Metacognitive Feedback

Why Is This Strategy Useful?
Some students are weighed down by the cognitive load associated with learning and organizing new knowledge, particularly in mathematics. Metacognition has been identified as a critical process that supports student learning and problem solving. Computers can serve as an effective aid in learning process and in developing mathematical reasoning because they provide students with immediate feedback about their progress and success in the task. The use of animated “agents” in computer software extends the cognitive scaffolding provided by various computer tools and representations (e.g., searchable text, simulations, concept maps, etc.) by embedding them in productive and motivating social-constructive interactions (e.g., peer teaching, collaboration, and assessment). In those types of interactions, the student teaches the animated agent and sharpens his or her conceptual understanding from the interactive experience.

Description of Strategy
Teachable Agents are software environments in which students teach a computer “agent” using well-structured visual representations. Sometimes, these “agents” will have a name (in the study below, one was “Betty’s Brain”). An important feature of these types of computer environments is that students can monitor how the computer agent answers questions, and can provide corrections if the computer makes mistakes. Students are encouraged to “learn-by-teaching” through the use of three primary strategies:

1. Teach the computer agent by using a concept map
2. Query the computer agent with your own questions to see if the computer understood
3. Quiz the computer with tests to see how well the computer agent does

Although this strategy is grounded in a specific computer environment, the principles of metacognitive feedback and “learn-by-teaching” can be extended to other contexts. However, metacognitive feedback must be accompanied by content cues in order for students to benefit. Students have to be taught and given enough opportunities to practice metacognitive strategies in socially engaging and relevant ways.

Research Evidence
One correlational study provides support for this approach. This study included 39 students in two 5th grade classrooms. The study was designed to compare the effects of the different types of feedback. Results showed that guided Metacognitive feedback better prepares the student for future learning tasks even in situations where the metacognitive support is removed. However, guided feedback with Metacognitive cues but no content information does not help novice learners with low prior knowledge. Students have to be taught and given enough opportunities to practice Metacognitive strategies in socially engaging and relevant ways.
Sample Studies Supporting this Strategy


Past research on feedback in computer-based learning environments has shown that corrective feedback helps immediate learning, whereas guided and metacognitive feedback help in gaining deep understanding and developing the ability to transfer knowledge. Feedback becomes important in discovery learning environments, where novice students are often overwhelmed by the cognitive load associated with learning and organizing new knowledge while monitoring their own learning progress. We focus on feedback mechanisms in teachable agent systems to help improve students’ abilities to monitor their agent’s knowledge, and, in the process, their own learning and understanding. Our studies demonstrate the effectiveness of guided metacognitive feedback in preparing students for future learning.

Additional Resources
The Teachable Agents Groups at Vanderbilt University. http://www.teachableagents.org/
The AAA Lab @ Stanford. http://aaalab.stanford.edu/teachable.html#