

Self-regulated learning as a pedagogical strategy in engineering students

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Research shows that students with high and low academic performance are different in their approaches to learning, that is, they have their own systematic way of transforming information into knowledge. Good students, for example, are able to employ a range of positive strategies for learning, such as performance monitoring and the use of an active task approach (Zimmerman and Martinez-Pons, 1986). These students are also more aware of the strategies they use and why they use them (Pintrich, 2000). Self-regulated learning (SRL) is defined as an active process in which students accept autonomy and responsibility for their own learning by actively setting goals and thereby planning, monitoring, regulating, and evaluating their learning progress (Boekaerts, Pintrich, and Zeidner, 2000). Self-regulated learning is a complex concept that includes several elements. According to (Zeidner et al., 2000) self-regulated learning involves various components: cognitive, affective, motivational, and behavioral, which provide the individual with the ability to adjust his or her actions and goals in order to achieve the desired result in the face of variable environmental conditions. Therefore, students are considered self-regulated to the extent that they are metacognitively, motivationally and behaviourally active in their own learning processes (Zimmerman, 1989a). These processes describe how learners pose problems, apply strategies, monitor their performance and interpret the results of their efforts (Paris & Winograd, 2001). Elements considered to be part of self-regulated learning, such as cognition, metacognition, motivation, behaviour and context, are described below (McKeachie et al., 1987; Zimmerman, 2000; Pintrich, 2000).

Some strategies are described below:

Cognition

Cognitive learning strategies are the methods that students use to search for and process information (McKeachie et al., 1987). Cognitive strategies help process and transform information into stable and dynamic knowledge structures (McCombs & Whisler, 1989).

In self-regulated learning students can make use of a large number of cognitive learning strategies to understand and assimilate learning content. One of the central aspects for the control and regulation of cognition is the effective selection and use of diverse cognitive strategies for memory, learning, reasoning, problem solving and the construction of meaning. Several researchers have studied various testing, organizing, and processing strategies that students can use to control their cognition and learning (Pintrich and De Groot, 1990, Pintrich et al., 1993; Pressley and Afflerbach, 1995; Schneider and Pressley, 1997, Weinstein and Mayer, 1986, Zimmerman and Martinez-Pons, 1986).

Testing Strategies

These strategies are used to select and code the information in a relatively unchanged form, by reciting or

repeating the information to be learned. These types of strategies are effective for learning factual material, however, they allow few connections to be made between new information and information already available in long-term memory. Oral repetition, underlining, copying, and selective verbal note-taking are examples of rehearsal strategies.

Organizational Strategies

These strategies are used to build internal connections between pieces of information given in the study material. They help students remember information by creating structures. Organization involves reorganizing the information to be learned in a way that makes the learning more meaningful. Thus, organizational strategies assist in the selection of information to be transferred to long-term memory and the construction of relationships between ideas implicit in the information. Examples of organisational strategies include grouping, sorting, categorising, developing hierarchies, building networks.

Elaboration Strategies

The elaboration strategies provide the most complete transformation of the information to be learned. These strategies extend beyond the given knowledge and therefore help to create links between the individual's previous knowledge and the new information given by the material to be learned. Examples of elaboration strategies include the use of mental images, paraphrasing text, creating analogies, generative note-taking, summarizing, verbal elaboration, and self-questioning.

While all three types of cognitive strategies have been shown to improve information acquisition and retention, processing strategies require the most activity and effort from the learner and, because of their role in facilitating the integration of new and existing knowledge, tend to be the most effective. Testing strategies, on the other hand, mainly serve to replicate new information without integration or transformation. Therefore, processing strategies tend to be the most effective in promoting meaningful and effective learning, while testing strategies are the least effective (McCrindle & Christensen, 1995).

Metacognition

Metacognition was a term introduced by Flavell (1976) to refer to the knowledge and awareness of one's own cognitive processes and the ability to actively control and manage those processes. The term "self-regulation" is associated with metacognitively guided, less intrinsically motivated, and strategic forms of learning (Winne, 1995, 1997; Zimmerman, 1990). Metacognition is the awareness students have of their general academic strengths and weaknesses, the cognitive resources they can apply to meet the demands of particular tasks, and their knowledge of how to regulate task participation to optimize learning processes and outcomes. Intrinsic motivation refers to learners' belief in self-regulated incremental learning, a high value placed on personal progress and deep understanding as opposed to outperforming peers or impressing others, high effectiveness for learning, and attributions that link outcomes to factors under their control (effective use of strategies). "Strategic" describes the way these students approach challenging tasks and problems, choosing from a set of tactics those they believe are most appropriate for the situation, and applying those tactics appropriately.

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