

Design of an Online Global Learning Community: International Collaboration of Grades 7-9 Science Students

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Abstract: This paper describes the design decisions made in the construction of an online global learning community for grades 7-9 science students. The collaborative learning tools of class profiles, student-scientist forums, and peer review featured in the From Local to Extreme Environments curriculum are discussed in detail. Initial evaluation of these tools and student reactions to global collaborations in this ongoing study will be accomplished through feedback during the unit and embedded surveys.

Following is a discussion of design decisions made in the development of three online tools featured in the From Local to Extreme Environments (FLEXE) project. The three tools (i.e. partner profiles, students-scientists forums, and online peer review) comprise the primary modes of interaction within the FLEXE online global learning community (GLC). The goals of the study are to characterize student involvement and reactions to online collaborations with diverse peers from different environments and to understand how science students use different scientific data sources as evidence in their written arguments. The project is currently in pilot use and evaluation.

The on-line GLC presented in this paper is defined as the student, teacher, and scientist members of the FLEXE community that participate in FLEXE learning activities. These members represent diverse nationalities, cultural backgrounds, native languages, local environments, and scientific knowledge bases. The term global, in this study, means outside of an individual classroom. The FLEXE GLC is possible through the use of web-based technology that facilitates communication between schools and between schools and scientists in different parts of the world. Students in the FLEXE project are engaged in activities similar to the science community. Students may be challenged by cultural differences and multiple languages but are aided by the universal inquiry process of science.

Context

FLEXE is an Earth Systems Science Project developed in partnership with the Global Learning and Observations to Benefit the Environment program (GLOBE), a worldwide web-based science and environmental education program. The mission of GLOBE is to promote teaching and learning of science, enhance environmental literacy and stewardship, and promote scientific discovery in a worldwide community of students, teachers and scientists (The GLOBE Program, 2008). GLOBE emphasizes learning through student collection and analysis of environmental data using scientific protocols and newly developed student research tools. FLEXE is funded by the U.S. National Science Foundation. FLEXE expands the boundaries of the science classroom by directly involving students in a GLC. In FLEXE, students, teachers, and deep-sea scientists from around the world engage in online discussions about scientific data. The activities in the program promote student discourse on Earth systems science through comparisons of local with extreme environments.

During the spring of 2009, teachers and students from the United States, Thailand, Australia, and Germany are participating in a pilot of the FLEXE Energy Unit. Approximately 2500 students and 55 teachers are involved. Most students are enrolled in grades seven through nine in Earth Science, General Science, or a related course. Students work in pairs to complete classroom activities and submit online responses. A small number of deep-sea scientists are also directly involved in the FLEXE Forums.

Online Collaboration Tools

Many online tools have been designed to help students engage in progressive scientific inquiry and enter into diverse communities of practice. In the following discussion we describe theoretical foundations that have influenced the design of FLEXE online tools with examples of existing online tools that highlight issues taken into account during design. The advancement of computer technologies has enabled the development of educational online tools that have their theoretical foundations in sociocultural learning theories. Students are now able to become involved in communities of practice through online interactions (Kelly & Green, 1998; Wenger, 1998). Online resources and communication tools enable learners to reach beyond the traditional walls of the classroom to gather archived and real-time scientific data from peers, scientific experts, and organizations. The use of online learning communities offers an increased opportunity for students to be

challenged by peers representing different environmental locations with varied experiences and scientific knowledge bases. Global membership increases the chance for students to interact with a large number of peers in their zone of proximal development (Vygotsky, 1978 in Schunk, 2004). In the FLEXE pilot, the principal contrast of domestic U.S. and U.S. - international class partnerships provides the opportunity to examine how international differences in culture, education, language, etc. affect student engagement and learning.

Researchers like Hakkarainen (2003) and colleagues have focused their studies of collaborative computer-supported classrooms on the theory of progressive inquiry. According to Hakkarainen, 5th and 6th grade students in these online collaborations are able to move "beyond intuitive explanations and toward theoretical scientific explanations" (2003, pg. 1072). Hakkarainen's findings show that students in online collaborations have opportunities not available in traditional classrooms, become aware of scientific grounds (evidence) from different perspectives and examples, and are challenged by alternative explanations that help them revise, refine and develop theoretical explanations.

Asynchronous communication is used in the FLEXE online tools described below. Education researchers have examined asynchronous online forums in studies of topics like argumentation and comparisons of in-class synchronous communication and Web-based asynchronous communication (e.g. Clark & Sampson, 2008; McNeil, Robin, & Miller, 2000). McNeil et al. (2000) describe collaboration and flexibility as benefits of asynchronous online communication. Asynchronous communications were found to change the students' role from passive note-takers to active participants that may engage with audio, video, multimedia, and simulation tools. McNeil et al. (2000) also found that students wrote higher quality responses because of peer review and the added time to reflect before replying. The benefit was noted for English as second language (ESL) students in particular.

Linn (2003) found that online discussions, in programs like CSILE and One Sky Many Voices, give students a chance to think before they respond, which contributes to knowledge integration by sustaining thinking about a topic. Major features highlighted in Linn's study and review are that online tools should be designed to specific disciplines, include an option for anonymity, have the ability to be personalized by their users, include heterogeneous groups, and take place over time spans of at least four to six weeks. FLEXE interactions are designed to allow students to work locally in pairs and establish class partnerships, which enable smaller numbers of students to participate in online class profiles. Online discussion within collaborative workspaces should be specific to a discipline and interactions with an expert(s) should be provided. Within a specific context, students should be challenged to address an everyday problem that they can personally relate to and work toward a common goal.

While existing online asynchronous communication tools informed the FLEXE design team, none of these tools were found to be directly applicable. The design team therefore constructed three online collaboration tools that addressed the challenges of scalability and ability to monitor and focus student work on specific learning outcomes of understanding energy transfer processes, energy sources, and learning through environmental comparisons. FLEXE students engage in a variety of asynchronous online communication. They are prompted to provide specific local environmental information in their Class Profiles. FLEXE Forums offer students interactions with deep-sea scientists in a scalable manner. FLEXE Peer Review engages students in meaningful interactions with a common goal of communicating results around a shared investigation. Ultimately, students construct knowledge by sharing scientific data and accessing numerous data sources.

Class Profiles

Class Profiles are designed to provide teachers and students with information about their partner class. The profiles are similar to My Space® or Ning® personal pages but are much more focused in scope and content. In creating the profile, teachers first discuss local environmental temperature data with their classes and submit these data to their profile. Student groups also write and post paragraph responses to questions about local environmental events and conditions. Teachers and students update their class profiles throughout the instructional unit as they complete additional activities and also communicate through the profile teacher email.

Class Profiles represent public bulletin board type communication and were carefully constructed to maintain student anonymity and appropriateness. Student anonymity is achieved throughout the unit with the use of student IDs that are assigned by the teachers and used as tags with all student submissions. To ensure student postings are appropriate and on topic, teacher monitoring of student submissions is required. Student paragraphs are reviewed by the teachers and posted to the class profiles after approval. Prompts help focus students' comments on specific topics (e.g. temperature variation or local extremes).

Student-Scientist Forums and Wrap-up Research Cruise

Two FLEXE Forums and a culminating research cruise enable student interactions with deep-sea scientists. The established ask-a-scientist model works well when one classroom interacts with a single scientist (Brown, Ash, Rutherford, Nakagawa, Gordon, & Campione, 1993) but the issue of scalability was the number one issue that had to be addressed in the design of this online tool. An innovative design was incorporated to facilitate

communication between thousands of students with a few scientists. In the FLEXE Forums, scientists introduce deep-sea data sets to the students and then pose a series of questions designed to help students analyze and interpret data. The graphical data sets are described online along with an introduction from each scientist. Supporting materials include a number of supplemental online links and a worksheet with a shorter description of the data, graph of the data, and a series of questions for students to answer. After completion of the worksheet, students answer four online summary questions for review by the scientists and FLEXE team. Select student responses are identified for inclusion in feedback from the FLEXE scientist featured in each forum. The inclusion of student group IDs and school names with students' answers in the scientists' feedback provides some individual recognition and communication between students and scientists that students find exciting.

Peer Review

The FLEXE curriculum includes an online peer review tool that simulates peer review in the scientific community. Studies of online peer review at the college level have shown that the process of writing and receiving reviews from other students can be effective in helping students develop analytical skills and understanding of the nature of science (Trautmann et al., 2003). The FLEXE Peer review examines this type of online collaboration with middle grades students.

The peer review process starts with scientific reports that students write about local investigations of extremes. The design of the peer review tool included considerations of number of reviews, standardization of review procedure, and the effects of international reviewers. The design ensures that each student group will conduct and receive two reviews that they can use to improve their scientific report before final submission. Students use a standardized review template that includes yes/no, open-ended, and overall rating questions. The effects of international reviews will be evaluated through the design of two pools of reports for the peer review process; one pool for students in U.S. class partnerships and another for students in U.S. to Thailand, Australian, and Germany partnerships. Engagement in peer review with an international community is expected to increase student engagement and improve student argumentative writing.

Evaluation

The FLEXE team is currently evaluating the online tools described above. Preliminary feedback indicates that teachers and students are excited to learn about their partner classes through the class profiles and eager to interact with deep-sea scientists in the forums and other students through peer review. The online collaboration tools provide students with scientific data from different environments and cause them to consider that data in their written explanations. Additional results from the use of the system, feedback from teachers, and embedded surveys of students' reactions to online collaboration will be available for discussion at the 2009 CSCS conference.

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