Self-regulation of technical drawing: do metacognition and motivation play a role?

When beginning a formation, a number of building or industry students in the Swiss vocational education and training encounter new challenging courses, especially the learning of technical drawing. Traditional technical learning methods focus mainly on drawing and interpreting plans of 2D and 3D objects. Spatial skills represent a critical process in the technical drawing (Adanez & Velasco, 2002) and the training of spatial skills allows better skills in drawing courses (Kadam et al., 2021). This doctorate is based on the social cognitive theory assuming that learning is not only influenced through cognitive variables but also by motivational beliefs, behaviors, and affects (Bandura, 1997).

Self-regulation is defined as the process of systematically organizing one's thoughts, feelings, and actions to attain one's goals (Usher & Schunk, 2018). Students with better self-regulation skills typically learn more with less effort and report higher levels of academic satisfaction (Schraw et al., 2006). Zimmerman (2000) proposed a cyclical nature of self-regulated learning around three phases where students learn to establish their own goals for learning, develop plans to achieve those goals (forethought phase), monitor the deployment and progress of those plans, exert control and change plans when necessary (performance phase), and judge when these have been achieved (reflection phase) (Hacker & Bol, 2019).

Motivational beliefs (self-efficacy and value) and metacognition (monitoring) are key processes during a self-regulated learning. *Self-efficacy* is defined as personal beliefs about one's capability to learn (Bandura, 1997). Studies emphasize the influence of self-efficacy during the forethought, performance and reflection phases of self-regulation (Pajares, 2008). *Value* refers to what influence the individual's desire to do a task and include four components: cost, importance, interest, and usefulness. Value explains in particular choice and persistence during a learning activity (Wigfield & Cambria, 2010). Self-regulation also requires that students *monitor* one's thoughts, feelings, and actions and making adaptation when needed (Usher & Schunk, 2018). Calibration enables accurately monitoring and refers to the correspondence between a student's perception of their performance and actual outcome. A positive relationship between calibration and performance is well documented (Chen & Bembenutty, 2017).

Little is known about the relationships between self-regulation, spatial skills, and technical drawing. This cumulative thesis focuses on two main research questions:

- What are the links between self-regulation and spatial skills?
- Does a self-regulated training improve spatial skills and technical drawing?

In the first step, a path analysis will be conducted to better understand the relationships between the self-regulation process, like motivational beliefs and metacognition, and spatial skills. The results of the first study will be used for building a training. The final step will be to check whether the results accumulated in the first two stages can be transferred to other professions.

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