

Facilitating Knowledge Communities in Science Classrooms through Scripted Collaboration

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Abstract: In two iterations of a design-based research we studied knowledge communities in secondary school science classrooms following the Knowledge Community and Inquiry model. We co-designed a Climate Change unit enriched with pedagogical and technological scaffolds to support collaborative inquiry. We examined the emergence of collective cognitive responsibility, knowledge co-construction processes, and students' depth of understanding of climate change science. Scaffolds were redesigned for iteration2 based on findings from Iteration1.

Introduction

This study attends to the problem of developing inquiry-oriented knowledge communities in secondary school science classrooms. Using the Knowledge Community and Inquiry model (Slotta & Peters, 2008) to guide curriculum design for a grade-10 Climate Change curriculum unit, we investigated the success of the model and proposed areas of improvement for upcoming studies. We use a design-based approach (DBRC, 2003). We conducted this study in two design iterations in 2008-2009 and 2009-2010 school-year in grade 9 classes of a high school in Toronto, Canada. The co-design team consisted of 3 researchers and a science teacher. Here, we share the co-designed curriculum for Iteration 1 and Iteration 2 of this study, emphasizing pedagogical and technological scaffolds designed to foster collaborative knowledge construction.

Design Iteration 1

Technology Platform

Wiki seemed an appropriate technology to be used. History function in wikis allows for tracking students contributions to their shared pages in terms of frequency and quality. A drawback of wikis, at the time of writing this dissertation, is that they do not allow more than one person to edit a page at a time.

Curriculum Co-design

Participants in Iteration1 were 42 students in 2 sections of a science class. Co-designed curriculum had 3 phases.

Phase 1: Establishing a knowledge community. This phase introduced the students to a knowledge community culture: Understanding the importance of collaboration and sharing in a public knowledge space. A central scaffold in this phase was an "Introduction to Knowledge Community" lecture to discuss the philosophy of science and the importance of becoming able to function in a knowledge society.

Phase 2: Collaborative inquiry project focused on identified issues. Phase 2 consisted of a whole class brainstorm and a small group collaborative inquiry project. The objective was for the students to co-construct a shared knowledge base to be used in a subsequent inquiry project. Scaffolds designed for this phase were:

- Brainstorm to identify important climate change issues. In a wiki page students from both sections added a climate change issue that they deemed important and asked an inquiry question about it.
- Collaborative inquiry to co-construct knowledge. The Regional Groups inquiry activity examined climate change issues in seven regions of Canada. The teacher divided the students from both sections in seven groups. We designed a template that scripted the content of the inquiry.

Phase 3: Utilizing co-constructed knowledge base. In phase 3 students were supposed to use their collective knowledge to determine how climate change would impact the work or agenda of specialists and to devise strategies to alleviate adverse effects of climate change in Canada. The main scaffold was a Collaborative inquiry to use shared knowledge. Upon completion of the Regional Group activity, six specialist groups were formed across two class sections and collaborated for three sessions using a wiki template.

Implications for Design Iteration 2

Based on formative analysis, we proposed three design guidelines for Iteration 2: A new scaffold for the collaborative inquiry to emphasizes science connections; A planning page for groups to use during collaborative inquiry projects; Embedded reflections to raise students' awareness.

Design Iteration 2

Technology Platform

In the summer of 2009, the co-design team saw the incapability of the existing wiki platform to support a collaborative curriculum. An alternative platform that ran on Drupal 6 was thus developed.

Curriculum Co-design

3 teachers implemented the redesigned Climate Change curriculum in 5 class sections. A three-phase curriculum, corresponding to three phases of the KCI model, was designed.

Phase 1: Establishing a knowledge community in climate change science. To introduce the students to the knowledge community culture (e.g. understanding the importance of collaboration and sharing knowledge in a public space) the following scaffolds were designed:

- Climate change issues brainstorm. Each class section started their brainstorm using ideas from previous classes as starting point. The goal was to synthesize students' ideas of climate change issues into a series of topics for an upcoming collaborative inquiry activity. By the end of this activity, students categorized their ideas and entered in the Brainstorm section of the Drupal site.
- Introduction to knowledge communities. The researchers talked to students about the concept of knowledge community. We emphasized that the highlight of the collaborative work would be to learn more by building on existing ideas.

Phase 2: Knowledge co-construction. Phase 2 consisted of a six-week collaborative inquiry project, five individual reflections, and a peer review activity. Collaboration scripts included:

- Climate issues in Canada: Collaborative inquiry. In a collaborative inquiry project small groups chose a climate change issue and examined it from several scientific and social perspectives. The purpose of this collaborative inquiry activity was to co-construct the core knowledge base of classroom community. The Climate Change Issues inquiry project. Informed by findings from Iteration 1, a more explicit scaffold was used for this inquiry. A multi-section page was implemented in Drupal for each Climate Change Issue that consisted of sections with embedded hints and/or sentence openers that sought explanatory responses (Hakkarainen, 2003). For this inquiry project, teachers in each of the five sections introduced the Climate Change Issues inquiry project and emphasized that 2 groups of students from 2 different sections would collaborate to conduct inquiry on a selected issue.
- Group planning pages. To reinforce students' awareness, a planning page was included where students could identify their goals, plan to accomplish them, and monitor the progress of collaborative inquiry.
- Individual reflections. 6 individual reflections were added to the Issues inquiry activity. Items addressed in reflections fell into two categories: Content knowledge, and metacognitive knowledge.
- Peer review. Small groups of students would have developed a comprehensive knowledge of their own issue but would lack awareness of the shared knowledge in other groups. Theoretical frameworks of knowledge communities, propose collective ownership towards shared knowledge. A peer review activity was designed for students to review knowledge shared in other groups.

Phase 3: Utilizing co-constructed knowledge base. In phase 3, curricular activities changed gears from knowledge co-construction to knowledge reuse and improvement. Phase 3 consisted of a small group inquiry activity to examine strengths and shortcomings of remediation plans, identified in phase 2, and to suggest improvements or propose a new plan. This phase consisted of one collaboration script.

- Collaborative inquiry to improve remediation plans. Previously, students had identified several remediation plans, which became the theme for phase 3 of curriculum. This inquiry activity was bound to single sections of classes. Students examined the effectiveness of selected remediation plan on relevant issues, suggested improvements to the plan, and predicted the implications of the modified plan in the future. Each group had a Drupal page with a built-in scaffold. Technological scaffold for remediation pages simulated simultaneous edits. Every remediation page was implemented as a collection of individually editable subpages concatenated in one page. Upon opening a remediation page, each student in the same group could edit one of the sections of the page independently.

Concluding Notes

Analysis of data collected in this research showed significant content knowledge gain from pre to post tests. We are currently in the process of analyzing collaboration patterns and group's collective knowledge advancement in Iteration2 to detect any improvement over individualistic/split-group knowledge co-construction in Iteration1.

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