Designing an on-line environment to scaffold cognitive self-regulation

Mark McMahon
Edith Cowan University, Perth, Australia
m.mcmahon@ecu.edu.au

Abstract: The move towards more flexible modes of tertiary education is requiring students to be able to regulate their own study habits. This is particularly true of on-line learning, where there may be less direct instructional support than in traditional face-to-face modes. However, to assume that students already have these skills is presumptuous. This paper describes a model for self-regulation and suggests how self-regulated learning can be enhanced through the integration of a proposed on-line learning environment. The main instructional approach is scaffolding, where support is provided by reflection and peer feedback, and through the use of tools for annotation and portfolio generation.

Keywords: metacognition, self-regulated learning, world wide web

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 (Australian National Training Authority, 1998; Bennett, Dunne, & Carre, 1999; Candy, Crebert, & O’Leary, 1994; Dearing, 1997; Mayer, 1992). 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 self-regulatory skills still requires proactive involvement and strategy forming (Zimmerman, 1989).

With the growth of flexible modes of tertiary learning and the subsequent shift to less didactic modes of teaching, it is hardly surprising that there is a high drop-out rate for students with poor study skills when they venture on-line (Loomis 2000). Brooks (1997, p. 135) goes so far as to claim that students “who are poor at self regulation easily can be slaughtered in www-based courses”. Therefore, mechanisms must be in place which bridge the nexus between supported and self-regulated learning. In order for this to happen, however, a sound understanding of what Self-Regulation is, and how it can be inculcated within in students, must be developed.

A Model 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.

A number of models have been proposed to expose the processes that underpin Self-Regulated Learning. Boekaerts (1997) provides a six component model based upon notions such as content domain, metacognitive knowledge and motivational strategy use. The elements are co-dependent and interact with each other in the application and development of goals, strategies and domain-specific knowledge.

Garcia (1994) articulates 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.

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.

**Figure 1 – A Model for Self-Regulation**

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.

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).

As an 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 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 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?

Enhancing Cognitive Self-Regulation

Any attempt at promoting Self-Regulation must first address the issue of the level at which to pitch instruction. Does Self-Regulation come about through modelling regulatory strategies, having students monitor their motivation and performance, or by attempting to raise general self-awareness? It may be argued that Metacognition is the primary enabling state for Self-Regulation just as the implementation of strategies is the inevitable outcome. However attempting to raise metacognitive awareness without a context or application is probably as fatuous as teaching strategies without the learner understanding their purpose and place as part of their study.

Lin (2001) identifies two main approaches to promoting Metacognition: strategy training; and the creation of a supportive social environment for Metacognition. In this paradigm, there are also two types of content that are taught: knowledge about a specific domain; and knowledge about the self-as-learner. It would appear then that a holistic approach is required; one that both models and directly teaches self-regulatory strategies within an authentic environment; one that provides support for learners while at the same time promoting individualisation, generalisability and self-reliance.

This paper argues a process of scaffolding that may be implemented at each of the three psychological levels of Metacognition, Self-Monitoring, and Strategy Formation (Figure 1). 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 a 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

Scaffolds for Self-Regulation

The above guidelines are general in nature. What is required is an approach to scaffolding which will support the development of Cognitive Strategies, Self-Monitoring Techniques, and 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. Since it is the enabling psychological state for self-monitoring and strategy formation, it is erroneous to consider Metacognition as a unique and exclusive construct. In fact, most guidelines for the development of Metacognition include cognitive and self-monitoring strategies. Blakely and Spence (1990) cited by Grabinger (1997, p. 673) posit the following basic strategies for Metacognition:

- 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.
- Students must participate in guided self-evaluation through individual conferences and checklists to help them focus on the thinking process.

Blakey & Spence (1990) summarise these strategies for developing Metacognitive behaviour:

- 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
- Self-evaluation

It is interesting that Blakey and Spence frame their recommendations around metacognitive behaviours. Metacognition is by definition an internal process, so many of these guidelines closely align with self-monitoring and strategy formation since they are more amenable to direct manipulation.

Environments to support Self-Regulation therefore must attempt to make the hidden constructs of Metacognition more manifest to the students. This involves engaging the learner in self-monitoring processes. Weinstein & Mayer (1986) argue that all metacognitive activities 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 (e.g., timing questions) in an exam situation (Garcia, 1994).

Finally, the specific strategies that students use must be scaffolded. Cognitive strategies are, in effect, the outcome of Metacognition and the self-monitoring process but are grounded in a specific academic context. 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.

**A proposal for the design of an Environment to Support Cognitive Self-Regulation**

As a synthesis of the above recommendations, an on-line tool is proposed which may assist in the development of Cognitive Self-Regulation. It is designed to assist tutors in providing direct instruction regarding Self-Regulation and to create activities that are purposeful and give the structure required by novices undertaking flexible learning. Learners will be able to access advice and activities seamlessly within a web environment and develop metacognitive skills as they monitor their progress through a continual level of activity throughout the course.

The product will be developed as a generic web-based annotation tool, using JavaScript, SQL and Microsoft Active Server Pages (ASP) to link to an ODBC compliant database which will contain the data generated by students and tutors. It will consist of the following modules:

- **Site Builder** – a GUI driven tool that will allow the tutor to attach specific instruction to web readings and to create form fields that the user will be able to complete as per instructions
- **Annotation tool** – this is the students’ view of the environment once a page has been set up by the instructor. Users will reflect on the readings, read other students’ comments and post comments to the database
- **Portfolio generator** – this tool will pool the database entries to generate a student’s portfolio which may be printed out or e-mailed to a tutor for further reflection and assessment purposes.

It must be acknowledged that the above is merely a framework to support Self-Regulation. As such it is a general tool that may be integrated to courses that promote Self-Regulation, but does not inherently do so. For it to be effective, the general principles of scaffolding and the creation of resources, learner supports, and feedback that encourage Cognitive Self-Regulation need to be integrated.

Central to the design is the opportunity for users to transform textual readings through annotation. This allows learners to have effective cognitive strategies modelled for them, and to practice those skills themselves. Since meaningful learning results from a deep level of processing, scaffolds that engage the learner in complex cognitions should be selected. The annotation tool, therefore, should allow learners not just to highlight main ideas, but to restate them, ask questions and receive feedback.

The other central concept is the use of an electronic portfolio. 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. A portfolio extends on this to act as both a journal and cumulative repository of students’ work. It allows learners’ to track their progress, which may have a positive impact on the affective dimension of Self-Regulation by providing an opportunity for learners’ to develop a sense of success and completion. However, it is also a useful cognitive tool in that it provides a basis upon which students can evaluate their own performance, see their developing understandings and identify areas upon which they need to concentrate.

Both of these types of components support the development of Self-Regulation through the integration of the following interaction types:

**Self-Reflections**: Students will be asked to reflect on a personal issue. This may involve the articulation of goals, or the response to focus questions about their experiences and understandings. These can then be drawn from the database at a later date to allow the user to respond to their own initial ideas and articulate the ways in which those ideas have developed.

**Summaries Critiques and Questions**: Students will be required to apply a variety of Cognitive strategies to readings, with a particular focus on transformative techniques through the use of an annotation tool. Students will be able to summarise readings in their own words, highlight parts of the reading about which they are unsure, and critique the ideas presented in readings. Tools that allow the user to enter summaries, critique and identify ambiguous or confusing sections of the readings will be present within the product at all times, though the prescriptiveness of their use will be faded as learners hopefully become more independent.

**Links & Applications**: Users will be able to submit images, documents, and Web links to the database. This will allow the user to go beyond simply reflecting on existing materials to finding other resources, creating their own designs and articulating philosophies.

**Peer Interactions**: These are the primary feedback mechanisms built into the Self-Regulatory environment. They will take the form of discussion board postings, but also reflections of others’ summaries, critiques, and question, as well as responses to others documents and links. In practice, this will work by having learners be able to turn on others’ annotations to a reading when they come to review it themselves. They will also be able to click on a ‘Compare’ button which will allow them to review other students’ work and respond to those. Where the user has made a response to a peer submission, this will be included in the generated portfolio.

**Summary and Conclusions**

It appears then, that Self-Regulation is not an easy instructional aim. 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). However, research has shown that it IS teachable, and certainly not ineluctably tied in with intangible and unalterable concepts such as intelligence (Symons, 1986). Learners will not always have access to the level of support which they receive in formal education, and this is particularly true of on-line learning, which is currently prone to high levels of attrition. It is important therefore that thought needs to be given to the process involved in users becoming aware of themselves and their own understandings, which in the end will only make them better learners. It must also be acknowledged that providing appropriate learning environments and valid assessment instruments to monitor students’ ability to self-regulate, as well as feedback and scaffolding on how to improve, is not an easy task for most tertiary educators.
It is intended that the environment will be developed during the first half of 2002 before being implemented as part of a unit in Instructional Design that 2nd year multimedia undergraduate students in ECU’s Bachelor of Communications undertake. The environment proposed is certainly not a panacea for the problem of students developing independent learning habits, since it is heavily dependent upon the design of the course in which it is used. However, what frames this proposal and the basis of future research in this area is the contention that, when integrated into a course that manifests the main tenets of scaffolding for meaningful learning, the development of Self-Regulation may be enhanced.

References


