Middle School Students' Construction of Visual Representations from Science Text

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Abstract. This poster provides an example of the growth in middle school students' representational competence in science. Before and after a unit of science instruction, 117 students from four Grade 6 and 7 classes were asked to read a passage about the parts of the sun and then to visually represent the information contained in the passage. Subsequently, students were interviewed about the decisions that they made while creating their representations. At the end of the science unit, students read a passage about the Earth's atmosphere and then created visual representations of the information. The questions guiding this study are: *What factors influence students in Grades 6 and 7 as they create visual representations of science concepts? What changes in middle school students' representational competence can be observed over time? What factors might contribute to those changes?*

Keywords: representational competence; science education; middle school education

Objectives

Science literacy includes reading and writing in science, processes that in turn include interpreting and creating visual representations such as diagrams, graphs, and charts (Moline, 1995; Norris and Phillips, 2003). The process of creating visual representations can aid in developing understanding – a specific example of writing-to-learn in science, or in this case, drawing-to-learn. The research described here, part of a larger project examining middle school students' representational competence in science, focuses on students' creation of visual representations after reading science information text. The questions guiding this focus study are: *What factors influence students in Grades 6 and 7 as they create visual representations of science concepts? What changes in middle school students' representational competence can be observed over time? What factors might contribute to those changes?*

Theoretical Context

Much of the research on visual representations has been conducted within a constructivist framework (e.g., Mayer, 2001, 2005) and constructivist perspectives on learning form the theoretical foundation for this study. The specific theoretical framework is provided by a two dimensional model of science literacy (Yore, Pimm, & Tuan, 2007). The tools with which science learning is mediated (cognitive abilities, reasoning, language, processes) comprise the fundamental dimension, while the science concepts and big ideas to be learned comprise the derived dimension. These two dimensions are interactive, with the development of aspects in one dimension influencing and facilitating the development of aspects in the other dimension. This study focuses on the fundamental aspect of scientific language, examining students' visual literacy, or representational competence, a term adapted from diSessa's (2004) description of metarepresentational competence.

A combination of words and pictures represents science as known by scientists and shapes student understanding of science. If students are to become expert users of the visual representations that are a key component of science information text, they need to understand the forms of representations and the conventions of those forms, the relationship between a representation and the information it represents, the importance of choosing and constructing the most appropriate form of representation,

and the ways in which representations can be integrated with, and related to, one another (Ainsworth, 2008).

Methods and Data Sources

This mixed methods project utilizes qualitative and quantitative data collection and analysis. Data sources include classroom observations, representational competence assessment measures, and semi-structured interviews with students. As part of regular classroom instruction, 117 Canadian middle school students from four Grade 6 and 7 classes were asked to read a passage about the parts of the sun and then visually represent the information contained in the passage. In addition, participating students were interviewed about their decisions as they created the visual representations. After a unit of instruction (Grade 6 – Diversity of Life and Grade 7 – The Earth's Crust), students were asked to read a passage about the Earth's atmosphere and visually represent this new information. In addition, the two Grade 6 classrooms were observed during two to three science blocks each week, and the field notes were analyzed to reveal potential influences in students' representational competence.

Results and Anticipated Outcomes

In order to make meaning from scientific textbooks, digital sources, and tradebooks, students must learn the conventions of the various visual representations that they will encounter (Fang, 2005; Lemke, 1998). Knowledge of these conventions also informs student construction of representations. The results of this study provide an indication of middle school students' awareness of such conventions and provide a snapshot of students' ability to follow those conventions when constructing visual representations. The visual representations of the parts of the sun and the Earth's atmosphere have been assessed using a checklist with items including accuracy of information and form of representation, and the aggregated results provide an indication of Grade 6 and 7 students' ability to create appropriate and accurate visual representations of science information. In addition, a comparison of the pre- and post-assessments shows growth in students' representational competence. The semi-structured interviews are currently being analyzed, following an open coding procedure, and the results are expected to provide insights into the decision making processes that occur when these Grade 6 and 7 students construct visual representations.

Educational Significance and Implications

It is hoped that this project will make a valuable contribution to the visual representation literature. Classroom research on students' interpretation and creation of visual representations has to-date consisted of a few preliminary studies, and much work is still to be done. Learning from visual representations is an emerging field of research and the processes involved in creating visual representations are even less well described. In addition to exploring the construction of visual representations in an authentic setting – a classroom rather than a laboratory – this project involves participants who are much younger than the university or high school students typically described in representation research. The results of this study provide insight into the processes involved when Grade 6 and 7 students create visual representations of science information. In addition, students' abilities to create visual representations are more clearly defined, and causal factors are tentatively identified, which will ultimately lead to improvements in classroom practice.

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