Iterative Participant and Activity Structures in a Peer Supported Science Infographic Curriculum

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Abstract: This study explores the design of a learning environment that promotes peer supported, collaborative cyberlearning of STEM content and discursive practices. We present a theoretical framework and case study describing the evolving activity structure of a curriculum that includes students designing science news infographics, along with participant structures that involved students alternating a variety of designer, audience and evaluator roles.

Keywords: Data visualization, participant & activity structure, infographics, STEM discourse

Major issue and theoretical framing

This working research study explores how high school age students support each other's STEM learning in collaborative cyberlearning environments through the creation and evaluation of data rich, argumentative infographics. We view these student generated infographics as 'cultural tools of science' that are embedded in particular communities of practice and promote students' critical engagement and synthesis of data in order to make and defend claims (Cornelius & Herrenkohl, 2004). The focus of this working paper is to explore how student engagement with scientific principles are mediated through the material and social means provided by creating and sharing infographics alongside their peers. Specifically, we are interested in how the iteratively refined activity structure of the infographic authoring project units and the changing participant structures for students afford a distributed and alternating set of responsibilities that encourage peer supported student learning.

An overarching goal of the Stem Literacy through Infographics project is to provide scaffolds and design that encourage students' engagement in scientific inquiry, which is connected to their own lives and includes meaningful communication with others. By designing and sharing infographics, students become familiar with the cultural tools and practices of scientific argumentation, and through various participant roles collaboratively negotiate meaning. The 'participant structure' in these classrooms concerns the social arrangements and responsibilities that are culturally expected of students (Philips, 1972). In the current study students' participant roles regularly oscillated between an intellectual role as designer and a role as an audience member, with increasing responsibility for both roles at each milestone moment. We conjecture that the alternating and distributed responsibility of participant structure from intellectual designer to peer audience member promoted an increased capacity to negotiate understanding, monitor comprehension, and challenge or engage in the disciplinary content knowledge presented in these infographics (Gielen, Peeters, Docy, Onghena, & Struyven, 2010).

While the participant structure and enacted roles of students changed throughout the semester, the overall 'unit activity structure' was more stable. Activity structures of curricular units differ from participant structure in that activity structures are about delineating sequences or blocks of time which relate conceptually to one another, and often include "milestone artifacts that are tied to the goals and structure of the discipline under study" (Polman, 2004, p. 461). In this sense, the combination of this sort of long term activity structure and changing participant structure reflects Vygotsky's general genetic law, in which learners first participate socially in the use of a cultural tool and later appropriate that tool. The case study below of a yearlong high school physical sciences class taught through the student creation of science news infographics demonstrates these ideas in practice.

Case study, data and methods

Data for this analysis are drawn from a case study of one physical science teacher's experience over the course of her first year implementing the infographic curriculum. 43 students participated in the study and data was drawn from 15 observational field notes, teacher and student generated content, and 13 interviews. In semester 1 students chose everyday phenomena that related to physics and used video tracking software to capture and quantify raw data of physical movement. Based on these data, students designed scientific infographics to explain physical properties related to motion, force and velocity. The project unit activity structure of this semester integrated 4 'milestone artifacts by way of infographic draft deadlines. The multiple instantiations of

milestone moments, activities, and evolving participant role structure ensured that students were performing both as designing authors and as evaluative audience members to support each other through cycles of feedback. At each cycle, their responsibility as design author or evaluative audience member expanded. In semester 2 students engaged in a research project to create a data rich infographic regarding "the chemistry of..." a topic of their choosing (see Table 1). In this term the activity structure was expanded to include 7 milestone moments and students also created and evaluated infographics with all text 'blacked out' as to evaluate the merits of the data representation and visual argumentation sans text.

Table 1: Semester 2 Activity Structure & Participant Roles; 'Develop a Scientific Argument of Everyday Chemistry'

Milestone 2:1: Concept Draft to Teacher	Milestone 2:2a: 1st Draft Infographic	Milestone 2:2b: 1st Draft Infographic	Milestone 2:3 Blacked Out Infographic	Milestone 2:4 Blacked Out Infographic	Milestone 2;5: Semi Final Infographic	Milestone 2:6: Present Final Infographic
DR; Info-graphic Design AR; N/A	DR; Make claims AR; Self-Evaluator	DR; Make Claims AR; Peer Evaluator	DR; Data Visualization AR; Peer Evaluator	DR; Data Visualization AR; Colleague	DR; Designer AR; Colleague	DR; Student AR; Public Audience

Participant Roles labeled as: 'DR' is designer author participant role, 'AR' is evaluative audience participant role

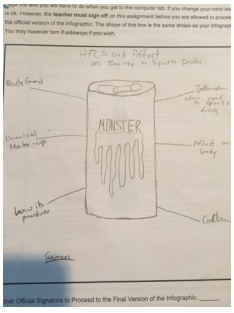

Figure 1. Proposal Draft

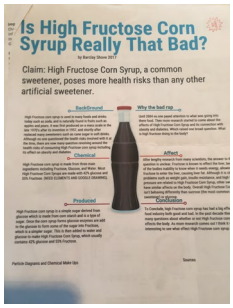

Figure 2. 'Make Claims' Draft

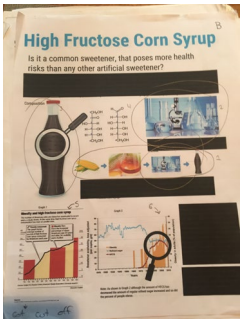

Figure 3. Blacked Out Draft

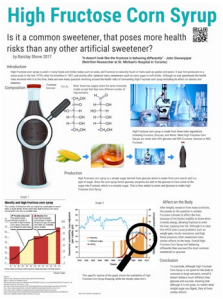

Figure 4. Final Draft

Discussion, significance, and implications

The analysis of semester one leads us to infer that these students were not familiar with participant structures for providing substantive written feedback to one another that included cultural practices beyond very general likes and dislikes. Both students and the instructor agreed that the long-term activity structure and increasingly varied participant role structure of semester two afforded collaborative learning opportunities missed in the first trial. Specifically the 'blacking out' activity (see Figure 1-4) and increasingly varied participant role as experienced evaluator encouraged students to think more deeply about visual argumentation and data representation. The case study reminds us that students need support in providing productive feedback to one another, and demonstrates that activity and participant structures can be important cultural resources for supporting learning.

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