COSEE-Ocean Systems: *Building Consensus and Understanding Through Collaboration*

Through the use of iterative feedback and evaluation, COSEE-Ocean Systems (OS) has developed several models and processes for facilitating interactions between mixed groups of research scientists and educators, graduate students and undergraduates. These models take into account the unique needs of the groups involved to create dynamic learning environments for all participants. Specifically, COSEE-OS has designed and piloted three different workshop models and an application/matching process that can be applied to meet the needs of several different collaborative "modes" or "groupings." The three models are referred to as: I) "Peer-to-Peer" when concerning research scientists and professional educators; II) "Mentor-Mentee" when research scientists work with students with less experience (e.g., graduate students); and III) "Mixed" collaborations when there are groups containing a diversity of backgrounds and experience. COSEE-OS has developed different strategies for each of these three models, along with an innovative application/matching process used in its collaborative workshops.

I) "Peer to Peer" Model of Scientist-Educator Collaborative Workshops

COSEE-OS "Scientist-Educator Collaborative" (SEC) workshops follow a "peer-to-peer" model of interaction between educators and scientists. In many scientist-educator interactions, the scientist is considered to be the expert while the educator is primarily considered to be a recipient of science content. The educators, in this scenario, have little to contribute to the scientist's knowledge base. In the SEC model, scientists and educators are considered to be on level ground with each group being "expert" in their own area (Figure 1). With the peer-to-peer model, it is key that both groups believe they have something to learn from each other, and this leads to a mutually beneficial collaboration. Through COSEE-OS facilitated workshops, scientists contribute rigorous content knowledge resulting from their scientific training and educators likewise contribute rigorous pedagogical expertise about the needs of different audiences.
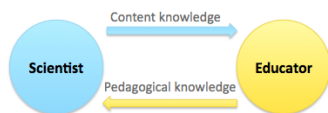
"Peer to Peer" Groups

Figure 1: "Peer to Peer" workshop model.

Through its SEC workshops, COSEE-OS has increased the capacity of scientists and educators to effectively communicate about complex science topics via the process of consensus-based concept mapping. Although the 117 educators who applied to participate in SEC workshops were mostly familiar with concept mapping, only one of the 25 participating scientists had previous experience with the technique. This prompted OS to include half-day scientist training sessions to prepare them for focused concept mapping with educators. A valuable two-way exchange of information takes place as these two groups collaborate to make a "consensus" concept map of a research topic that they can apply to their own work. Such professional development is a rarity given that scientists' traditional role in such workshops is usually limited to delivering content.

For many scientists, SEC workshops also provide an opportunity to receive immediate constructive feedback on the efficacy of their communication to non-science audiences. Educators, on the other hand, provide scientists an opportunity to learn about the challenges that they face integrating scientific topics into K-12 classrooms. The mutually beneficial nature of SEC workshops has fostered positive interactions between scientists and educators: on average, educators (n=67) rated the quality of interaction 6.6 on a 7.0 Likert-type scale. 91% of educators indicated on evaluations (n=67) that the process of concept mapping helped them think through the topics they had learned during the workshop.

> **Workshop Application Matching Process**
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> COSEE-OS has developed a quantitative method to match workshop applicants with scientists using Ocean and Climate Literacy Essential Principles as a framework. For each workshop, the set of Principles that best align with the scientists' research areas are included in application surveys. During the application process, potential participants rate their comfort with specific Principles, along with relevance to their teaching or research situations.
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> When matching individual participants with Principles (i.e., as a proxy for specific scientists), priority is placed on those with which participants are *least* comfortable. Conversely, the higher a participant rates a Principle's "relevance," the more likely he or she will be matched with the associated scientist. Based on post-workshop evaluation of all Principles covered in OS workshops, 76% of educators had a positive change in their comfort level and 75% had a positive change in their perception of the Principles' relevance.

II) "Mentor-Mentee" Model of Faculty-Graduate Student Collaborative Workshops

In the mentor-mentee mode, one group is considered more experienced than the other but both groups are interested in learning how to effectively share their content with a third-party audience (Figure 2). An example of this model is the "Faculty-Graduate Student Collaborative" (FGSC) workshop. While both the research faculty and graduate students posses scientific knowledge, they have varied levels of experience relating their content to "non-scientist"

Figure 2: "Mentor-Mentee" workshop model.

audiences. The introduction of a third-party audience during the workshop provides the less experienced graduate students an opportunity to step into the "expert" role and receive feedback for their own skill development.
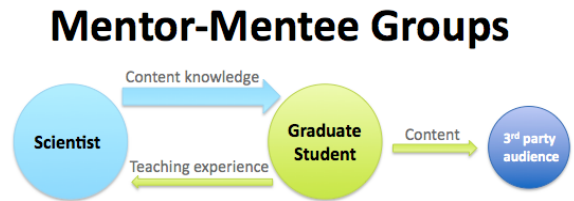
When this model was piloted and evaluated in a Winter 2010 FGSC workshop, graduate students and post-docs reported that concept-map based presentations to the third-party audience (i.e., high school students) was highly valuable, rating it an average of 6.4 on a 7.0 point Likert scale for usefulness. Additionally, 41% of the participants reported that the workshop increased their ability to "present and translate scientific information to a general audience." Both in the post-workshop evaluation and during a follow-on online focus group (Spring 2010), many participants requested additional opportunities to practice their presentation and/or teaching skills and to learn more about pedagogy. The FGSC workshop model continues to be refined through the incorporation of participant feedback, and will soon be implemented at three additional Centers -- COSEE-California, COSEE Networked Ocean World (NOW) and COSEE-West.

III) "Mixed Group" Model Used in Multiple Contexts

In this mode, there are multiple participants with varied and uneven levels of experience and background expertise. For example, the group may have a mix of professors, educators, graduate students and/or undergraduate students. A key goal of the approach is establishing the group cohesion necessary to collaborate on a common project. Thus COSEE-OS has designed the interaction to allow all individuals to hear from the others as "experts" on their own life experiences. This process helps diffuse notions that one party may be purely a "recipient" of knowledge and thus has less to contribute. The mixed-group mode has been applied by COSEE-OS in several courses at the University of Maine and most recently in the COSEE-Coastal Trends (CT) program, "Scientist-Educator Partnership" (SEP).

In the SEP program, teams consisting of an underrepresented undergraduate student, a research scientist, a graduate student and a classroom teacher work on six-week research and education projects. The Summer 2010 SEP included one four-person research team at the Horn Point Laboratory in Cambridge, MD working on a project about watersheds. By integrating concept mapping into the SEP orientation, COSEE-CT hoped to increase group consensus and cohesion by establishing "common ground" for the participants and for their project planning ideas. As a pre-orientation "homework" exercise, each participant made a concept map of his or her own life experiences that were shared during orientation. The participants found links between their own stories and other members of the team, helping to "break the ice." Soon afterward, team members collaboratively developed a concept map about their research to organize their processes and end-products (i.e., education modules). Several participants commented that the concept mapping exercises were helpful for them to both learn about the topic and to think through the "bounds" of the project.