Abstract: We developed a set of content-based, multimedia questionnaires for surveying students’ beliefs of scientific model and modeling. The questionnaire constructs included: nature of model, purpose of model, nature and process of modeling, and evaluation of modeling (Schwarz et al., 2009). We investigated the extent to which the representational features of the models (i.e., modality, dimensionality, and dynamics), and students’ education levels influence students’ beliefs of models.

Models are seen as inseparable part to science and both models and modeling are essential to science learning (Gilbert, 2008, 1993; Harrison & Treagust, 1998; Lehrer & Schauble, 2003, 2006; Schwarz, 2009; Stewart, artier, & Passmore, 2005). For instance, National research council (1996) enlisted students understanding of models and modeling as one of the main goals of science teaching. Researchers suggested teaching models and modeling should not only focuses on science concepts but also should promote sophisticated beliefs of scientific models (Gobert, et al., 2010; Prins, Bulte, & Pilot, 2010;aghaven & Glaser, 1995). Beliefs of scientific models can be seen as part of epistemology of science (Justi & Gillbert, 2003; Prins, et al., 2010). Among studies investigating the students’ beliefs or views of models, however, few studies investigated the relationship between the type of representations of the models and students’ beliefs of models. Therefore, in this study, we took advantage of online multimedia and presented models with various representational characteristics.

In this study, we aimed to answer the following research questions:

1. How do students’ beliefs of models relate to different representational characteristics of the models?
2. To what extent do high school students’ beliefs of models differ from middle school students?

Significance of this study

In addition to addressing the potential impact of representational characteristics on beliefs of models, this study also attempts to understand the potential impact of the subject domain by contextualizing survey questions. Past research used interviews or text-based questionnaire to understand students’ general beliefs of models and modeling; however, those questions are usually content-free or decontextualized. For instance, Gorsslight et al. (1991) asked students what comes to mind when you hear the word model. We believed that students’ beliefs of models are similar to epistemological beliefs that are domain specific. Therefore, we anchored the survey questions in middle-school level biology content. This will give the survey questions richer content. In the future, we will further design questionnaires based on different subject domain.

Theoretical and methodological approach

In this study, we designed an online survey with multimedia representations. The online survey included four different constructs: 1) nature of models 2) purpose of models, 3) nature or process of modeling, and 4) model evaluation (Gorsslight,inger, Jay & Smith, 1991; Schwarz et al., 2009). The three representational dimensions are modality, dimensionality, and dynamics (Ainsworth, 2006). For modality, we refer to the difference between text-based model and graphical or chart models. The dimensionality refers to comparison between 2D models and 3D models. Finally, we compare students’ beliefs of dynamic and static models.

This is a study in progress and we are currently in the process of collecting data. In this study, we will survey about 40 8th graders and 60 11th graders. The questionnaire is semi-structured with multiple choices and open-ended questions with regards to why students choose the answer. We will also interview 8 middle school students as well as 8 high school students to better understand the reasons behind their beliefs of models. We used the same questionnaire as an interview protocol.

The answers to the multiple choices will be tallied and analyzed statistically. The interview data will be transcribed verbatim. Open-ended coding will apply to the answers to the open-ended questions and then to create categories of students’ reasoning.
Predicted Results and Implications

We hypothesized that students' epistemological beliefs of models can be influenced to some extent by the representational characteristics. If it is true, then models with different representational characteristics may also influence the modeling process. Also, we believed that there are differences in students' beliefs between middle school and high school students, as high school students may have more knowledge in biology and may have had more opportunities to explore science models. Finally, the results from the open-ended questions can serve as the foundation for creating a two-tier epistemological survey. The first tier would be selecting their beliefs and the second tier would be choosing the reasons behind.

Selected References


