Young Adults' Use of Semiotics in Science News Infographics

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Abstract: This study examines how secondary school students use semiotics in creating science news infographics. A total of 156 students participated over two years in formal school and out-of-school contexts and created 170 infographics through a collaborative process, using computer-based tools. Analysis of the infographics shows both the promise of students producing complex, data-driven representations that allow multiple comparisons and the challenges of overuse by learners of non-value adding icons and still images in the process.

Keywords: semiotics, infographics, multimodal representations, science literacy, data journalism

Introduction
Visual inscriptions are essential elements of STEM education (Gilbert, 2008; Yore & Hand, 2010). They are often used in science textbooks and scientific journals to organize and communicate data and ideas. Researchers examined the nature and purpose of such inscriptions in relation to the role they play in students’ learning (e.g., Lee, 2010), the challenges of learning from visual inscriptions (e.g., Bowen & Roth, 2002), and ways of developing students’ representational competence (e.g., diSessa & Sherin, 2000). In-depth understanding of students’ learning with visual representations and developing their representational competence necessitates examining the kinds of semiotic tools students use when they produce representations by themselves. When students produce visual inscriptions based on topics of their choice (as is the case in our project), they are both authors of the content and designers of the representation at the same time. Traditionally, authors of texts focus on the style, perspective, grammar, and spelling of their writing. Designers, on the other hand, used to focus mainly on visual presentation of the message (O’Grady & O’Grady, 2008). What kinds of representational repertoires do secondary school students use? How do their choice of semiotic tools contribute to the overall quality of the infographics? Answers to such questions can help to understand how students approach learning with and from representations as well as to design instruction for fostering their competence at multimodal representation. In this poster, we focus on students’ use of learned and inventive representational forms in creating science news infographics.

Methods
This proposal is based on NSF funded research on STEM literacy in which students conduct data journalism by authoring infographics. We focus on one aspect of the project data, student generated artifacts (infographics). The project is situated in the Midwestern United States, and involves young adults aged 14 to 17 in a secondary school and an out of school internship program. The project started in fall 2012 and continued through spring 2014 with different groups of students each academic year. A total of 138 students participated at the secondary school, and another 18 interns participated in the out-of-school internship. Students had choice of working in pairs or alone. Overall, students produced a total of 170 final versions of infographics, of which we analyzed 123 (72%) using an inductive approach, constantly comparing the types of representational tools students used and the dimensionality (number of insights) of the visual inscriptions. The inductive categories are described in the findings section below.

Findings
Students used different types of representations in creating their infographics ranging from a minimum of one and a maximum of seven types of representations with an average of 2.86. These include pictures, icons, schematic charts, pictographs, quantitative graphs, text and others. We grouped the types of representations into four: iconic, text, schematic, and charts and graphs. Iconic representations depict structural associations with the referent object and may include icons and pictures. Text representations are descriptions using words and sentences (not including labels and titles). Schematic representations depict components of invisible phenomena and the relationships between the components. Examples include organizational charts and semantic maps. Charts and graphs represent quantitative data to provide concrete insight about the nature and relationship of datasets. Figure 1 presents the frequency of these types of representations in student-generated infographics.
As an indicator of semiotic richness and representational efficiency, we also analyzed the number of dimensions each infographic provided for readers without the text component. That is, how many aspects of the represented phenomenon are addressed by the non-text representations? We then calculated a dimensionality ratio where we divided the number of dimensions an infographic has by the number of non-text representations. The dimensionality ratio tells the extent to which students created parsimonious representations by organizing their data and communicating more ideas with denser visual elements; the extent to which students used or avoided using unnecessary or less useful diagrams in their infographics. Ratio values of less than 1 imply use of representations without adding meaningful dimension to the message. A common case is the use of icons to represent a physical object without embedding any data, such as, a picture of a cigarette next to a bar graph that shows the number of smokers by gender, or a diagram of a brain next to data about brain injuries. If the dimensionality ratio is 1, it means one type of representation communicates one dimension of the issue under consideration. A ratio of greater than 1 implies one type of representation provides more than one dimension where it allows multiple layers of comparison. Further elaboration of these analyses and examples of the categories are included in the conference poster.

Conclusions and implications
Multimodal representations are increasingly used in science communications both in formal school and out of school contexts. Students who can decipher these representations and determine good, data-driven infographics from less useful ones with merely decorative images will be at an advantage over students with less sophisticated semiotic repertoires. Our findings show both the promises and challenges of working with young adults to develop their representational competence. On the positive side, 72% of all infographics are data-driven representations using charts and graphs, and 16% of all infographics have more dimensions than types of representations. Students do not seem to have trouble making use of iconic representations, as 86% include iconic depictions. But iconic depictions are less useful when utilized extensively, as happened in the 33% of infographics with a dimensionality ratio of less than 1. These infographics with low dimensionality ratios make use of non-value adding or decorative representations. The study has implications for understanding young adults learning with representations and in designing learning environments that foster greater student competence at multimodal representation.

References