Online Science Classroom Collaborations: A Comparison of Domestic and International Learning Communities

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Abstract: Students' views of their online collaboration and samples of scientific writing were studied within a principal contrast of U.S. students in domestic or international class partnerships. Results show that U.S. students in international partnerships maintained a higher level of excitement about their partnership and wrote a larger number of accurate scientific claims using more evidence and certain discourse components. Findings from this study have implications for further research and classroom practice.

Introduction

Current science learning communities are often constrained within the physical walls of a classroom. In contrast, scientific communities expand beyond the physical confines of a laboratory or meeting room. Scientists often engage in ongoing discourse with colleagues from all over the world. They participate in and contribute to peer-reviewed journals, newsletters, list-serves, conferences, and web seminars. The science education community can make use of online communication tools, as scientists have, to help students and teachers venture out of their classroom and become involved in global learning communities (GLCs). Research and thinking in this area of learning communities has focused on the contexts of group work, single classrooms, or limited online interactions (e.g. Lave & Wenger, 1991; Kelly & Green, 1998). However, global science education is emerging as a new area of research that has the possibility to significantly impact student discourse and the structure of science education.

Context

This research is set in the context of the From Local to Extreme Environments (FLEXE) instructional unit on energy concepts. FLEXE is an Earth Systems Science Project funded by the U.S. National Science Foundation and developed in partnership with Global Learning through Observation to Benefit the Environment, a worldwide web-based science and environmental education program. In FLEXE, students and teachers from United States, Thailand, Australia, and Germany along with deep-sea scientists engaged in online discussions about scientific data. FLEXE (both classroom based and on-line) activities promote student discourse in comparisons of local and extreme environments.

Approximately 1400 students and 50 teachers were involved in the FLEXE program during the spring of 2009. Most students were in grades seven through nine in Earth Science, General Science, or a related course. Students worked locally in pairs to complete classroom activities and submit online responses. Students then communicated by way of asynchronous online communication in class profiles, peer reviews bioassay experiments, student-scientist forums, and a wrap-up deep-sea research cruise. Local environmental data provided by students were used in these and other online and in-class activities. A principal contrast of domestic U.S. and U.S. to international class partnerships was established to study online learning communities. For a thorough description of the design decisions considered during the construction of FLEXE online collaboration tools see Kerlin, Goehring, Carlsen, Larsen, & Fisher (2009).

Methodological Approaches

A mixed methods approach was used to study the GLC established in the FLEXE program. Embedded surveys called quick questions (QQs) were employed to gather students' reactions to their class partnerships. Qualitative argumentation analysis of students' written scientific arguments characterized how students used evidence from different sources to back their scientific claims. One QQ from each of two sets of questions was randomly given to students upon completion of each online activity. The first, a multiple-choice question, was from a set about science content and processes. The second question, a Likert scale question, was selected from a set of students' views of the nature of science, attitudes toward science, and views of their class partnership. At this point, the six Likert scale questions that characterized students' views of their class partnership have been analyzed and are available for discussion. The Likert scale responses from samples of students are treated as interval data. The treatment of the responses as such allows for the comparison of the responses using T-tests and univariate two-way ANOVAs to determine differences between the two partnerships.

Qualitative analysis of student writing samples was conducted to characterize U.S. students' scientific writing. A framework for analysis of students' arguments with different data sources was applied to a stratified random sample of two student arguments associated with each U.S. teacher from four activities within the unit.

A few additional randomly selected student arguments were added to the samples to equalize the number of samples from each partnership. The framework was iteratively refined throughout initial analysis but has its foundations in an earlier studies by Kerlin, McDonald, & Kelly (2009), Jimenez-Aleixandre, Rodriguez, & Duschl (2000), and Kelly, Regev, & Prothero (2005). This study also expands on earlier work by Kerlin et al. (2009) and Hug and McNeil (2008) to gain understanding of how students use various primary and secondary scientific data sources to justify scientific claims.

Findings

The trends from initial analysis of students' views of partnerships and student scientific writing all support the hypothesis that international partnerships lead to favorable educational outcomes The embedded QQ results for questions about student excitement of their partnership show that U.S. students in international class partnerships maintained a higher level of excitement, throughout the instructional unit, to learn about the environment of their partner school and the lives of students in that environment than U.S. students in domestic class partnerships.

Argumentative discourse analysis of samples of student writing from four different activities showed favorable trends for participation of U.S. students in international partnerships. U.S. students in international partnerships wrote a higher number and greater percentage of correct scientific claims than U.S. students in domestic U.S. partnerships in three out of four of the activities analyzed. Students in international partnerships used larger count, mean, and median bits of evidence to support their scientific claims. We also found that students in international partnerships had fewer incorrect or invalid bits of evidence. In addition, U.S. students in international class partnerships had greater use of contrast, experience, and causality evidentiary discourse components.

Conclusions

The results from this study provide insight into student use of a complex set of data sources and views about online class partnerships. Variation in environmental data provided by students in different online partnerships and unfamiliarity of perceived audiences may account for the results described above. For example, U.S. students in international class partnerships examined environmental data from their partners that had a greater chance of being dissimilar to their local environmental data than their counterparts in domestic partnerships. Students innately considered and used the disparate scientific data more carefully and more thoroughly because the data itself prompted them to think from different perspectives and reconsider scientific reasoning from a global stance. The second factor that may account for the results is a function of the perceived audience. Throughout the activities students wrote responses to their teacher, scientists, and/or other students. Students with international partners seemed to place more stock in the use of data to justify their written arguments.

The methodologies employed have implications for use in other research projects and instructional practice. The embedded QQ survey method may be particularly useful in other large-scale projects with on-line components. The use of the argumentation analytic is useful in other studies of how students use data to support their scientific arguments. The instructional implication from this study is that students should be provided with opportunities to communicate with peers and use data sources from outside their classroom. The findings show that science classrooms should begin to incorporate online communication tools and engage in GLCs.

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