“Betty’s Brain: An Open-Ended Learning Environment for Middle School Science”

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Abstract
Over several years, our research team has developed Betty’s Brain, an open-ended multi-agent environment that utilizes the learning-by-teaching paradigm to help middle school students learn science. In Betty’s Brain (www.teachableagents.org), students teach a virtual Teachable Agent called Betty using a visual causal map representation. Once taught, Betty, can answer questions, explain her answers, and when requested by the student take quizzes, which are a set of questions created and graded by a mentor agent named Mr. Davis. Overall, the learning and teaching task is complex, open-ended, and choice-rich, and learners must employ a number of cognitive and metacognitive skills to achieve success. Their cognitive and metacognitive activities are scaffolded through dialogue and feedback provided by Betty and Mr. Davis. Experimental studies run in middle school classrooms show that students learn science content and develop some metacognitive learning strategies as they interact with Betty and Mr. Davis. However, some students fail to complete their teaching task because they lack an understanding of a number of the cognitive and metacognitive skills needed to become successful learners. We discuss recent additions to the Betty’s Brain system, primarily a model-driven assessments methodology for characterizing and evaluating the students’ actions as they learn in the environment.

Biographical Note
Gautam Biswas (www.vuse.vanderbilt.edu/~biswas) conducts research in Intelligent Systems with interests in hybrid systems modeling, simulation, and analysis, and their applications to: (1) diagnosis, prognosis, and fault-adaptive control; and (2) STEM learning environments in K-12 classrooms. The most notable project with educational applications is the Teachable Agents project, where students learn science by building causal models of natural processes. His research projects in embedded systems and learning environments has been supported by funding from NASA, NSF, DARPA, and the US Department of Education.