
Major Findings Resulting from Activities – Summative Report

A. Center for Research, Evaluation and Assessment, LHS Evaluation Results

Communicating Ocean Science to Informal Audiences

Final Evaluation Report

Center for Research, Evaluation and Assessment

Lawrence Hall of Science

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Background

Communicating Ocean Sciences to Informal Audiences (COSIA) is a National Science Foundation-funded project designed to teach university science students (undergraduate and graduate level) how to communicate science using research and theory from science education. The project supports partnerships between science faculty at universities and educators at nearby informal science educational institutions (ISEIs) to teach this course that was developed by science educators at the Lawrence Hall of Science (LHS).

The Center for Research, Evaluation and Assessment (REA), at UC Berkeley's Lawrence Hall of Science has served as internal evaluator on the COSIA project. While REA is housed at LHS, it is an independent Center within the organization. Accordingly, REA Center staff maintain objectivity, as they do not work for or report to any individual program. The evaluation conducted by REA consisted of an assessment of the quality and effectiveness of the materials and activities developed.

The evaluation of COSIA has included an examination of the following project deliverables:

- Professional Development Workshops,
- COSIA Handbooks,
- Informal science activities, and
- The COSIA course.

This report summarizes the findings of the REA internal evaluation over the entire course of the project as they relate to the topics above. A great deal of additional information was gathered for formative purposes. This information was provided to the project team for the purpose of improving the deliverables as they were being developed and refined, and will not be presented here.

Evaluation Questions

In order to generate evaluation questions for the project deliverables, specific outcomes and impacts needed to be defined. To this end, leaders from the partner institutions, including six Informal Science Education institutions (ISEIs) and six Institutions of Higher Education (IHEs) and other stakeholders in the project (scientists, researchers, project advisors) completed an online survey at the beginning of the project. The survey asked them to outline resources and experience that might be useful to the project, articulate their understanding of their role in the project and to define what they hoped the outcomes of the project would be. Stakeholder surveys were collected from 22 individuals. Each of the six partner sites were also visited by two of the COSIA project team and one evaluator. The site visits served several purposes including: an opportunity for local partners and COSIA team members to meet and get to know each other and the local institutions; to assess the priorities, needs and concerns of the partners; and to determine the content interests and foci of university faculty and ISE exhibitions. Data gathered from the stakeholders survey was used to guide discussions and brief interviews with partners were conducted to supplement survey data.

Information gathered through the stakeholders survey and site visits were used to further define and articulate the goals and desired outcomes for project deliverables, specifically the informal science activities and the COSIA course. When asked what they hoped the college students taking the course would gain, a better ability to communicate content was mentioned most frequently. Understanding of pedagogy and learning theory, as well as gaining appreciation for public outreach and good communication skills were also listed by many. Learning science content was mentioned by the fewest respondents. Interestingly, when asked what they hoped the general public would learn from the COSIA experience, stakeholders talked more about “scientists as people”, positive feelings and science processes than science content. This suggests that they are more concerned about the improving the perception of science and scientists than communicating content. When asked about specific ocean science concepts for the public, most stakeholders mentioned conservation and impact messages and connections between humans and oceans. Climate was also mentioned frequently.

Building from findings of the stakeholder surveys and site visit interviews, the following specific evaluation questions were generated:

- To what extent are the Professional Development Workshops and COSIA handbooks important to the success of the course?
- In what ways do the workshops and handbook provide a valuable resource or opportunity to professional participants?
- How do the informal science activities impact the public’s perception of science and scientists?
- How do informal science activities contribute to the public’s ideas of ocean conservation and human impact?
- In what ways does the course contribute to COSIA students’
 - understanding of pedagogy and learning theory?

- improved communication skills?
- appreciation of public outreach?
- What impacts does the COSIA course have on participating faculty and institutions?

Evaluation Results

COSIA Professional Development Workshops and handbooks

Two-day professional development workshops were presented at LHS in June of each project year to familiarize partners and potential new participants with inquiry-based pedagogy and learning theory. Ocean sciences activities were used to illustrate educational approaches. Exemplary activities were demonstrated and participants received instructional materials, the COSIA course instructor's handbook, and opportunities to tailor informal education activities to their site, audience and institutional priorities. At the end of day two, participants were asked to complete a written evaluation of the workshop. These surveys were designed primarily to gather information about who might be teaching COSIA in the future and to help improve future workshops. Workshop surveys were collected from 55 individuals across the three years.

Findings from the workshop surveys indicate that the Professional Development Workshops are important to the success of teaching the course, and a valuable opportunity to both learn new teaching strategies and to network with other professionals.

A vast majority of respondents to the workshop survey felt that the professional development workshop was important to their success teaching the course. When asked to rate the importance of the workshop on a five point scale, the mean response score 4.8. The overall value of the workshop scored slightly higher with a mean of 4.9 out of 5; all participants rated this either a 4 or 5 on the five-point scale.

Participants were asked to explain what the most valuable part of the workshop was to them both personally and professionally. Networking opportunities and exposure to or review of pedagogical topics were mentioned most frequently; the Inquiry, Questioning Strategies and Learning Cycle sections of the workshop were noted explicitly. Several felt that receiving the COSIA curriculum handbook was the most valuable part. Participants also appreciated seeing a variety of teaching methods in action as well as having opportunities for professional reflection, discussing practice with others and learning from more experienced peers.

Attendees said the following about the workshop:

- *"[It] prepared me for working successfully with grad students."*
- *"Group activities and small discussion groups were fascinating way to work with others."*
- *"I hope to use some of these active learning approaches in teaching my other courses"*

The online surveys given to instructors after the course had been taught revealed that although most instructors made minor changes to the lesson plans, they felt that the COSIA Handbook was very important to the success of their class with a mean of 4.5 out of five. Furthermore, 80% of the ISEIs, staff beyond those contracted by the project are using COSIA activities with the general public. In addition to using activities, some ISEIs report that they will use information from the handbook lessons to inform the training of their own educators.

“I have learned a great deal of information from the readings and the information contained in the [handbook]. I intend to incorporate much of this information into my training classes for docents and new staff at my facility.”

Ratings and comments from professional participants indicate that both the workshops and the handbook are important to the success of the course. Further, they are valuable resources providing activities, training strategies and background information about teaching and learning, as well as opportunities to network and learn from others in the field.

Informal Science Activities

The COSIA course required students to spend six hours engaging with the public on the exhibition floors of the ISEI. During that time, students worked in pairs to practice communication skills learned from the course as well as test out the design of the floor activity, which they designed and developed. The events at which students engaged with the public varied according to the arrangements made by the course instructors. During the springs of 2008 and 2010, evaluators observed COSIA students presenting activities to the public. Following an observed interaction, evaluators conducted a brief interview with the visitors. Observations documented the number of people in a group, their age and demographic information. Interviews asked visitors about their experience with the activity and the facilitators, and probed for potential cognitive and behavioral impacts. Visitor observations and interviews were collected at six sites and resulted in 95 interviews with 352 visitors. Forty-five COSIA students from five universities were observed interacting with the public at 24 different activities. All members of a group were invited to participate in the interview, though in multi-generational groups (those with kids and adults), children mostly answered the questions. The first set of questions asked visitors to reflect on the experience and recall what they did and what the activity was about or trying to communicate. The second set of questions asked them to comment about the facilitators and how the activities may affect their perceptions of the ocean, science, and scientists.

Based on the observations, visitors stayed at the activity carts/tables from 30 seconds to 39 minutes, with an average time of 7.4 minutes. Visitor groups ranged from 1 to 10 people, with most groups (64%) consisting of 2-4 people. Groups consisted of both schools groups (38%) and family groups (62%) and had a wide variety of ages. The physical presence of the activity was an important aspect of attracting visitors. For

about 70% of the groups observed, the objects attracted the visitors to the activity, which support the significant role of objects to learning experiences in ISEIs.

When asked what the activity was about, the most common response was to describe the activity—elaborate on what they did or on the science ideas underlying the activity— or identify the objects or science ideas represented by the activity. Some visitors also explained the activity; that is, they provided causal relationships between ideas discussed in the activity. The following are exemplars of visitors' comments:

- *Whales and what they and can't eat.*
- *Sound frequency*
- *Waves*
- *Density, showing how the glider goes up and down. Pumping water in to sink and out to float.*
- *CO₂ in the ocean changing pH.*
- *How sea otters eat. They have sharp teeth – four molars in a row and really sharp. Sharper than human teeth.*
- *Water moves and always keeps going. Waves are started by wind, boats and earthquakes*

When asked what other people could learn from doing this activity, visitors continued to describe the science content or concepts as described above (51%). However almost a third (31%) noted that others could become more environmentally conscious and educated. While occurrence of comments such as these were predominantly from activities with a deliberate environmental message, there were also occasions when visitors made such comments after doing activities that were not intending to communicate an environmental message. Representative visitor comments include:

- *Everything that hits the ground affects our water supply.*
- *We need to stop fishing so much, so that there are more fish and food for the whales to eat.*
- *Just because you don't live near water, you can still pollute the ocean.*
- *Humans are changing the environment. Too much CO₂ in the ocean makes it hard for animals to make their shells.*

Visitors were asked whether their opinions about ocean science and their assumptions of science and scientists changed as a result of doing these activities. These questions were intended to determine perceived impact that these COSIA activities and facilitators may have on visitors. Regarding whether there was a change in their opinions or appreciation of ocean science, 71% of respondents acknowledged there was a change, while 20% said

there was no change. The remaining 9% of respondents said ‘maybe’. Those who said there was no change generally attributed that to their existing knowledge and appreciation of the ocean prior to the activity. The changes in opinions and appreciation of the ocean were split between environmental consciousness - that is, visitors’ appreciation of the ocean changed because they felt the activity raised awareness and offered actions they could take to help the ocean, and gaining new knowledge. Examples of visitor’s comments are below.

- *It makes me want to study more about the ocean. I am going to tell my uncle, who fishes every day, to fish less.*
- *Farmers need to get fertilizer that does not wash into the ocean. We won’t want to swim there and fish could die.*
- *I didn’t know much about starfish before. I think that animals are more intelligent than I thought before.*
- *Some animals that live in the ocean are bothered by engine noise*

Visitors were asked to give their impressions of the facilitators. All comments were positive. The most common descriptors were: smart, helpful, and nice. Many facilitators were also said to be “friendly” and “good at explaining”. Most visitors (54%) did not know that the facilitators were college students studying to be scientists. Interestingly, when asked to talk further about their perceptions of science and scientists after engaging with these “future scientists”, 35% of respondents commented that these interactions challenged their stereotype of scientists, and 34% said their perceptions of science changed. Their comments suggested that, for at least 69% of visitors, their impressions of science and scientists were affected by interacting with these “future scientists”. In particular, the interactions changed their ideas about what scientists are like and what studying science includes. They commented that they see now that scientists can be approachable and interested in educating the public, and that “science” was more than just lab experiments, physics, and space exploration, that science included learning about the ocean as well. The following are examples of visitors’ comments.

- *I would like to be a scientist after coming here.*
- *Scientists can explore everything about the world, and make you think it is cool.*
- *I used to think that science was just about space; it’s actually about sea animals too.*
- *[Scientists] are good people and care about what they are doing. Not boring.*
- *Scientists are not just those nerdy guys.*
- *Before, I thought that scientists just did experiments. I didn’t know that they help the planet.*

- *Scientists teach children about what they know.*
- *Scientists are ordinary people just like us wanting to make a difference in the world.*

Data from student surveys indicates that COSIA students are mostly female (76%) and 40% are from ethnically diverse backgrounds. This suggests that not only are visitors seeing that scientists can be friendly and helpful, but also that scientists can be from a variety of demographics, including those traditionally under-represented in science.

Conclusions

In general, most visitors were able to elaborate on, and offer some details about, the science ideas underlying the activities. Some also identified causal relationships between ideas presented in the activities. Ideas on environmental consciousness emerged when visitors considered what others could find out from the activities they just completed. The quality of visitors' immediate responses suggests that the activities and the facilitators communicated the intended scientific ideas sufficiently.

Most visitors acknowledged that their attitudes about the ocean changed as a result of doing these activities. Environmental consciousness and gaining new knowledge were the most common reasons attributed to change in visitors' attitudes about the ocean. All visitors made positive comments about the facilitators. Many visitors acknowledged that interacting with these young, "future" scientists changed their stereotype of science and scientists (unapproachable, exclusively physics or space oriented, and not doing anything for us) to recognize scientists as ordinary people and interested in helping people, and science to be inclusive of the ocean and environment. Thus these COSIA facilitators potentially have a strong impact on the public's perceptions of science and scientists as they present themselves as an approachable and articulate, new generation of scientists.

COSIA Course Impacts

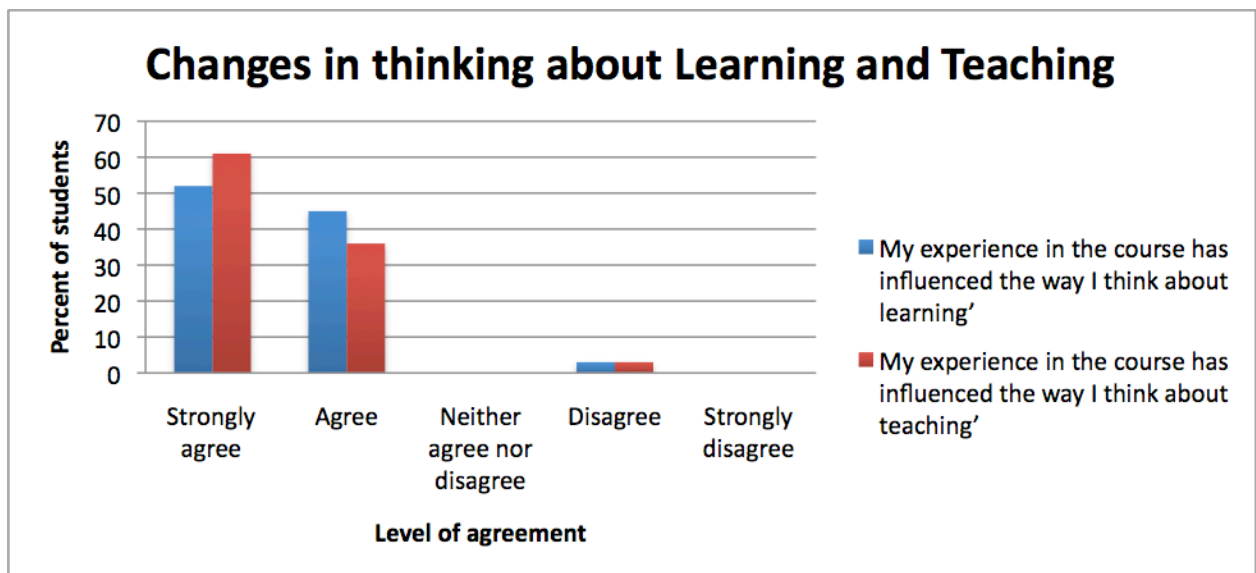
At the beginning and end of each term that the COSIA course was taught at IHEs, an online survey was distributed to the instructors and to all students taking the course. These surveys served both a formative and summative role gathering data about people's experience with the course and providing input for improvements as well as documenting impacts on the instructors, students and institutions. Over the course of the project, surveys were collected from 38 different faculty and staff at fifteen institutions and from 358 students from thirteen IHEs.

Evaluation results regarding the COSIA course and its impact on the participants are impressive; findings from the three years of evaluation suggest that participation in the COSIA course has had profound impacts on not only the students, but the faculty and museum professionals as well.

Impact on College Students

Students report an overall positive experience with the course and showed significant changes in their attitudes and knowledge about teaching and learning, an increased familiarity with educational concepts and improved levels of comfort, preparedness and enjoyment with topics such as teaching science and public speaking. In addition to the skills necessary to communicate science, instructors and students alike report that the course is helping the students to gain a deeper understanding and appreciation of the need to communicate to public audiences and the value of outreach to the community. Finally, the course is influencing the career paths of those who take it. More students are considering education as a possible career and many have used the course as a springboard for more immediate opportunities such as internships and summer jobs.

On post surveys, a vast majority of students agreed with the statements, ‘My experience in the course has influenced the way I think about learning’ and ‘My experience in the course has influenced the way I think about teaching’. Only 7 of 200 students (3.5%) disagreed to some extent with these statements.



Students were asked both at the beginning and end of the term to what extent they agreed with several statements pertaining to teaching philosophy. Pre/post comparisons of student data show statistically significant changes regarding how students think about these statements. Across the three years, students consistently agreed more with statements such as

- Discussing ideas is a good way to learn science
- People learn best when they work together
- People learn best through hands-on activities
- It is important to consider what students already know about a topic,

and agreed less with the statements:

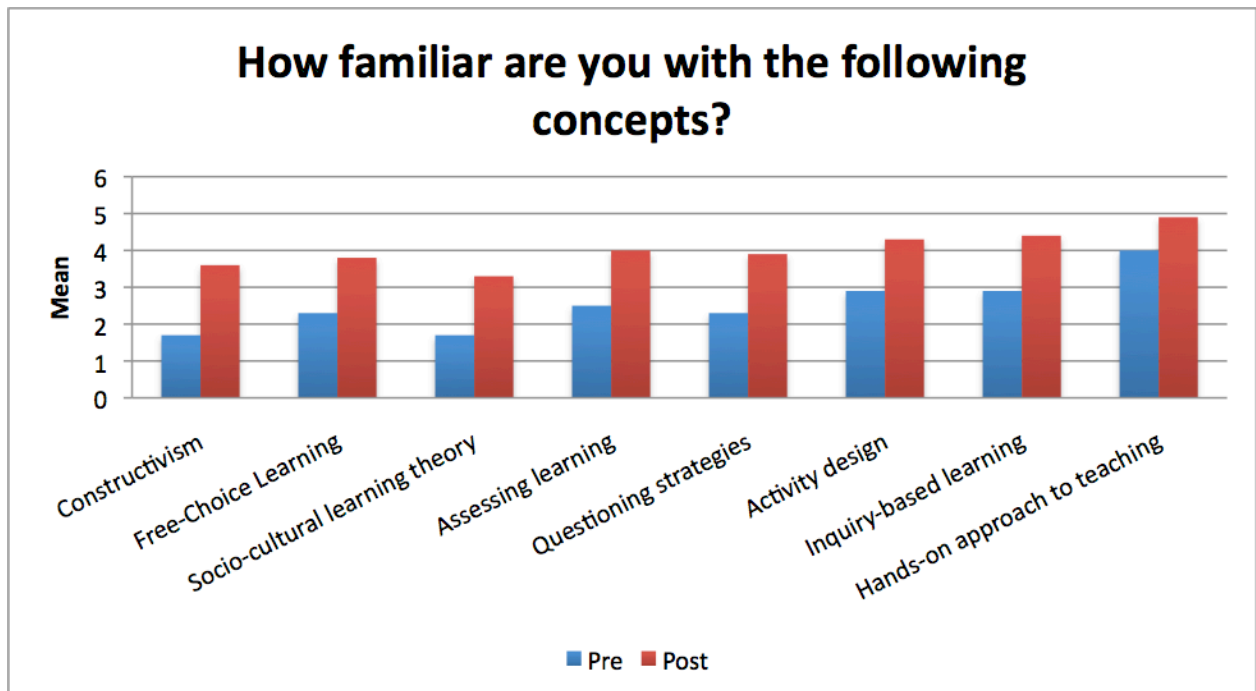
- Listening to presentations is a good way to learn science concepts
- It is important to present a lot of facts to teach science
- If presented with a clear, coherent explanation, people will learn the concept
- When designing activities, one should assume no useful prior knowledge

These changes suggest a considerable shift away from a didactic approach to teaching and toward ideas that highlight the importance of social context, prior knowledge and constructivism.

Students each year also showed statistically significant increases in their ratings of how much they agreed with the following statement:

- I feel very comfortable leading a discussion.
- I feel very comfortable speaking to the public.
- I feel well prepared to teach people about science.
- I feel well prepared to teach people about OCEAN science.
- I enjoy teaching science to kids.
- I enjoy teaching science to the general public.

Further, students showed statistically significant increases in familiarity with educational concepts.



In open-ended survey items, students articulated the impacts that they felt the course had on them. The examples below illustrate the overwhelmingly positive comments the students provided.

I really enjoyed the class and felt like the concepts were very important to learn. When I first thought about teaching, I really didn't think that so many concepts were involved. It opened my eyes and taught me how people learn and do not learn.

This should be a required course for all science PhD candidates because most of them will go on to teach in some capacity. Found it extremely useful, applicable, and helpful to my future

I learned a great deal about communicating science to a wide swath of potential audiences. I would highly recommend this course to other students, regardless of whether they were considering careers in teaching.

I loved this course! It reminded me that science is not successful unless it can be communicated to a general audience. The discussions and activities were fun and educational, and made me take a step back and think about how I have been taught and how other people learn.

It definitely taught me that teaching and communicating science is just as important as doing the science itself.

This is one of the most influential courses I have taken. I feel that it offers students a unique educational experience that has the potential to affect their futures much more than any fact-based science course I've ever taken. COSIA provided students with a positive and inclusive environment in which to collaborate, learn, and teach. I have already begun to recommend the course to others in my department.

The teaching perspectives/concepts covered in this course really revolutionized my thoughts on learning, and how to go about teaching. I really liked that there was an even mix of "theory"/concepts and real world examples and discussion.

Course like COS/COSIA can really make a positive influence on bridging the wide gap between scientists and the public. I think more of my fellow students and colleagues would be more willing to participate in outreach if they are given tools to teach and communicate science better.

I think its a great course and should be incorporated into the course requirements of research programs. When you are pursuing research, it is easy to forget how important it is to be able to communicate your science to a broader audience.

This was a great course that I would recommend all graduate students take at some point during their education. This was a very Positive experience and the most applicable and useful class that I have taken to date.

Overall, I became more comfortable in approaching individuals and speaking in front of audiences.

Survey data including pre-post comparisons and the students' own comments make it clear that the COSIA course has had substantial impacts on those who take it. The course successfully contributes to the students' understanding of pedagogy and learning theory, improved communication skills and appreciation of public outreach.

Impact on Professional Participants and Institutions

Data collected through on-line surveys of faculty and museum professionals involved in teaching the COISA course were analyzed to assess the impact of their participation in the COSIA project. Faculty and museum participants see the COSIA course as an opportunity to build partnerships between professional communities with complementary expertise to achieve a goal that neither could do on their own. Through this process, those involved anticipate changes in their professional practices, both in how they do their jobs day-to-day, and also in their institutional practices and policies.

Nearly all respondents indicated that their experience with the COSIA course would have some impact (40%) or a great impact (59%) on their professional practices. When asked how participation in COSIA has affected their professional practices', participants indicated that they have had the opportunity to improve their own teaching and communication skills as well as the relationship with their partner institution.

Respondents had this to say:

I learned a lot about how people learn - though I'd taught at the university level for several years, all of the pedagogical literature was new to me. How people construct knowledge and make meaning, incorporating inquiry, asking good questions - this knowledge will be very helpful to me in my teaching.

I've learned a significant amount about teaching and learning as a course instructor, including much self-reflection on my own teaching approaches and learning style. I feel that I'm a much better educator than I was even a short time ago as a result of being involved in the course.

COSIA will really influence my teaching. I definitely see myself incorporating more inquiry, more demonstrations, and better questions into my teaching. I'm also much more interested in informal learning environments.

As someone with formal training in the sciences, but not education, this course continues to help me develop as an education professional, and puts me in contact with other like-

mindful individuals from whom I can draw knowledge and inspiration. Every time I teach the course I consider myself a student along with the other 'matriculating' students. The course has also helped me to gain a better appreciation for the world of informal science education, considering that much of my prior experience had focused on the K-12 environment.

Open-ended responses indicate that participating in COSIA will impact not only the individuals directly involved, but will influence practices at the institutional level.

Institutionally, I think the course has gradually gained recognition as a valuable offering for the graduate and undergraduate students. I think it serves an important role here because there are no other formal courses that offer students the same opportunity to begin to develop critical communication skills.

Over the past 3 years that the course has been offered at our institution I have noticed that the instructor(s) have become mentors to many of the students beyond the duration of the course. This mentoring is primarily in the area of E&O, however I have noticed that the students come to these mentors for advice relating to achieving their degrees as well. I believe that the safe learning environment that COSIA provides is very valued by the students, and provides something that for many is missing from the traditional structuring of PhD programs.

I have learned a great deal of information from the readings and the information contained in the [handbook]. I intend to incorporate much of this information into my training classes for docents and new staff at my facility.

The students came up with activities that will be used by staff and volunteers as part of our education programs.

COSIA is changing the professional practice of the faculty in our building. They [other faculty] are coming and asking for help in modifying their teaching of 100 and 200 level classes. I think this is exciting and ultimately what a course like COSIA can/should do.

I will likely be teaching a course very similar to this on a regular basis to our grad students. It may eventually become a part of the core curriculum for grad students.

Conclusions

Data collected through the internal evaluation indicates that the COSIA course has been a successful project that has made significant impacts on target audiences. The project has provided important and valuable resources through the Professional Development Workshop and handbook, and have provided the field with a variety of high-quality activities for ISEIs that demonstrate an impressive contribution to the public's understanding of ocean science content, conservation and preconceptions of science and

scientists. Perhaps most impressive are the impacts that the course has on the next generation of scientists who, through COSIA are gaining a better understanding of learning theory, a more sophisticated philosophy regarding education, appreciation of outreach efforts and practical experience teaching in the field.

B. Results from External Evaluation: Inverness Research

Communicating Ocean Sciences to Informal Audiences (COSIA) Evaluation Progress Report May 2010

Introduction

Inverness Research has served as the external evaluators for the COSIA project since the beginning, in 2006. For the past three years, our work has focused on COSIA as an investment in the future, rather than simply a project that provides immediate services. We have spent the past two years identifying the returns on the NSF's investment, and documenting how they are realized. First, we have explicated the Theory of Action for the COSIA project, describing ways in which NSF's funding dollars are translated into benefits and intended outcomes, such as increased capacity and capital. Our interviews and site visits from this year have been in service of documenting the key components and design features of COSIA and its Theory of Action that result in a range of multiple benefits – both for professional and public audiences.

Evaluation activities completed this year

- Attended COS Partners' Meeting, June 2009
- Expanded the study to include an additional site visit, February 2010
- Conducted site visit to Rutgers University, April 2010

Findings to date

A full technical final evaluation report, which includes three case studies, is available on our website at:

http://www.inverness-research.org/abstracts/ab2010-06_Rpt-COSIA-final-eval-rpt.html

Our findings to date indicate that the investment made in the COSIA project has yielded important benefits, including direct tangible benefits to informal educators, scientists, and students. These include the creation of what we call “working assets”. Students reported having gained a deeper understanding of both formal and informal learning theory, as a result of their participation in COSIA. They also communicated the value of the connections and relationships they have cultivated through the COSIA experience, in terms of being able to communicate science to a wider variety of audiences. Our data also

indicate that the cycle of the COSIA course (the planning, implementing, and reflection), as well as the collaboration itself, has been valuable to the educators and the students involved. Furthermore, our studies support the proposition that participation in COSIA has contributed to the creation of strong partnerships. We have evidence that this form of a project works and that the specific local sites involved are generating valuable knowledge about the key components of strong partnerships. Importantly, there is a core group at LHS that knows how to provide centralized support and to be at the center of a nascent or emerging network. Through the emergence of a national network, COSIA is developing an infrastructure to facilitate communication and collaboration among local sites. Finally, the work has resulted in concrete resources – tools, guides, and courses – that provide a foundation for and bolster this partnership work.

Our final report details these findings and is intended to speak to a variety of audiences interested in projects that bring together scientists and educators to communicate current science.

C. Report on the *Evaluation of Students' Activities*, LHS

This investigation was conducted in 2008, the second year of the grant, and evaluated the activities designed by COSIA students at all the sites. We documented how the students implemented the activities they designed for the course, how they interacted with the public, and how the public responded to their activities, the science they communicated, and their presence as “future” scientists. It was necessary to keep in mind that while these student facilitators were formally learning about teaching and communication skills, they were still novices. Nonetheless, findings could inform course developers and instructors on how facilitators applied what they were taught, and also offer recommendations for improvement to the course. The complete report and poster presentation can be found at <http://www.coseeca.net/resources/>. We have included a few findings and their relevance below.

RESULTS

In total, we conducted 21 hours of data collection resulting in 95 observations and 61 interviews of 352 visitors. We observed 45 students from five universities interacting with the public at 24 different activities. Visitors stayed at an activity from 30 seconds to 23 minutes, with an average time of 5.8 minutes. Three major conclusions are reported here.

Children versus adults

Observations revealed that, in general, students tended to lead demonstrations as they engaged with visitors, and their interactions with adults were noticeably different from those with children.

Changed perceptions

About 60% of visitors acknowledged that their attitudes about the ocean changed as a result of doing these activities; those that said there was no change in their attitude clarified that they were already knowledgeable about and cared for the ocean.

Visitors most commonly attributed environmental consciousness and gaining new knowledge for changing their attitudes about the ocean. All visitors made positive comments about the students. Some visitors acknowledged that interacting with these

young, “future” scientists changed their stereotype of science and scientists (as unapproachable, exclusively physics or space oriented, and not doing anything for us) to recognize scientists as ordinary people interested in helping society, and science to be inclusive of the ocean and the environment. Thus these science students potentially have a strong impact on the publics’ perceptions of science and scientists as they present themselves as an approachable and articulate, new generation of scientists.

RELEVANCE

There is urgency for scientists to be more proficient in communicating with the public, teaching them about science and engaging in dialogue with them about socioscientific issues (Leshner, 2007). The university course featured in this investigation brings together research and theory in science education with the affordances of ISEIs to offer one way to educate future scientists. We find that these university science students engage with the public sufficiently well, and that they impact the publics’ perceptions of science and scientists. Moreover, we draw attention to how ISEIs can be more than places to learn and teach science, but also powerful places for young scientists to learn to develop their teaching knowledge and skills. Thus our work contributes to a critical focus in science and science education—the preparation of future scientists to communicate science.
