Student Difficulties in Developing Rich Mental Models of Complex Earth & Environmental Systems
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Abstract
The formation of authentic and accurate student mental models of complex Earth systems presents unique cognitive difficulties. Multiple representations, including both digital and physical expressions of Earth systems, can support student abilities to connect rich internal models and real-world phenomena. Therefore, in order to facilitate enhanced student mental model development in undergraduate geoscience students, multiple representations were used as the pedagogical intervention in this work. The manipulation of multiple representations, the development and testing of conceptual models based on available evidence, and exposure to authentic, complex and ill-constrained problems were the components of the instructional framework.

Data based on rubric evaluations and principal component analyses suggest students’ ability to learn during problem-based learning modules is highly influenced by their cognitive skills and content knowledge, where construction of their mental models is directly affected. Sub-clusters of principal component data suggest that students had difficulty with reasoning skills, critical thinking skills, cognitive load issues, linking large/small scale phenomena, and understanding of the characteristics and behaviors of systems. Further, multiple misconceptions and the lack of complexity and completeness in representations of the studied systems were revealed in student mental model expressions.

Background

Implemented Modules

Student Imperfect Conceptions

Factors Associated with Student Learning Difficulties

The Information Technology

The Physical Model

The Conceptual Model – Coastal Eutrophication

More Information
http://its.tamu.edu

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