Logging Students' Model-Based Learning and Inquiry Skills in Science

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Overview to the project

Recent advances in educational technology have allowed us to capture students' learning on a more fine-grained level than before. This has important implications for Cognitive Science by informing us about students' learning processes on a much deeper level, and for Education because students' log files can be used to provide formative assessments for teachers so that they can make curricular and pedagogical decisions in real time.

We describe the Modeling Across the Curriculum Project (mac.concord.org; IERI # 0115699), a project in which we developed and refined Pedagogica™ (Horwitz and Burke 2002), a runtime and authoring environment, as well as three interactive curricular units for high school science in Genetics, Newtonian Mechanics, and Gas Laws. Pedagogica™ provides runtime support for scripting of Java components such as general-purpose software tools, manipulable models, and assessments that pose challenges to students; Pedagogica™ also monitors what students do with the models and tools. The scripts enable a researcher or curriculum developer to control all aspects of the learner's interaction with software tools by changing the nature of the scaffolding and the assessments provided (Gobert et al, 2004). Our curricular activities for Biology (Genetics), Physics (Newtonian Mechanics), and Chemistry (Gas Laws) combine aspects of open-ended exploratory tools with content-specific text and multimedia –a combination we call a "hypermodel" (Horwitz 1995).

The main goals of the MAC project are to promote students' content knowledge and model-based inquiry skills. Our data extraction tools, when applied to the log files, afford us a very detailed view of the students' interactions with our models. Some the general types of data extracted are: time in screen, model interaction time, inputs to models, (i.e., numbers entered into variables as in Dynamica, or parents or gametes chosen for breeding in BioLogica), answers (for auto-scorable answers only), and typing time (for open response questions). These data are used as components of their model-based learning (Gobert & Buckley, 2000) such as how systematic or haphazard students are in learning with models. Additionally, log files are used as indices of their model-based inquiry skills both within and across domains, allowing us to assess transfer from one domain to another, and assess how a student's inquiry skills are progressing independent of content learning. Since our activities are enacted over multiple days and in three domains, we avoid the problems faced by earlier studies of inquiry in which there was not enough data to get at students' inquiry skills (Shavelson et al, 1999). Lastly, we can provide teachers with formative and summative assessment data bearing on both students' content learning and model-based inquiry skills. We are currently collecting data from 13 Member/Partner schools and 200+ Contributing schools. Log data from BioLogica™ and Dynamica™ will be presented in order to demonstrate how we use our data extraction tools to characterize both students' systematicity in learning with models and their inquiry skills.

References

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