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Scientific Model Evaluation during a Gallery Walk

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Abstract: Students in science education struggle with creating and iteratively revising models based on evidence. We report on an implementation of a "gallery walk" activity where 5th grade students used the Model and Evidence Mapping Environment (MEME) software tool to develop and then critique each other's models of an algal bloom. MEME was designed to support students in creating visual models organized around the components and mechanisms of the target phenomena, linking evidence to those models, and then providing and responding to comments on the specific features of the model. Findings illustrate how this was a productive environment for students to make their ideas about modeling criteria visible, and how their ideas cut across normative dimensions of modeling expertise.

Keywords: modeling, science education, complex systems, peer critique

Objectives or purposes

Modeling is a core practice across scientific domains, and thus an important practice for students to learn (NRC, 2013). Scientists create models of phenomena based on the evidence they currently have, and iteratively refine these models in response to feedback and new evidence (Pierson, Clark, & Sherard, 2017; Schwarz, Reiser, Davis, Kenyon, et al., 2009). Thus, helping students learn how to engage in modeling practices necessarily means helping them understand the epistemic elements of this practice, including the value of continuously refining models of a phenomenon to reflect new evidence (Duncan, Chinn, & Barzilai, 2018). The Scaffolding Explanations and Epistemic Development for Systems (SEEDS) Project aims to understand how fifth grade students engage with evidence as they explore a phenomenon (algal blooms) through modeling. To support this modeling practice, we developed the Model and Evidence Mapping Environment (MEME): a software tool that helps students create a simple visual model, view new evidence of the phenomena being studied, iteratively refine their model in response to the evidence, and explicitly link evidence to the model to help indicate how the features of their model are supported by the available evidence (see Figure 1). To help students reflect upon and revise their models, MEME also includes a "comment" function that the teacher and other students can use to offer feedback on specific aspects of the model. The current paper reports on the implementation of a "gallery walk" activity in which students offered feedback on two of their peers' models, then responded to their peers' feedback. This activity was intended to help students identify opportunities for improving their models, and to help make students ideas about modeling and its' relationship to evidence public for discussion and reflection.

Methods

The gallery walk was a single activity incorporated into a five-week long unit with a grade five classroom of 20 students (of which 15 boys and 4 girls consented to participate in the research) at a public elementary school in the American Midwest. The students worked in dyads throughout most of the unit with each dyad assigned a computer to access MEME. During the unit, students were introduced to modeling, presented with the phenomenon of interest (green "stuff" on a pond leading to fish dying), and provided access within MEME to research reports and computer simulations to use as evidence while iteratively updating their own models. New evidence was introduced and explored each session, with students encouraged to revise their models as they uncovered new ideas. After 10 sessions, the students participated in the gallery walk. All sessions were video recorded.

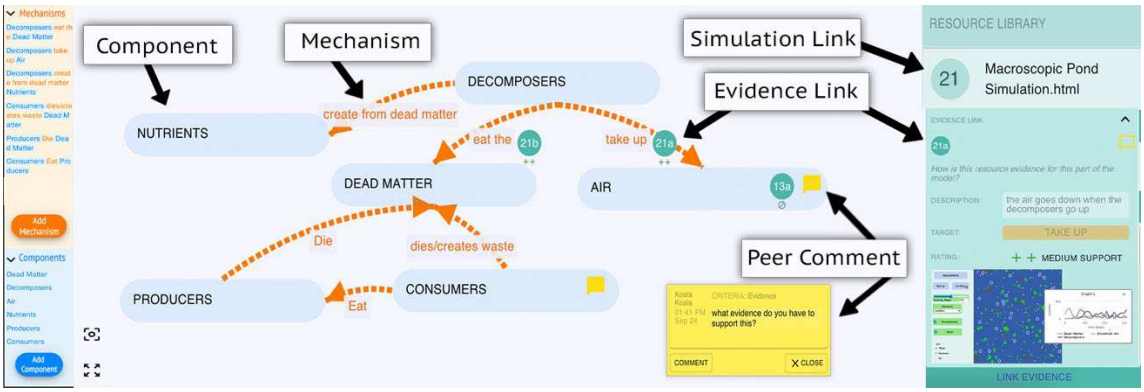

Figure 1. A student groups' model, with an open comment that asks what evidence the authors had to support their choice, a common question when students were unclear about an element, or thought it was incorrect

Results

Our analysis of students' interactions with MEME re-enforce the evidence that 5th grade students can engage in productive model critique sessions, particularly when organized around a "gallery walk" model and shared collective criteria. Furthermore, they shed light on students' negotiation and understanding of good modeling practices, and the role of evidence in these practices. Notably, students appear to focus first on obvious gaps in the model (e.g., a missing mechanism connecting a component to the rest of the model), or missing evidence. However, with the help of MEME, students did look for evidence to support their peer's models, and even discussed whether the evidence they had available to them supported or contradicted the model in clear ways. While our long-term hope is that students will focus primarily on these more nuanced evidentiary standards, we also recognize that it is hard to evaluate a model that doesn't make sense to the viewer. Thus, this apparent sequence of moving from seemingly superficial comments to more nuanced critique is quite intuitive, and future work would benefit from engaging both levels as those seemingly superficial levels are in fact necessary groundwork for the more robust sensemaking.

References

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