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Joseph Luca
Edith Cowan University

Mark Mcmahon
Edith Cowan University

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Mark McMahon & Joe Luca School of Communications and Multimedia Edith Cowan University, AUSTRALIA
m.mcmahon@ecu.edu.au, j.luca@ecu.edu.au

Abstract: Increasingly, universities are being asked by industry, government and funding authorities to help prepare students for industry with appropriate professional and life long learning skills. How can tertiary educators design and implement learning activities to help promote the development of these skills? In this paper we investigate a method of scaffolding the development of these skills through a conceptual framework based on self-regulated learning. This framework is applied to a third year higher education learning environment, and supported with a variety of on-line tools to scaffold students learning. These include an on-line validated professional skills testing instrument, an on-line self and peer assessment journals which are consolidated into streamlined reports for the tutor, and on-line student contracts, designed to encourage commitment and strategy formation early in the semester. Each of these are discussed, and also pre and post testing results are shown for a validated testing instrument, given to students to identify their strengths and weaknesses.

Introduction

With the rapid growth of Interactive technologies and on-line learning, there is a consistent demand for graduating students to have life long learning skills that enable learners' to continually upgrade their skills and knowledge through their own self-motivation and learning skills (Bennett, Dunne, & Carre, 1999; Candy, Crebert, & O'Leary, 1994; Dearing, 1997). An important aspect for 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 certain limits to what certain 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 forming (Zimmerman, 1989). The challenge for educators then is to find teaching and learning methods that can support the generation of life long learning skills that are relevant to a wide variety of professional contexts.

This paper will discuss three specific techniques that are used both to assess and enhance students' abilities to create life long professional and learning strategies. These strategies are framed within a theoretical model of self-regulation that identifies the psychological states, processes and outcomes that are inherent in independent learning. The aim of this study was to implement strategies that could be used within each of these levels to support the development of these skills.

A Definition of Self Regulation

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 Boekarts, 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. 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 framework 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 appears to be the key process in the development of self-regulatory strategies.

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 notions relating to cognition, metacognition, content and motivation.

These elements are co-dependent and interact with each other in the application and development of goals, strategies and domain-specific knowledge. Garcia & 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 1 represents a synthesis of the above frameworks. It 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. Self regulation is viewed here as the intersection of self awareness at both a rational and emotional level. Metacognition and self concept are seen as the primary enabling process in this model, with self monitoring and motivation as subordinate processes which are involved in the development of cognitive and motivational strategies.

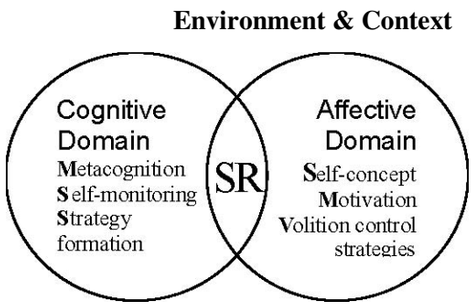

Figure 1: Conceptual Framework

Enhancing Cognitive Self-Regulation Through Scaffolding

There is a large body of work which examines 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). However, the focus of this paper is on the specific knowledge that students have about their abilities and the cognitive strategies they use rather than the subjective values which they attribute to themselves and their abilities.

The primary enabling state for cognitive self-regulation, Metacognition is a concept that this 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. There is a growing consensus for example, that Metacognition is only mildly correlated with unalterable measures of ability such as IQ (Schraw, 1986). Recent theorists are starting 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, however, doesn't solve a major problem, which is how to design instruction that will actually enhance students' ability to regulate their learning. Does it come through modelling regulatory strategies, having students monitor their performance, or by attempting to raise general metacognitive awareness? This paper argues a process of scaffolding that may be implemented at each of the three cognitive levels of Metacognition, Self-Monitoring, and Strategy formation (Figure 1). At the broadest level, students need to be placed in the mode of reflecting on their own cognitive abilities. This may be general in nature, but can be enhanced through the use of self-monitoring. Also, cognitive strategies for regulation need to be enacted in a purposeful and structured way. This is not going to happen automatically; the role of scaffolding is to support the learner's transition from dependent learner to self-regulating learner.

Scaffolds are forms of learning support provided to bridge the gap between existing skills and potential skills. Central to the notion of scaffolding is Vygotsky's Zone of Proximal Development (Vygotsky, 1978), which can be seen as space between the level of actual achievement and the level of achievement possible with assistance. Just as physical scaffolding provides an framework during early phases of building, instructional scaffolds act as initial support which is gradually removed as the learner becomes more independent. Scaffolding can take many forms. Winnips & McLoughlan (2001), for example, propose video commentary, providing Web links, and linking to good examples of student work among others; but such scaffolds can exist within the following broader macro strategies proposed by Hogan & Pressley (1997):

- Pre-engagement
- Establishing a shared goal
- Actively diagnosing the understandings and needs of learners
- Providing tailored assistance
- Maintaining pursuit of a goal
- Giving feedback
- Controlling frustration of risk
- Assisting internalisation, independence, and generalization to other contexts

While many of these strategies are targeting the affective rather than rational components of self-regulation (for example 'controlling frustration and risk'), they still provide a useful heuristic in developing scaffolds to support the constructs of Metacognition, Self-Monitoring, and Strategy Development shown in Figure 1.

Scaffolds for Metacognition

Metacognition is self awareness at a global level, and exists independently from a specific context. Scaffolding for Metacognition, then, must be done at a level that can exist outside a particular knowledge domain. This may exist as explicit instruction, though the internalisation of such abstract concepts may be somewhat challenging. In this case, Metacognition was stimulated through the use of the WORKING assessment instrument (Miles & Grummon, 1996). The WORKING inventory is a self-assessment package for workplace skills, designed to help students understand what skills employers require, and how they rate against these. These skills are generally quite different to the regular academic and technical competencies students are normally tested for. They include the following nine skills: taking responsibility, working in teams, persisting, a sense of quality, life-long learning, adapting to change, problem solving, information processing and systems thinking.

The inventory does not just provide a tool to diagnose the understandings and needs of learners, but also acts as a means of giving customised feedback to the learners and is a vital tool to assist with learners' pre-engagement. In stimulating their perceptions of their own working abilities, the WORKING inventory works both to assess and assist in the development of Metacognition. The instrument was used in semester 1, 2001 with a class of ninety final year multimedia tertiary students studying project management methodology. It was given at the beginning and end of semester and showed an overall increase of 13% across the nine scales.

	Being Responsible	Team Skills	Persisting	A sense of Quality	Life Long Learning	Adapting to Change	Problem Solving	Info Processing	Systems Thinking	Total
Pre	52	49	44	48	51	56	49	52	59	170
Post	67	69	68	64	66	65	74	77	76	192

Table 1: Pre/Post WORKING Results

Feedback was given to each student, based on their overall scores. For example, "Level 1: Beginning ABE Literacy" is explained as: "*Has few or no effective workplace habits and skills; likely to lack a well-developed sense of flexibility, persistence, and quality; poor at problem-solving and learning. May have a low sense of responsibility".* Students were also given tailored feedback on each scale, which allowed them to target specific weaknesses, by trying to develop strategies to enhance these skills over the semester, supported with tutor help.

Scaffolds for Self-Monitoring

Weinstein & Mayer (1986) argue that all metacognitive activ ities incorporate to some extent the monitoring of comprehension, and all models of self-regulation, from behaviourist to social-cognitive involve self-monitoring as the core metacognitive process, whether described in terms such as self-monitoring, self-observation, or inner speech (Zimmerman, 1989). Self-monitoring strategies may involve tracking of attention while reading a text or listening to a lecture, self-testing through the use of questions about text material to check for understanding, monitoring comprehension of a lecture, use of test taking strategies (eg timing questions) in an exam situation (Garcia, 1994). Core to all of these however is the evidence of a reflective process on the part of the learner. One method of encouraging

self-monitoring is to use the strategy of journaling. Journaling has been identified as a useful tool to increase self-awareness (Brooks, 1997) and is an ideal scaffold in that it assists the internalisation of new understandings as well as the setting of goals and monitoring of their achievement.

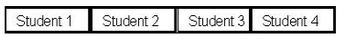

Figure 2: On-line journal for weekly peer assessments

In this study, students completed self and peer assessment journals each week through an on-line application. They completed self-assessment journals in which personal views of their progress were recorded. Here, students considered their success in finishing assigned tasks (scale from 1 to 5), the quality achieved (scale from 1 to 5), how successful they had been in managing their time (scale from –2 to +2), and comments justifying these scores. This was available for peers to view and consider before peer assessment took place, which was based on agreed tasks for that week (Figure 2). Students confidentially rated their peers on four criteria: attendance at meetings, collaboration, success in completing required tasks and quality of delivered tasks. Tutors used this confidential information to discuss progress and make decisions about transferring marks at "tutor led peer assessment sessions". These sessions provided a forum in which students could see the results of their self and peer assessments, and how accurate they had been in relation to the teams' interpretation and the tutor's summary.

Scaffolds for Strategy formation

Cognitive strategies are, in effect, the outcome of Metacognition and the self-monitoring process. These strategies are numerous, and include approaches for rehearsal, elaboration, and organization (Weinstein & Mayer, 1986). Certainly self-regulating students use techniques such as paraphrasing, highlighting and concept mapping, and these are skills that can be taught through direct instruction. Ultimately, however, the implementation of such strategies must be enacted by the learner. Assisting learners to articulate at the outset the strategies that they will be implemented within their projects provides a strong initial scaffold, as it allows the establishment of a goal, and the plan for maintaining the pursuit of that goal. The teacher can use this plan to tailor assistance, and the plan itself acts as a milestone against which learners can continue to assess their performance.

As a pre-engagement tool and to enhance the authenticity of their projects, learners in this unit were required to enter into a student contract (Figure 4). The contract was an agreement between themselves, their team members', and the tutor. Its purpose is to outline each student's responsibilities such as team role, responsibilities, topics for their portfolio, amount of time committed to achieve these tasks, and contributions they would make to help the group achieve its goals. This is completed in week 3, with a meeting in which a "Team Contract" is signed, were all team members agree that the roles, tasks and times allocated for all team members' are acceptable. This helped students commit to specific responsibilities in order to create a collaborative environment in which they would establish shared goals through an agreed plan.

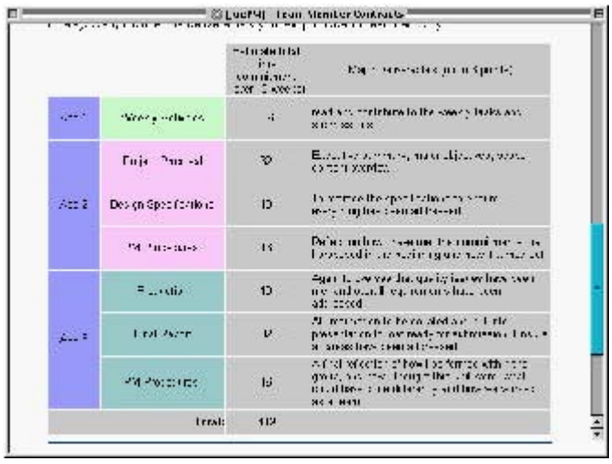

Figure 4: Sample Student Contract

Conclusion

There is currently much debate focused on creating optimal conditions in learning environments for self-regulated learning, to help students develop as independent learners. This paper has provided a conceptual framework to help identify important elements needed for self-regulation, and provided scaffolds to support Metacognition, Self-Monitoring and Strategy Formation. However, providing appropriate learning environments and valid assessment instruments to help students' develop these skills is not an easy task. At which level should Self-Regulated learning be targeted? Should Metacognitive strategies be targeted before Strategy Formation, or should Self-Monitoring be practised first? We suggest that all of these cognitive elements need to be considered concurrently. The design of the learning environment must integrate appropriate learning activities as outlined above, to scaffold the development of these skills.

Students must actively engage with authentic learning activities, which are student-centred but scaffolded to give guidance and support. In the above examples, the WORKING inventory helped interrogate students' professional skills, and provided customised feedback on how to improve these, as well as providing tutor and on-line support. At the same time, students were continually monitoring self and peer performance through an on-line application that provided regular and consolidated feedback on their progress and viewpoints. These activities enabled students to regularly gain feedback on how successful their strategies had been as outlined in their contracts, and through reflective practice allowed them make continual improvement.

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