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Relations between young students' strategic behaviours, domain-specific self-concept, and performance in a problem-solving situation

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Abstract

This study aimed at investigating the relations between students' strategic behaviour during problem solving, task performance and domain-specific self-concept. A total of 167 first- and second-graders were individually examined in tasks involving cubes assembly and in academic self-concept in mathematics. Students' cognitive, metacognitive, and Motivational/Volitional Strategic Behaviours were video-recorded and rated by two independent observers. Structural equation modelling showed that the cognitive and Metacognitive Strategic Behaviours were explained by a cognitive self-regulation factor which correlated with the Motivational/Volitional Strategic Behaviour factor. The importance of the cognitive self-regulation factor for task performance and the association of domain-specific self-concept with Motivational/Volitional Strategic Behaviour were shown.

Keywords: Self-regulatory strategies; Self-concept in mathematics; Cognition; Metacognition; Motivation; Volition

1. Introduction

According to the self-regulated learning approach, students are self-regulating when they are aware of their capabilities, of the strategies and resources required for effectively performing a task, as well as when they plan, monitor, and regulate actions towards their learning goals (Paris & Paris, 2001; Zimmerman, 1999). Mastering and applying multiple strategies to effectively monitor and regulate learning and problem solving are essential components of self-regulated learning and they are critical for successful performance (Alexander, Graham, & Harris, 1998; Pressley & Hilden, 2006; Weinstein, Husman, & Dierking, 2000). For effective self-regulation, however, positive beliefs about one's own abilities are also needed (Schunk & Zimmerman, 2006). Students who believe that they are capable of performing academic tasks tend to engage more in strategic action (Alexander et al., 1998).

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The aim of the present study was to investigate the relations between early elementary students' strategic behaviours during a specific problem-solving situation, their task performance, and their academic self-concept in mathematics. The study also aimed at exploring if the various categories of strategic action identified in literature can be also identified in the participant students' strategic behaviour, and what are the relations of these categories to performance and self-concept. In this study, students' strategic behaviour during problem solving was examined by means of direct observation instead of a self-report instrument. Self-report inventories have been criticised as measures designed "…to cause the learner to recall or to generate a particular kind of response" (Winne & Perry, 2000, p. 532). Winne, Jamieson-Noel, and Muis (2002) have also argued that learners' self-reports of study tactics calibrate poorly to moderately with traces of tactics actually used while studying. Therefore, it has been claimed that students' overt behaviour during learning and problem solving might be used to infer internal self-regulatory and thought processes (Siegler, 2006).

1.1. Strategic action as a component of self-regulated learning

A component of self-regulated learning is strategic action (Winne et al., 2002). Various categories of strategies have been identified by researchers as essential components of self-regulated learning. The present study, based on current research that endorses the interaction of cognitive, metacognitive, and affective components in self-regulated learning (Efklides, Niemivirta, & Yamauchi, 2002; Gourgey, 2002; Mayer, 1998; Sperling, Howard, Miller, & Murphy, 2002; Weinstein et al., 2000; Winne, 1996; Wolters, 2003; Zimmerman, 1999), focused on cognitive, metacognitive and motivational/volitional strategies. *Cognitive strategies* are procedures that students use to learn, remember, and understand. They comprise of rehearsal, elaboration, and organizational strategies, such as analyzing and combining activities and choosing between main and trivial information (Alexander et al., 1998; Mayer, 1998; Pintrich, 1999; Pressley & Hilden, 2006; Weinstein et al., 2000; Winne, 1996; Zimmerman & Martinez-Pons, 1988).

Another category of strategic action pertains to the metacognitive skills of planning, monitoring, and modifying one's own cognition (Corno, 1986; Zimmerman, 1994; Zimmerman & Martinez-Pons, 1988). *Metacognitive strategies* enable one to monitor, control and evaluate performance, in other words, to use knowledge strategically (Corno, 1986; Gourgey, 2002; Mayer, 1998; Pintrich, 1999; Wolters & Pintrich, 1998; Zimmerman, 1999). Goal setting, planning, self-monitoring, regulation of the cognitive process, and evaluation of the learning outcome are broader types of metacognitive skills, which may serve as general or task-specific procedures that control cognitive processing (Alexander et al., 1998; Mayer, 1998; Paris & Paris, 2001; Winne, 1996; Wolters & Pintrich, 1998). Ample research has shown that students' use of cognitive and metacognitive skills and strategies make a significant contribution to academic achievement in a variety of content domains (Alexander et al., 1998; Brown, Bransford, Ferrara, & Campione, 1983; Pintrich & DeGroot, 1990; Pressley & Hilden, 2006). This seems also to be true for school mathematics in the first elementary school years (see Fuchs et al., 2003; Lucangeli & Cornoldi, 1997; Vanleuvan & Wang, 1997).

Furthermore, strategies through which individuals initiate action and, maintain, or enhance their motivation towards a task are also viewed as critical determinants of students' learning and achievement (Corno, 1986; Mayer, 1998; Weinstein et al., 2000; Wolters, 2003; Zimmerman, 1999). These strategies are motivational and volitional processes (Kuhl, 1985) that interact with the person's affect and level of activation, and are manifested in autonomous work, persistence in face of difficulties, and maintaining self-motivation towards the task at hand (Kuyper, van der Werf, & Lubbers, 2000; Wolters & Rosenthal, 2000). *Motivational/volitional strategies* have been found to be directly related to academic skills, grades, and performance (Onatsu-Arvilommi, Nurmi, & Aunola, 2002; Wolters, 2003; Wolters & Rosenthal, 2000), while in other studies to be indirectly related to performance through their influences on choices, interest, value, effort spent, and use of strategies (Kuyper et al., 2000; Wolters, 2003).

Winne et al. (2002) reported that use of cognitive strategies is connected to other aspects of self-regulation such as metacognition and motivation (see also Hartman & Sternberg, 1993). Interaction among strategic activities is well documented in literature. Strategies for regulating cognition and strategies for regulating motivation are closely related (Veenman, Kok, & Blöte, 2005; Weinstein et al., 2000; Wolters, 2003; Wolters & Rosenthal, 2000). Alexander et al. (1998) claimed that becoming more strategic serve as a catalyst for strategy change as well.

1.2. Strategic action, self-concept, and achievement

Students' ability to learn in a self-regulated manner requires that they have a relatively well-defined and stable self-concept in both global and domain-specific sense, and that they believe they have the abilities required to exert control