill and will, is necessary to develop a complete picture of the factors that are integral to individuals' abilities to manage their own learning. Throughout the study, one constant finding was the strength of affective components in mediating subjects' perceptions of themselves and the ways in which they used Mark-UP.

One of the strongest findings was that many subjects reported a tendency to blame themselves when receiving negative feedback, worry about failure, feel discomfort with expressing opinions and have difficulty in finding motivation combined with a tendency to give up when study is difficult. While many subjects reported positively to specific volitional strategy use it appeared that many also reported difficulty in developing motivation and an even lower reported level of self-concept.

It was not surprising, therefore, that affective dimensions of learning impacted greatly on subjects' use of the product. As well as these internal emotional states and processes, the reality for many subjects was also that their study was only one of many competing aspects of their lives resulting in a low reported level of supportiveness of their external environment.

A manifestation of this was in an overall slightly lower level of activity within Mark-UP towards the end of the semester than earlier on, as other assignments and external constraints such as the need to earn money, family life and so on started to take their toll. It could be argued, therefore, that while Mark-UP was an effective tool in terms of its ability to support metacognitive regulation, it probably had much less effect on subjects' self-regulation overall. Certainly it may have been a contributing factor to many of the subjects' plans and evaluations of their learning being based around external measures of performance and internal measures of effort. Poor motivation was also the reason given by two interview students as to why they did not complete a second self-evaluation towards the end of the semester.

In the end, while it is possible to examine cognition as a discrete entity, the failure to acknowledge the affective dimensions of self-regulation means that many of the potential variables that impact on cognition are removed. Ultimately, a lack of focus on self-concept, motivation and volitional control means:

> *Learners may lack motivation to effortfully assess or change task approaches. This seems to be the case when students adopt performance goal orientations that undermine self-regulation (e.g., Graham & Golan, 1991; Borkowski & Muthukrishna, 1992). Alternatively, beliefs that learning should be easy (Schommer, 1990; Schommer et al., 1992) may lead students to apply less effort to monitoring. Or, students may lack effective action control strategies to motivate effortful cognition (Corno, 1993). Feedback that supports students' construction of positive motivational beliefs and/or use of action control strategies thus may support engagement in self-regulation. (Butler & Winne, 1995, p. 274)*

While it was beyond the scope of this study to engage in promoting the affective dimensions of self-regulation, any future version of Mark-UP may benefit from taking these findings into account. Obviously this would involve a major revision of the product – not necessarily of the tools within Mark-UP, but certainly of the design of the learning strategy associated with their use. As well as focusing on specific strategy use, and the underpinning self-monitoring processes necessary to promote metacognitive activity, strategies would need to be implemented in the forms of positive feedback, consideration of methods to promote motivational attributes such as challenge, control and curiosity when engaging in learning activities as well as the scaffolding of specific volitional strategies to facilitate learner's abilities to maintain a consistent level of effort. Many of the recommendations about improvements to Mark-UP in terms of its flexibility and provision of choice and personal relevance may have relevance to developing the value of the environment as a tool for

affective self-regulation, however such changes must also be made in a strategic manner that is beyond the scope of this thesis.

9.3 Limitations of the research

As with all research, acknowledgement must be made of the limitations of the study, particularly with regard to its exploratory aims and the contextual nature of the research setting. Specifically, the following issues need to be acknowledged:

1. The research subjects did not consist of a random selection, but were selected from a specific university unit of study. This meant that the generalisability of the findings are limited by the fact, for example, that the subject group consisted of students who could be defined has having an interest and reasonable level of existing skills in technology.
2. The short time span and limited number of subjects meant that findings about Mark-UP's ability to improve learning outcomes and student metacognition could not be part of the study, requiring a more general exploration of patterns of self-monitoring within the product.
3. As this was the first true implementation of Mark-UP, the presence of minor errors may have affected subjects' attitudes to the product in ways which would not affect future versions.
4. The interpretive nature of the study and incorporation of self-judgements as a form of data limited the ability to make direct causal attributions and general affirmations about subjects' metacognition as well as the ability to directly measure the concepts to be studied. Instead, deep and triangulated forms of data enabled *suggestions* to be made about subjects' cognition as they used Mark-UP.
5. Allied to the interpretive nature of the study, a properly validated and reliable questionnaire instrument would have assisted in making judgements about subjects' metacognitive perceptions
6. The groundedness of the study within a specific design approach and within the domain of reading comprehension limited the ability to develop conclusions that crossed domains.

These limitations do not necessarily invalidate the findings of the research. All of the issues above were accommodated when developing the research methodology and considered in the reporting of findings, and provide qualifications that need to be considered when interpreting the findings.

The study still provided a range of findings that may be applicable to other products and other research settings. Ensuring mindfulness of the limitations of the research when developing interventions of a similar nature may assist future researchers in developing an appropriate methodology and setting.

9.4 Concluding comments

While a great deal of research over the last two decades has gone into defining the dynamics of self-regulation, 'minimal efforts have been made to integrate it systematically with interventions' (Zimmerman, 2000, p. 230, cited by Hubbard & Simpson, 2003). Mark-UP was an attempt to explore one aspect of this, specifically related to engaging learners in the processes inherent in metacognitive regulation of learning, within the domain of reading comprehension.

It is reasonable to conclude that other domains of learning may be susceptible to similar interventions, by identifying the key processes of planning, monitoring, and evaluation as they are manifest within metacognitive regulation within that domain. For example, within the domain of teamwork, researchers may seek to explore how students engage in planning by assigning team roles, and setting milestones. Having students monitor their own progress as well as that of others engages learners in self-monitoring, while having students reflect on their final performance and suggestions for their own improvement may provide evaluation, while initiating a further round of planning.

Like most effective research, as many questions were raised as were answered. In particular, future research into environments to support the development of cognitive self-regulation may benefit from considering the following questions:

- How can the flexibility of products for assisting in developing cognitive self-regulation be enhanced for stronger students while maintaining an appropriate level of structure and support to provide the scaffolding of cognitive strategies for weaker students?
- How can a high level of feedback be integrated into products such as Mark-UP to enhance their potential as environments for self-monitoring?
- How can the research into metacognitive regulation be furthered to develop ways of examining the relationship between cognitive and affective components of self-regulation as well as effective ways of reporting and measuring internal psychological states?

This chapter has summarised the findings of this study and suggested ways in which improvements to Mark-UP may be made with regard to its interface and useability as well as its value as an environment to engage learners in self-monitoring. This is design-based

research and therefore the findings do not stop with this thesis, but require an extra iteration of design to build on the value of Mark-UP. Enhancements to the level of support and feedback within the environment, the provision of greater flexibility of use, and expanding on the current approach to integrate non-cognitive components of self-regulation may all contribute to a stronger learning environment for the promotion of self-monitoring.

For those learners who are already operating at a high level of self-regulation, environments such as Mark-UP may be somewhat redundant:

> *An important consequence of Self-regulatory behavior is that students who self-regulate find a way to learn. It does not matter if the instructor is a poor lecturer, the textbook is confusing, the test is difficult, the room is noisy, or if multiple exams are scheduled for the same week; self-regulatory learners find a way to excel. (Dembo & Praks Seli, 2004, p. 3)*

However, for metacognitively moderate and weaker learners, the need for environments that promote students' ability to learn independently is real and pressing. For these learners, environments need to be created that scaffold their development of learning strategies and metacognitive application of these.

In particular the affective dimensions of self-regulation need to be foregrounded in future developments. It has been argued that educational researchers have ignored motivation as an explanation of why students fail to change their learning and study strategies (Nist & Simpson, 1993), and it is reasonable to argue that this study has been guilty of that. The flipside of the impact of volitional factors on cognitive strategy use, however, is the positive role of metacognition in enhancing learners' values of themselves where effective 'strategy use has a direct impact on self-concept, attitudes about learning, and attributional beliefs about personal control' (Borkowski, Carr, Rellinger, and Pressley, 1990, cited by Vandergrift, 2002, p. 571). After all, the best learners are not just ones who understanding their learning, engage in self-monitoring and develop effective cognitive strategies. Strong learners have confidence in themselves and can use strategies not only to assist their learning but also manage their time and control their effort. While it is certainly true that learners do not become metacognitive through brief interventions such as this one, it is contended that continued research, development and utilisation of environments such as Mark-UP that will eventually yield improvements to students' cognitive regulation and perseverance.

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A Appendix 1: Design of Mark-UP Activities and Data Collection Points

Week 1: What is Good Design?	
Barker, P. & King, T. (1993). Evaluating interactive multimedia courseware – A Methodology. *Computers Education*, Vol 21 No 4, pp 307-309	
Activity	**Research Implications**
Design Problem Problem: Create a review tool to evaluate a commercial website, *Post a response* What do you think would be the most important criteria? Are there any that you would like to add to the list? Use the criteria identified in appendix 3 of this article to develop your own list of guidelines.	**Data Collection Point** Subjects complete a survey to gather information about their perceived abilities as self-regulated learners and other demographic information such as their experiences with technology. **No Mark-UP activity** Unscaffolded task – no access as yet to the available tools. This provides an opportunity for subjects to demonstrate existing skills in transferring knowledge from reading to the design problem.

Week 2: Information Design	
Andres, C. (1999). Building Hierarchically structured site plans. In *Great Web Architecture* (Ch 1, pp. 3-15). Foster City: IDG Books.	
Activity	**Research Implications**
Design Problem You have been asked by your employer to create a web portal that can be used as a home page for a variety of users. *Post a response* What are the needs of this type of site with regard to the site structure and how does it differ from some other types of sites (eg electronic storybooks)? Describe how you would structure the content and functionality to best serve users. **Mark-UP Activities** 1. **Review URL**. Link to information about how to summarise effectively. 2. Write a **summary** of this chapter. What are the main.	**Mark-UP Activities** 1. Strategy instruction. Makes explicit the role of summarizing as a regulatory strategy. 2. Students become familiar with the strategy of summarizing and the Summary tool. Engages students in deriving meaning from a text and forces them to reflect on that meaning by articulating it in a condensed form. Adding another level of response where they compare their response to a model answer engages the student in evaluation.

Week 3: Screen Design	
About.com (2003) Graphic Design Tutorials – Principles of Design [on-line] Available: http://desktoppub.about.com/cs/graphicdesign/	
Activity	**Research Implications**
Design Problem Propose a new look and feel for a site *a) Review URL* http://ourworld.compuserve.com/homepages/Scott_Novick/bb_home.htm. *b) Post a response* What is wrong with the screen design and how can it be improved? **Mark-UP Activities** 1. *Review URL* – a link to information about annotation as a strategy. 2. *Annotate* this reading. Identify what you think are the most important points, and seek clarification on any aspects that you don't understand. Try to add a response to another student's annotation.	**Mark-UP Activities** 1. Strategy instruction. 2. Students become familiar with the annotation tool to ask questions about an article. Engages user in questioning and highlighting strategies and are prompted to reflect on their own interpretation through replying to others.

Week 4: Designing for Learning	
Park, I., & Hannafin, M.J. (1993). Empirically-based guidelines for the design of interactive multimedia. *Educational Technology, Research and Development*, 41(3), 63-85	
Activity	**Research Implications**
Task Contribute to a better *Mark-UP*. Now that you have been using Mark-UP for four weeks, you are being asked to suggest strategies for improvement. *Discuss* Consider whether and how it aligns with some of the principles in this week's reading. In what ways does it exemplify these principles, and do you think there are any lost opportunities? How would you improve its learning effectiveness? Do you agree with the opinions of other students? Share your ideas on the discussion board. **Mark-UP Activities** 1. *Annotate* this reading. For at least 5 of the principles defined, provide examples either from e-learning or face-to-face experiences which demonstrate these principles or the lack of them in action. Don't forget also to comment on others' responses.	**Data Collection Point** The task had students engaging in the reading strategy of drawing inference. This elicits metacognitive reflection on the learners' own experience. It also provided some data to inform Research Aim 1, dealing with the utility of Mark-UP. **Mark-UP Activities** Annotation strategy reinforced, and some structure provided to help scaffold its use.

Week 5: Design Methodology & Evaluation	
Fetherston, T. (1997). Designing Cognitive and Constructivist Educational Interactive Multimedia. Edith Cowan University: Perth	
Activity	**Research Implications**
Design Problem No Design Problem this week. **Mark-UP Activities** 1. *Post an URL.* Find a site that proposes a different model for Instructional Design. What are the similarities and differences between this one and the one you have found? Do they differ in terms of the assumed size of the product, level of expertise required or implied theory of learning? 2. *Portfolio*. Collate your contributions to Mark-UP through the portfolio tool. Review your progress throughout the semester and enter your comments below, addressing issues such as: • Which readings have been most problematic so far and why • How you have overcome difficulties reading the weekly articles and which tools have been more useful for this • Whether you have noticed any development in your ability to read documents of this type over the semester, and if so in what ways	**Mark-UP Activities** Post URL tool introduced, with information to help scaffold its strategic use. **Data Collection Point** Subjects reflect on their portfolio, which engages them in evaluating their performance so far, and planning for strategies to improve their reading of academic texts. Their response to this task is used to inform the exploration of Research Aim 2, dealing with Mark-UP as an environment to support self-monitoring, in particular metacognitive evaluation.

Week 6: Interactive Multimedia Environments	
Newby, T. J., Stepich, D. A., Lehman, J. D. & Russell, J. D. (2000). Identifying methods and media for learning. In Instructional Technology for teaching and learning (Ch 5 pp. 90-114). New Jersey: Prentice Hall.	
Activity	**Research Implications**
Design Problem Propose a learning environment for designing energy efficient houses. *a) Review URL* View some information and specification about energy efficient houses at the following address. http://www.eren.doe.gov/erec/factsheets/eehouse.html. *b) Post a response* Using this information as a basis suggest an appropriate learning strategy for an Interactive Multimedia environment to assist learners in developing skills for building an energy efficient house. **Mark-UP Activities** Now that you have been introduced to all of the tools available within Mark-UP, it is now up to you to consider ways in which you can use the environment to monitor your understandings of the readings and the broader implications raised. As you use the tools, think about how they may best improve your learning. Continue to summarise and annotate the readings, find other relevant links, and start and respond to discussion topics. For example, with this reading you may want to: • Annotate it with examples of real life experiences with the various methods discussed • Provide a summary of the advantages and disadvantages of each of the methods • Find a link to a site or product which demonstrates one or more of the methods • Start a discussion about which methods you think are most valuable for different learning contexts Tools available: 1. Annotation 2. Summary 3. Forum Discussion 4. Post URL	**Mark-UP Activities** Support is now being faded, at least in terms of the role of the teacher within the environment. Learners choose to use the tools they find most relevant and continue to receive peer feedback to activate self-monitoring.

Week 7: Factors Influencing Design	
Wynn, S. (1995). Interactive Multimedia: Ensuring Motivation of the Learner. Edith Cowan University: Perth	
Activity	**Research Implications**
Design Problem Enhance a business's on-line profile. A fast food chain has approached you with a problem: while they are a large and popular business, the fact that they deal with customers primarily through retail outlets means that they find no-one visits their website. *Post an URL & Response* Find an example of a traditional off-line business which is successful in creating a site that people want to visit. What are the features of the site that are motivating and how can you get customers attracted to a fast food site? View at least one other website posted and give it a rating. **Mark-UP Activities** Use the tools available to help develop your understandings of the topics covered in this week's reading. Some activities you may want to consider: • Start a discussion and contribute to others comments about what learning experiences you have found motivating or enjoyable and what has made them so • Annotate each criteria for motivation within the reading with your own suggestions for how they can be integrated into a multimedia product Note, the points above are only suggestions. Use the tools in the ways that best help you to come to terms with the ideas in the reading. 1. Annotation 2. Summary 3. Forum Discussion 4. Post URL **General Response Task – Portfolio** (moved to week 9 as marking wasn't able to be completed on time).	**Mark-UP Activities** Further fading of initial scaffolds. Fewer suggestions as to possible regulatory strategies. As learners start to use the environment in their own ways, there may be less direct feedback from other students.

Week 8: Non-contact Study Week

Week 9: Interaction Design

Dix, A. Finlay, J., Abowd, G. & Beale, R. (1993). Interaction Styles. In *Human-computer interaction.* (pp. 102-114). Hemel Hempstead: Prentice Hall.

Activity	Research Implications
Design Problem OS Z! For this task you are required to design the next generation of interfaces for operating systems. *Post a response* Use your understandings of the traditional interaction styles of mouse driven windows and menu systems to identify the weaknesses with current operating systems and propose how users may interact with the next generation of operating systems given the emerging technologies. **General Response Task – Portfolio** Reflect on feedback you have received from your submission of your partially completed portfolio. *Post a response* Respond to the comments identifying your strengths and weaknesses regarding your ability to read and understand documents of this type. Provide some strategies that you can use to improve this aspect over the next few weeks. **Mark-UP Activities** Use the tools available to develop your understandings of the topics covered in this week's reading. This will assist you in responding to this week's problem. 1. Annotation 2. Summary 3. Forum Discussion 4. Post URL	**Data Collection Point** Response to portfolio feedback used to inform exploration of Research Aim 2, specifically with regard to Planning and Evaluation. **Mark-UP Activities** No learning support except for the self-monitoring inherent using the tools.

Week 10: Documenting Design	
Orr, K. L., Golas, K. C., & Yao, K. (1994, Winter). Storyboard Development for Multimedia Training. *Journal of Interactive Instruction Development*, 18-30.	
Activity	**Research Implications**
Design Problem Implement these guidelines. Review the guidelines proposed in this document in the light of your group's design for assignment 2. *Post a response* Does your own design follow or break any of the suggestions provided? Give reasons for why you made the choices you made, or suggest ways in which you will modify your design. **Mark-UP Activities** Use the tools available to develop your understandings of the topics covered in this week's reading. This will assist you in responding to this week's problem. 1. Annotation 2. Summary 3. Forum Discussion 4. Post URL	**Mark-UP Activities** As with the previous week, no learning support except for the self-monitoring inherent using the tools.

Week 11: A Design Case Study	
McMahon, M. (1995). A Textual Storyboard Example. Perth, WA: West-One	
Activity	**Research Implications**
Design Problem Horses for Courses – propose an approach to storyboarding your design *Post a response* The example provided shows one way to storyboard a product. The narrative nature of this product and its use of a town square interface have required documentation in the form of a story outline and visual storyboards, accompanied by character interaction scripts. This may not be the most appropriate approach for all situations however. How do you intend to storyboard your product in the light of this example and the nature of your design? **Mark-UP Activities** Use the tools available to develop your understandings of the topics covered in this week's reading. This will assist you in responding to this week's problem. 1. Annotation 2. Summary 3. Forum Discussion 4. Post URL	**Mark-UP Activities** As with the previous week, no learning support except for the self-monitoring inherent using the tools.

Week 12: Web Design	
Nielsen, J. & Tahir, M. (2002). Homepage Useability: 50 Websites Deconstructed pp. 1-27. New Riders	
Activity	**Research Implications**
Design Problem Letter to a webmaster – improving their homepage *URL Post and Response* There are a lot of bad web home pages out there, not all from small businesses or individuals. Your role in this task is to find one. Compose an imaginary e-mail that you would send to the webmaster about how the homepage could be improved, using this week's reading as a basis for your points. **Mark-UP Activities** Use the tools available to develop your understandings of the topics covered in this week's reading. This will assist you in responding to this week's problem. 1. Annotation 2. Summary 3. Forum Discussion 4. Post URL	**Mark-UP Activities** As with the previous week, no learning support except for the self-monitoring inherent using the tools.

Week 13: Design Issues	
Laurel, B. (1990). Interface Agents: Metaphors with Character. In B. Laurel (Ed.) *The Art of Human-Computer Interface Design* (pp. 355-365). Reading: Addison Wesley. Total Pages 523	
Activity	**Research Implications**
Design Problem Redesign the MS Office paper clip. *Post a response* We have come a long way in our understandings of what makes for a good interface agent since the MS Office paper clip was created. You need to redesign it. Consider the functionality and character with which you want to imbue your agent and how end users may best interact with it, using your understanding of the reading to inform your design. **Mark-UP Activities** Use the tools available to develop your understandings of the topics covered in this week's reading. This will assist you in responding to this week's problem. 1. Annotation 2. Summary 3. Forum Discussion 4. Post URL	**Mark-UP Activities** As with the previous week, no learning support except for the self-monitoring inherent using the tools.

Week 14: Unit Review	
No Reading	
Activity	**Research Implications**
Task Self Analysis: Review the work you have completed throughout the semester, and identify the ways in which your understandings have changed, both with regard to your conceptual understanding of course content and your ability to use strategies to help you understand the readings throughout the semester. *Post a response* How has your performance been in comparison to the improvement strategies you identified in week 7? **Activities - Portfolio** It is now time to submit your Portfolio. Once you have entered your concluding comments, collate your portfolio and submit it to your tutor. 1. Submit your portfolio	**Data Collection Points** **Task** The self-analysis assesses the extent to which students have formalized their strategy use through the self-monitoring processes they've had to engage in. Note, the prompts are more general than the previous review in weeks 5 & 7. **Portfolio submission** Specific responses from subjects' portfolios were be used to explore subjects' self-monitoring in their use of the tools beyond the specific data collection points already outlined. **Subject Interviews** 12 subjects were interviewed shortly after submission of their final portfolios. **Final Survey** A final survey was conducted in week 13. This survey covered similar aspects to the original survey but also asked specific questions about Mark-UP to explore subjects' experiences with the product and how these influenced their perceived cognitive regulation.

A Appendix 2: End of Semester Questionnaire

Study Habits Questionnaire

Number:

The number you have been allocated will allow a pre- and post-assessment comparison. In all other senses, this is an anonymous questionnaire. Please place a tick next to the following statements, identifying the extent to which you agree or disagree with them.

Statements Relating to my Study Practices	SA Strongly Agree	A Agree	N Neither Agree nor Disagree	D Disagree	SD Strongly Disagree	N/A Not Applicable
I find it helpful to compare my ideas with other students to make sure I am on the right track						
It is important for me to find ways of applying what I am studying to real settings						
I find relating information to my own experiences valuable						
Making notes helps me understand what I am studying						
Studying makes me feel good about myself						
When I sit down to study I have difficulty working out where to begin						
Making notes in my textbook helps me to make sense of what I am reading						
I tend to blame myself when I receive negative feedback on assignments						
Giving an opinion in class is a nerve-wracking experience						
It is useful for me to think about my studies before I go to class						
I compare what I've achieved in learning to what I planned to achieve						
I feel it is important for me to stay up to date with all of my course requirements						
It is important for me to work my way through course readings even when they are uninteresting						
I understand concepts better when I imagine them in practice						
Giving myself rewards is a useful way of maintaining effort when I study						
I tend to give up when study is difficult						
I avoid other activities when I need to study						
I work best when I set myself specific lengths of time to study and stick with them						
I find it useful to set myself goals for learning						
I worry about failing my units						
I find it difficult to study subjects I don't enjoy						
I know how I learn best						
Summarizing passages helps me to understand the content to be learned						
I know what I am good at as well as the things I have difficulty with						
It is hard for me to find the motivation to begin studying						
Translating course materials into my own words improves my learning						
I am comfortable with using technology						
I have studied on-line before						
I prefer to study at my own pace						
I don't like using Apple Mac computers						
I have a good computer set-up at home						
I have a good Internet connection at home						
Reading off a computer screen is uncomfortable for me						
I am familiar with using an Internet web browser						
I classify myself as a competent computer user						
I prefer to learn face to face than on-line						
I have regular access to the Internet at home						
I have regular access to the Internet at work						
I have difficulty fitting my study in with my other responsibilities						
My social life interferes with my course work						
I have a conducive environment in which to study at home						
My work and study experiences have required me to think strategically						
I often find myself in a position of responsibility						
I am comfortable with the idea of working and studying independently						

Statements relating to *Mark-UP*	Strongly Agree SA	Agree A	Neither Agree nor Disagree N	Disagree D	Strongly Disagree SD	Not Applicable N/A
I found annotation to be a useful activity						
I found summarising a useful activity						
I found posting URLs and reviewing others a useful activity						
I found discussing issues on the bulletin board a useful activity						
I found solving the weekly problems a useful activity						
The workload within Mark-UP was excessive						
My English skills made using Mark-UP more difficult						
I felt uncomfortable giving an opinion in Mark-UP						
Mark-UP helped me to understand the readings						
I knew what was expected from each of the tasks						
I found reviewing my portfolio a useful activity						
The screens loaded quickly enough						
Using Mark-UP helped me understand the way I learn						

Has Mark-UP changed the way you read academic texts? If so, in what way?

Are there any factors that have influenced (hindered or helped) your use of Mark-UP during the semester?

What advice would you give to a student who is using Mark-UP for the first time?

In general, what were the strengths and weaknesses of Mark-UP? How could it be improved?