

# Chapter XLIX

## Metacognitive Feedback in Online Mathematical Discussion

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### ABSTRACT

*Effects of two online inquiry discussions in mathematics are compared: one inquiry was based on metacognitive feedback guidance (MFG) and the other with no such guidance (NG). The MFG students were exposed to the IMPROVE metacognitive questioning method that serves as cues for solving the problem and features of providing feedback (Kramarski & Mevarech, 2003). A total of 80 eighth-grade students participated in the study. Students were asked to solve online a real-life task and provide feedback to their peers about the solution process. Results indicated that the MFG students significantly outperformed the NG students in online problem-solving task. The MFG students were engaged more in online discussion with respect to mathematical and metacognitive aspects. They also succeeded more on a delayed written mathematical transfer test. Theoretical and practical implications of the study are discussed.*

### INTRODUCTION

Rapid advances in computer technologies have facilitated the development of electronic tools and resources that have, in turn, expanded the opportunities to empower students' mathematical learning. Computers can help create challenging environments for mathematical learning in several ways. Computers can offer tools that support inquiry learning, such as tools to analyse or visualize data, tools that help learners state hypotheses, and tools that help learners manage the learning

process (de Jong, 2006b). Computers can support collaboration among learners, allowing them to communicate, share data, results and ideas, and discuss consequences for the knowledge that is under construction.

Researchers pointed out that electronic learning affords learners with opportunities for active, student-centered learning where the students themselves decide what to learn, how to learn, whether they understand the material, when to change plans and strategies, and when to increase effort, based on their own needs and interests

pointed out that in such an environment, learners need to be able to regulate, control, and evaluate their own learning progress (Azevedo & Cromely, 2004; Britt and Gabrys, 2001).

Although at face value the potential of these opportunities is compelling, research shows that students are usually not in fact “mindfully engaged” when it comes to learning with computer-based tools.

Students often get bogged down by the logistics of their work, and focus on superficial measures of progress. They do not see the “big picture” and are unable to consider alternatives to their solution. Furthermore, they do not know how to articulate and explain their reasoning. Thus, students need support in identifying effective ways to reflect upon their ideas and productively regulate them (e.g., Azevedo & Cromely, 2004; Kramatski & Mizrachi, 2006; Palincsar & Brown, 1984).

The purpose of this research is to evaluate the effectiveness of self-regulated learning support in assisting students with online inquiry learning in mathematics. Prior to explicating the design of the study, a brief overview of online inquiry learning in mathematics and self-regulation utilized in the study is provided.

### **Online Inquiry Learning in Mathematics**

Standards in the area of mathematical education have largely emphasized the importance of promoting mathematical problem-solving and reasoning skills by inquiry learning (NCTM: National Council of Teachers of Mathematics, 2000, PISA: Programme for International Students Assessment, 2003). Inquiry learning is the process of being engaged in learning in which students solve problems, pose questions, construct solutions, and explain their reasoning (e.g., Schraw, Crippen and Hartley, 2006). According to the standards, problems should be based on a wide range of mathematical knowledge and mathematical skills, and often ask solvers to use different representations in their solutions (PISA, 2003).

Furthermore, explanations (also known as justifications) involve constructing, refuting, and comparing arguments using various types of reasoning. Explanations have the potential for engaging students, making students’ thinking visible, and refuting misconceptions (Nussbaum and Sinatra, 2002).

One obvious way to bring students into the processes of scientific inquiry is by offering them environments and tasks that allow them to carry out the processes and help them build personal knowledge that they can use and explain what they learn. Online discussion in computer-based learning have facilitated the opportunities to empower inquiry learning. It enables students advocate their own individual opinions, sometimes backed by facts and sometimes unfounded (Sherry, Billig, and Tavalin, 2000). Discussion mediates shared meaning. Through critically examining the reasoning of others and participating in the resolution of disagreements, students learn to monitor their thinking in the service of reasoning about important mathematical concepts (e.g., Artz and Yaloz-Femia, 1999; McClain & Cobb, 2001). However, research indicates that just being engaged in online mathematical discussion is not enough to enhance mathematical inquiry ability. Self-regulated learning support for problem solving and providing elaborated explanations is needed (e.g., Oh & Jonassent, 2007; King, 1992; Kramarski & Mizrachi, 2006).

### **Self-Regulation of Learning (SRL)**

Self-regulation of learning (SRL) refers to a cyclical and recursive process which utilizes feedback mechanisms for students to understand, control and adjust their learning accordingly (e.g., Butler & Winne, 1995). The process involves a combination of four areas for regulation during learning: Cognition, metacognition, motivation, and context condition (Pintrich, 2000; Schraw, Crippen, & Hartley, 2006). Cognition refers to strategies of simple problem-solving, and critical thinking.

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