P1.22 THE EARTH SYSTEM SCIENCE EDUCATION ALLIANCE AND GLOBAL CLIMATE CHANGE EDUCATION

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1. INTRODUCTION

The Earth System Science Education Alliance (ESSEA) is a NASA, NSF and NOAA-supported program implemented by the Institute for Global Environmental Strategies (IGES) to improve the quality of geoscience instruction for pre-service and in-service K-12 teachers. Started in 2000, the program currently includes the participation of 40+ institutions, with over 3,000 teachers having completed an ESSEA course as of fall 2009. ESSEA is administered by the Institute for Global Environmental strategies through a grant from the National Science Foundation and is also supported by NASA and NOAA. These institutions and faculty receive training, technical support, the ability to create and share their own course modules, and join an active community of Earth system science educators.

ESSEA courses are based on a series of online modules for teachers that are offered by participating institutions. Presently ESSEA is supporting colleges and universities in teacher preparation and professional development for pre-service and in-service K-12 teachers. Universities and educational institutions offering ESSEA courses have been a successful teacher professional development program enhancing teachers' environmental literacy and ability to teach Earth system science. This program is ideally positioned to leverage its 40+ university consortium in geoscience literacy for increasing ESS understanding and use of data, information, and programs. The current ESSEA program of more than fifty modules can be found. at **esseacourses.strategies.org**

The Institute for Global Environmental Strategies (IGES) is enhancing and building on this foundation by: 1) Using the ESSEA online courses as a model to introduce newly upgraded Earth System Science undergraduate and graduate courses for teachers; 2) Introducing extensive use of data and existing Earth system educational materials to support the teacher courses; and 3) Disseminating model teaching practices and program success through annual conferences, continuing support, and presentations at geoscience and education conferences. (Witiw, Close, and Myers, 2009)

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2. BACKGROUIND

An overriding objective in the development of each of the online courses was to create "high-impact, motivating reasons" for individuals to engage in the material. Course developers purposely designed an online learning environment where interdependence among participants would provide the glue that holds together a successful community of learners, learners who would rely on each other for input. Interdependence is built as a result of a complex task, roles, shared resources, and joint products (Johnson, and Johnson, 1992). The course content is shaped to challenge the teachers' prior learning experiences and knowledge-building skills through group problem solving, online research, and constructive feedback as part of the ESSEA learning experience. (Botti, 2001)

Theory, modeling, practice, feedback and coaching are essential elements of in-service education and are incorporated into ESSEA courses. (Joyce and Showers, 1980, 1996; Loucks-Horsely, 2003). The ESSEA online learning environment provides "spaces" that define, support, and refine participant roles and tasks. Discussion roles that occur within the personal journal and learning spaces are carefully scaffolded to promote the modes of thought required for each task. Fundamental skills, such as "how to contribute to the conversation" within the discussion spaces, and establishing criteria for how to be a "critical friend" are carefully developed. Bereiter's discussion of inquiry (1992) guides the framing of the ESSEA course structure as one in which participants subject any belief to examination, frame questions and propositions in terms of evidence, and work toward a common understanding satisfactory to all.

The ESSEA experience has demonstrated that these design features of online structures and spaces replicate the energy and momentum generated by normal human face-to-face interaction. Capra (1997) stated that sustainable communities are characterized by information available on demand, feedback loops for individual self-regulation, clearly-defined niches or roles, and clear goals. Davis (1997) suggested that

community-building principles can be translated into the online environment by having clear goals supported by carefully defined rubrics, by creating challenges that cause relationships to form through the exchanges of ideas, by providing regular reflection for individuals and groups, and by creating a structure or place that mirrors the key forms of social interaction to occur that permit the virtual community to form. These pioneering ideas led the ESSEA staff to formulate experiences that guide participants through the social dynamics of the online learning process.

The inquiry-based courses provide teachers with the content knowledge and tools they need to incorporate Earth system science into their curricula. ESSEA modules are also available on this site as teacher resources. A typical ESSEA course is 12–16 weeks and includes 3–4 modules on Earth system science topics, which are selected by the course instructor. Each module is designed to take three weeks in a normal university semester. A course may consist of as many as five modules, with academic credit awarded accordingly. Normally a course will begin with an introductory module that introduces the concepts of Earth system science analysis. When faculty set up their ESSEA course, they select the inquiry strategy that they will use; the course software sets the course up with instructions and assignments specific to each of these inquiry strategies. Problem-based learning, cooperative learning (Jigsaw), and Group Investigation methodologies are available to faculty members. (Witiw, Close, and Myers, 2009)

The ESSEA online learning environments are places for collaboration and knowledge building, not simply a repository for Earth system content. The online sites offer week-by-week instructions, information regarding rubric-supported expectations, guidance for thriving in online communities, and discussion areas. Facilitators support, coach, reply to journal entries, and intervene only to provide administrative instructions, to maintain the flow and direction of the course, or to address specific Earth science or pedagogical issues. (Botti, 2001)

3. ESSEA CLIMATE CHANGE MODULES

All ESSEA modules are designed to support construction of Earth System knowledge by engaging teachers as learners in inquiry-guided instruction. Global climate change is an excellent example of how Earth is an interconnected system. The Earth as a system from the perspective of climate and global change is an ideal environmental concern for describing the interactions between the various parts of the Earth system, including human activities

ESSEA modules begin with a “scenario” that provides the context for the ESS Analysis. Background is provided so that course participants can begin making connections among the ESS interactions that occur. With the scenario as context, several ESSEA modules are available that revolve around global climate change. Course participants use Earth System Science analysis to exam possible causes of and possible impacts on climate change. Climate is influenced by many different Earth spheres from aerosols in the atmosphere, to erupting volcanoes, and ocean circulation. Current ESSEA global climate change modules cover topics that range from El Nino and coral reefs destruction to Brazilian deforestation and disappearing Arctic ice sheets

In 2009, funding from NASA and NOAA were added to NSF funding. These grants support continuing the emphasis on climate change. Climate change modules presently being piloted include, among others, the role of methane, the Little Ice Age, Abrupt Climate Change, Arctic Oscillation Finally, additional global climate change modules currently under development cover topics that include sunspots, thermal islands, contrails, and the effects of African and Chinese dust.

Each global climate change module is divided into three cycles with four assignments to be completed for each module. Individual assignments include examining prior knowledge and developing a lesson plan, while group assignments include researching the global climate change topic and developing an Earth system science analysis. Each module is designed to show how events do not occur in isolation and consists of three cycles. In the first cycle, a teacher will begin by reading a climate change scenario and then explore his or her own beliefs of what is happening in the Earth system, sharing these ideas with teammates. In cycle two, the teachers investigate the climate change related issue and build a knowledge base. In cycle three, the teachers build their own lesson plan based upon what they have learned about global climate change.

4. SUMMARY

Courses through ESSEA are an effective way of providing professional development to teachers in the area of global climate change. Addressing climate change is no simple task. Some scientists attribute global climate change to human activity. Skeptics are looking for more support to merit change. The Earth System Science Education Alliance is an ideal method for educators to learn about global climate change and experience they can approach the topic in their classrooms.

At many universities, in addition to teacher training, ESSEA materials are adapted for use in general education science classes. Universities that offer ESSEA courses can be found on the ESSEA web site. Many of these universities offer totally online courses.

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