Chapter 20
Transmitting Metacognitive Pedagogy to Math Pre-Service Educators

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ABSTRACT
The purpose of this chapter is to investigate the impact of embedding metacognition into pre-service education with two intended outcomes: to develop pre-service educators’ identification development of metacognition and to transmit metacognitive pedagogy to pre-service educators. An ethnography chronicles an intervention introduced through a mathematics methodology course for pre-service educators at a Canadian institution. The focus of the intervention emphasized explicit instruction of metacognition and the development of a metacognitive reflective practice supported by weekly metacognitive prompts. Data was collected from both students’ reflections and instructor’s responding prompts and were analyzed using thematic analysis.

INTRODUCTION AND PURPOSE
The purpose of this chapter is to explore the impact of embedding metacognition, more commonly known as “thinking about thinking” (Flavell, 1979), into pre-service teacher education with two intended outcomes: to develop pre-service educators’ identification development of metacognition, and to transmit metacognitive pedagogy to pre-service educators.

Research identifies metacognitive instruction as an important objective within the hierarchy of educational objectives (Radmehr & Drake, 2017; Schoenfeld, 1992). Radmehr and Drake show metacognitive knowledge to be a higher-level form of cognitive knowledge. This confirms the model presented by Anderson, et. al. (2001) in their revision of Bloom’s Taxonomy of educational objectives. Research shows metacognition to support academic achievement and achievement beyond school (Sangers-Jokic
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& Whitebread, 2011), problem solving (Desoete, Ruyers & Buysse, 2001), critical thinking (Kuhn, 1999), and is a “most powerful predictor of learning” (Wang, Haertel & Walberg, 1990, p.3). From the authors’ experience as educators, growth in learners’ abilities to problem solve and think critically are observed when metacognitive instruction is explicitly addressed.

General metacognitive ability, when taught within the context of learning, assists in transitioning implicit knowledge of learning into explicit, conscious use of general learning processes (van Velzen, 2016). In other words, students engage in effective learning strategies proactively, rather than reactively, when taught metacognition within the context of their learning. Further, students’ motivation is a predictor of critical thinking performance (Patton, Fry, & Klages, 2008), particularly in pre-service educators’ use of metacognitive tools (Stolk & Harari, 2014; Afamasaga-Fuata’i & Sooaemalelagi, 2014). Since metacognitive instruction enhances learners’ motivation (e.g., Belenky & Nokes-Malach, 2013), it is reasonable to infer that metacognitive instruction will enhance critical thinking performance.

Students need to develop language to discuss and understand metacognition (Jones, 2016). Teachers’ understanding of metacognition also impacts how they use metacognitive strategies and tools with their students (Myers, 2008). Previous research highlights the importance of practising the development of metacognition, explicitly (Gutierrez, Schraw, Kuch, & Richmond, 2016; Wedelin, Adawi, Jahan, & Andersson, 2015; van der Stel & Veenman, 2014; Mevarech & Amrany, 2008). Therefore, embedding metacognitive instruction explicitly into a curriculum should aid in developing pre-service educators’ identification and understanding of their metacognitive knowledge and skills. This, in turn, should support the transmission of metacognitive skills from pre-service teachers to their respective classrooms (Wilson & Bai, 2010).

LITERATURE REVIEW

This literature review will provide the necessary definitions and relationships of the essential constructs, as well as the chosen theoretical frameworks supporting this research. Contained within this literature review is a framework for metacognition and its’ impact on critical thinking and problem solving. This literature review concludes with a suggested framework for instructing metacognition, which is then operationalized into the present study.

METACOGNITION

Flavell (1971) introduced the concept of metacognition. Several operational definitions are in use within research. More commonly known as “thinking about thinking” (Flavell, 1979), metacognition may also be defined as the knowledge and control of an individual’s cognitive system. In the case of metacognition, thinking is both an action and object. If one considers an object, such as a ball, thoughts of a description of the ball, usefulness of the ball, and ownership of the ball will emerge. For metacognition, one considers a thought, such as the strategy of seeking help, and may consider a description of what the strategy is, when to use it, and how to apply this strategy.

Two main components of metacognition are identified as the knowledge of cognition and the regulation of cognition. Schraw and Dennison (1994) expanded on Brown’s (1987) model of metacognition with differentiations in the regulatory components of metacognition. Some researchers view self-regulated
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