# Self-Regulation in Science Education

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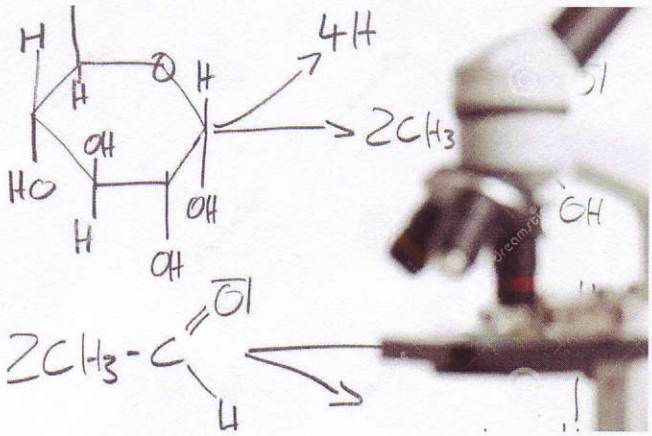

## Introduction

The presented poster presentation reviews recent research on principles of **self-regulated learning** (SRL) and discusses the implementation of the research findings in science education. Many studies suggest (Boekaerts, Pintrich & Zeidner, 2000; Zimmermann & Schunk, 2001; Butler & Winne, 1995) that self-regulation is used by a student who directs his/her **learning without being directed from the outside.** Rather than taking a passive role, self-regulated learners are active participants in the learning process, who seek new information and take steps to master new skills. Self-regulated learning has become a widely discussed issue nowadays with attempt to improve science teaching and learning in regular science classes. On this basis, we focus on the effective methods and development of three components of self-regulated learning, including **cognitive, metacognitive and motivation** understanding of SRL from the perspective of science education literature.

## The role of Cognition, Metacognition, and Motivation

*The first* we focus on three components of SRL, including cognition, metacognition, and motivation. *The second* section focuses on three general instructional strategies for improving self-regulation in the science classroom.

***Student during SRL process regulates:***

- **Cognition** – includes skills necessary to encode, memorise, and recall information (choosing simple learning strategies, problem solving, critical thinking, etc.).
- **Metacognition** – includes skills that enable learners to understand and monitor their cognitive processes (realizing their own learning strategies, planning and evaluation procedures, chooses different learning strategies). Knowledge of cognition and regulation of cognition (evaluates and controls).
- **Motivation** – includes beliefs and attitudes that affect the use and development of cognitive and metacognitive skill (academic self-efficacy, task value, test anxiety, etc.).


Figure 1. *Components of self-regulation learning.*

SRL refers to our *ability to understand and control our learning environments*. If we want to be successful in that, we must set goals, select strategies that help us achieve these goals, implement those strategies, and monitor our progress towards our goals (Schunk, 1996). Few students are fully self-regulated; however, those with better SRL skills typically learn more with less effort and notice higher levels of academic satisfaction. Self-regulated learner is also internally motivated, experiences lower levels of test anxiety and achieves optimistic self-efficacy.

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Much of the research in science education has focused on two broad areas; curriculum change in science education and the use of multiple instructional strategies to improve learning (Kelly & Anderson, 2000). We focus on two selected instructional strategies for improving SRL needed to succeed at higher levels of science: *(1) the role of collaborative support, (2) the use of technology and (3) the impact of student and teacher beliefs.*

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***1. Collaboration*** in the form of help from teachers and students encourages learning and SRL for many reasons. Firstly, teacher provides explicit examples of how to perform a task and provides explicit feedback (Schunk, 1996). Secondly, collaborative support such as co-teaching, tutors, peer-models, or small groups provide an opportunity for discussion of scientific concepts and reflection that promotes SRL.

Hogan (1999) developed the *Thinking Aloud Together program* as a means to promote metacognition and self-regulation in a small group collaborative setting. *The Peer Instruction program* developed at Harvard University by Mazur (Prentice Hall, 1997) is a good example of student collaboration model for large science lecture sections.

***2. The use of technology***, hardware and software in the process of inquiry, as a construction tool for creating representations of mental models, as a collaborative communication medium, to model expert techniques and to provide feedback during problem solving. The technology supports SRL by functioning as: a knowledge representation tool, a cognitive scaffold, a feedback, and a collaborative communication device. An interesting example is *nStudy* developed by Winne et al. (2006).

***3. Student and teacher beliefs*** play a crucial role in science learning for both students and teachers. Effective instruction, peer modeling, and cooperative learning communities all appear to improve student self-efficacy (Pajares, 1996). Detailed informational feedback increases student self-efficacy as well, but especially self-regulatory skills and metacognition (Butler & Winne, 1995; White, 1998).

SRL theory focuses on the transition from dependent to independent-autonomous learner. SRL is not a mental ability or an academic performance skill; rather it is the self-directive process by which learners transform their mental abilities into academic skills. There are many ways that cognitive, metacognitive, and motivational skills are enhanced using variety strategies. We believe that schools need to prepare students as life-long learners in science and other academic domains.

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