
**Center for Adaptive Optics
Education and Human Resources Program**

**Evaluation Highlights
2003 Professional Development Workshop**



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Evaluation Highlights

Center for Adaptive Optics 2003 Professional Development Workshop

Goals

The Professional Development Workshop is a program of the Center for Adaptive Optics (CfAO) at the University of California, Santa Cruz. Officially launched in 2001, the program was designed help address the massive decline in student enrollment in science, mathematics, engineering, and technology (SMET) fields at institutions of higher education. The effort is targeted at graduate and post doctoral students in astronomy, optomology, and vision science who have an interest in adaptive optics and in developing their competencies as future teaching faculty members.

Participating Academic Institutions

University of California, Santa Cruz (Headquarters) • University of California, Berkeley • University of California, Irvine • University of California, Los Angeles • University of Chicago • University of Houston • University of Rochester • Indiana University • Lawrence Livermore National Laboratory • Montana State University • California Institute of Technology

CfAO's strategy to address the national issue of declining enrollment in SMET is to equip future scientists and engineers entering into faculty positions with effective research based teaching practices. New faculty using a broader range of teaching practices are in a unique position to markedly influence the rate at which undergraduate students enter and remain in SMET academic programs and successfully enter careers in these fields.

The Workshop is facilitated by staff from the San Francisco Exploratorium, and includes presentations on research in teaching and learning, labs and science inquiry activities, networking with representatives in local industry educational institutions, and field trips to research and technology firms. Activities emphasize research in adaptive optics.

Professional Development Workshop Components

- *Research on science learning and teaching*
- *Exploratorium inquiry-based instructional model*
- *Curriculum development and assessment*
- *Peer mentoring and structured support*
- *Visits to technical facilities*
- *Peer collaboration and networking*
- *Communicating science research to the community*

The goals of the program are:

- provide participating graduate and postdoctoral students with an annual week-long professional development workshop in inquiry-based research, curriculum development, and research-based teaching approaches
- support participants in developing and refining their teaching practices through targeted teaching opportunities, peer-to-peer networking, and ongoing support activities offered by the CfAO community
- build an interactive community of skilled teaching practitioners who are proficient in research-based teaching strategies
- develop a context for interdisciplinary interaction and collaboration between vision science and astronomy graduate students, post doctoral students, and researchers

Evaluation Activities

Research and evaluation activities have been developed and embedded in the program design to assist the program in monitoring the effectiveness of the Workshop and documenting the various levels of participant and program outcomes. A longitudinal tracking system comprised of surveys and personal reporting is place to gather data from participants as they launch their university teaching careers. Research activities are also being carried out that will help the project illuminate factors that support and detract from participants' success in implementing reforms in science teaching at the university level and to document the trajectory of participants' growth in their teaching practices. Findings will be shared in the scientific and educational communities through presentations and professional publications.

Evaluation activities took place throughout the week of the 2003 Workshop are:

- Pre-workshop interviews with a sample of 11 first, second, and third year participants
- Post workshop participant survey customized for first, second, and third year participants

The results of the survey were produced and shared with Workshop instructional staff for mapping and refining program directions. Evaluator and participant recommendations were also delivered to help staff identify opportunities for refinement in areas such as recruitment, workshop design, and follow up support activities for alumni.

Evaluation Highlights

Overview

The CfAO Professional Development Workshop, attended by 25-35 CfAO graduate and postdoctoral students annually, has become one of CfAO's most visible and innovative education programs. The Workshop is staffed by distinguished science educators and researchers from the San Francisco Exploratorium and the University of California Santa Cruz Education Department, and also includes collaborations with members of the Maui scientific and educational community.

The target audience for the program, graduate students and postdoctoral students progressing on to faculty teaching and research positions, are the primary audience for this program because they hold tremendous potential for reforming undergraduate education in science through improved teaching methods and curriculum. The goal is to develop a cohort of newly trained entering faculty members with the enthusiasm, pedagogical skills, and expertise to design and deliver science education that will reach the broader population of students.

CfAO plans to disseminate the model nationally through published case studies, professional publications, evaluation findings, conference presentations and roundtables, and a "best practices" handbook outlining the design of professional development workshop and follow up activities.

A total of 31 CfAO members, affiliated graduate students and postdoctoral researchers participated in the 2003 Workshop from across the country. NSF officers, CfAO and Exploratorium staff, invited members of the Maui scientific and educational community also attended.

Overall Assessment

- The CfAO Workshop model is gaining attention across disciplines at UCSC, and has the potential to evolve as an exemplar that could be adapted to other Universities and academic disciplines. The Workshop demonstrates an innovative effort to integrate research and education within the structure of the CfAO and to provide valuable professional development to graduate and post doctoral students. The program helps fill an educational need felt by many graduate students with plans to progress into faculty positions. That is to enter their roles equipped with not only expertise in their discipline, but also knowledge of the most current science education research and a set of refined teaching skills and competencies. Graduate and post doctoral students are a good fit for piloting this model of professional development, and can play a role in increasing the numbers of students who pursue SMET-related academic programs and careers.
- The Workshop and support activities are producing a core of experienced new leaders with enhanced knowledge of educational research and inquiry-based instructional methods. Multiple years of participation has had a very positive effect on returning participants. Evidence from the evaluation shows that participants are progressively deepening their teaching practices, enriching their knowledge of inquiry, reflecting on the continuum of their professional growth, and refining their teaching skills based on authentic teaching experiences.

Workshop Design and Implementation

- As a whole, the design and implementation of the Workshop received very high marks from the 2003 cohort, with an average rating across the main components a 3.4 on a 4.0 scale. The Workshop component that overwhelmingly received the highest ratings for usefulness to the participants was the series of sessions devoted to the introduction to inquiry teaching strategy, the practice inquiries and reflective discussions designed to immerse participants as learners in inquiry teaching, and the inquiry design sessions. Participants highly valued a "deep and wide" immersion in the practice of teaching and extensive interactions with Exploratorium inquiry teaching experts, a rare opportunity for any scientist.

- The 2003 Workshop design included new parallel sessions in more advanced topics such as assessment and leadership opportunities for returning participants. Seven participants returned for the third year. These participants served as facilitators of inquiry lessons and also as “shadowers” who observed their fellow presenters and provided structured feedback. The five 2003 second year participants received a deeper immersion in instructional methods and curriculum development and an opportunity to support their first year peers. The intention behind the layered approach is to provide a supportive context for developing and refining participants’ teaching skills and an interactive network of scientists who are engaged in similar professional development activities. The third year participants rated the session devoted to preparation for inquiry, a first time offering, very high with 86% rating it “very useful” and 14% rating it “fairly useful.” The session devoted to assessment, also a first time offering, received lower ratings, primarily due to the complexity of the topic and the shortage of time available to devote to the subject. Over two-thirds (71%) rated it “fairly useful” while 14% rated it “very useful.” The topic is of high interest to participants and their feedback will help focus the session for the 2004 Workshop.
- Debriefing sessions were included in the 2003 Workshop to enable third year facilitators and “shadowers” to share and synthesize their experiences with instructional staff and their colleagues. Both sessions received high marks from the returning participants. The debrief for the new facilitators session received a rating of “very useful” from 83% of the third year participants. The second debriefing session held later in the week was also rated “very useful” by 83% of the participants.
- The two primary facilitators from the San Francisco Exploratorium received the highest ratings (3.6 and 3.8 respectively on a 4-point scale) on the quality of their facilitation and participant support for the second straight year. Serving as trainers, models, and mentors, they translate high impact science teaching strategies to participants and assisted as they created their own curriculum to implement in their home instructional settings. They are highly praised by participants year after year.

Influences of the Workshop

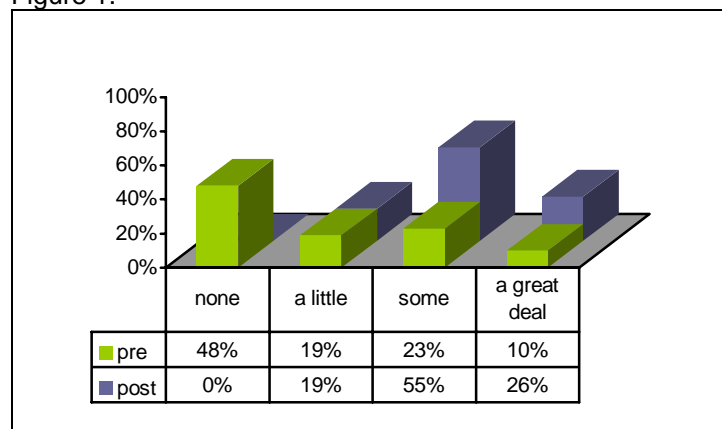
Participants’ Experiences with the Inquiry Approach

In this section, brief data points are presented along with bar charts showing pre/post comparison data on key elements related to inquiry-based teaching. Overall, participants’ reported pre/post gains in their knowledge, skills, and confidence in inquiry-based instructional approaches.

- Participants’ pre/post ratings of their knowledge of research that underlies inquiry-based teaching

Almost half of the participants reported having no knowledge of research on inquiry-based teaching at the beginning of the Workshop. At the conclusion, 55% reported knowing “some” and 25% reported knowing “a great deal.”

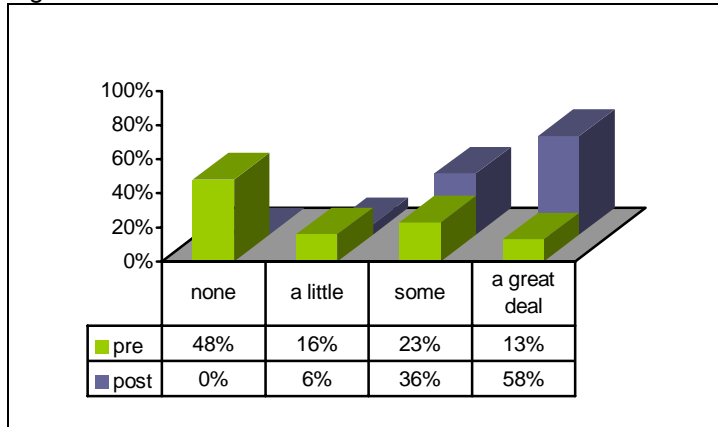
Figure 1.



- Participants' pre/post ratings of their knowledge of the structure of an inquiry lesson

Prior to the Workshop 80% of the 2003 cohort had very little or no knowledge at all of the structure of an inquiry-centered lesson. After the Workshop, this shifted to 36% reporting that they had "some" knowledge and 26% reporting that they had "a great deal" of knowledge.

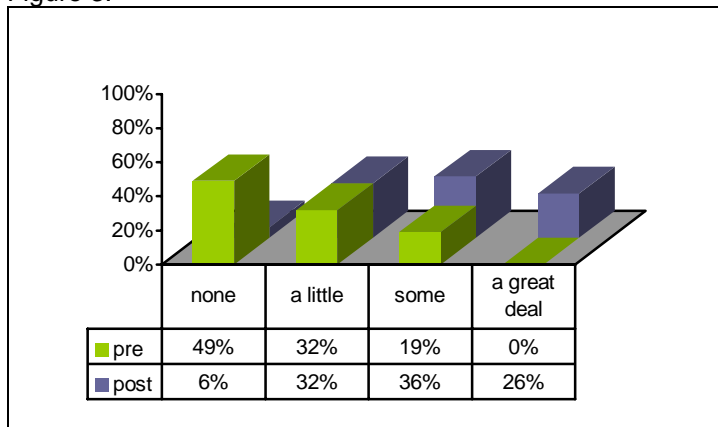
Figure 2.



- Participants' pre/post ratings of their knowledge of techniques for facilitating inquiry and discussion

At the beginning of the Workshop 49% of the participants had no knowledge of inquiry-based instructional techniques and 32% had "a little." At the conclusion of the Workshop, 36% reported having "some" knowledge and 26% said they felt they had "a great deal" of knowledge.

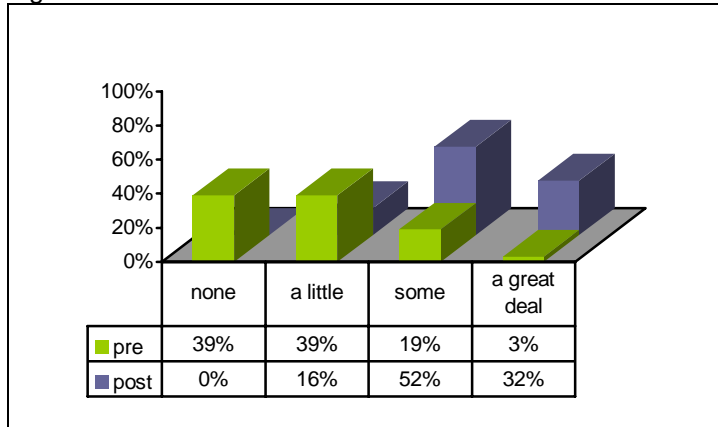
Figure 3.



- Participants' pre/post ratings of their capacity to carry out inquiry-based strategies

The percentage of participants who reported that they had “some” or “ a great deal” of capacity to carry out inquiry strategies in their teaching settings increased from 19% to 84% after the Workshop.

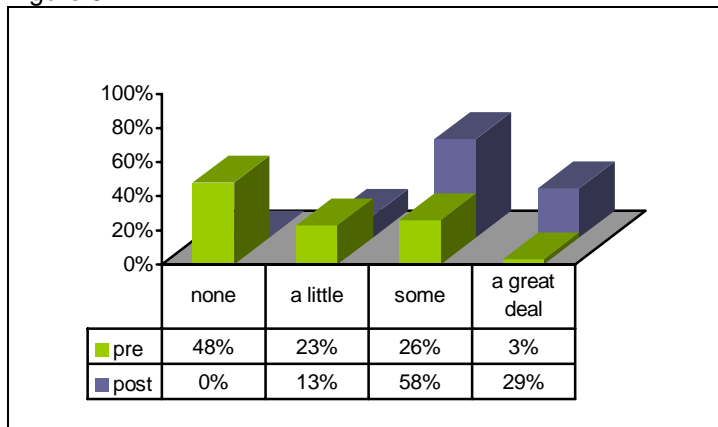
Figure 4.



- Participants' pre/post ratings of their capacity to design an inquiry activity for a teaching situation

There was a significant pre/post shift in participants' reports of their abilities to construct an inquiry activity. Before the Workshop, only 29% reported having “some” or “a great deal” of capacity to create an inquiry lesson. At the conclusion of the Workshop, this number rose to 87%.

Figure 5.



Transformative Elements of the Workshop

- Comments from the first year participants on the most transformative elements of the Workshop included the research and readings presented on teaching and learning, observing the inquiry process in action, and participating in inquiry lessons in the role of a learner. This group of participants consistently referred to the Workshop as an eye-opening experience, one that opened a “black box” exposing convincing research on what works in teaching and specific strategies that can assist learners in integrating new knowledge. Two first year participants commented on the most transformative aspects of the Workshop for them:

Actually seeing written on paper ideas, principles about learning and teaching which I had already thought of before, but had never seen articulated. Three kinds of hands-on learning raised awareness of these categories and when they are appropriate. Inquiry learning is what it's about.

The realization that there are complex phenomena that I didn't notice/think about before that can be explained by simple principles and that letting even relatively poor students work with what they know can lead to greater understanding. The realization that the science education sector has only served a minority of students well.

- The second year participants had somewhat different comments on the transformative aspects of the Workshop. Since they had already had a basic introduction to inquiry teaching and research, their comments centered more on the value of revisiting the inquiry approach and deepening their knowledge on inquiry design and facilitation techniques. A second year participant's comment:

Redoing the inquiry and the inquiry design. Coming into the Workshop knowing a bit about inquiry improves the experience tenfold. My learning, questioning, planning, and practice were much more directed and I'm coming away from this conference a much better teacher.

- In addition to participating in the entire workshop, individuals returning for the third year were tasked with facilitation and peer mentoring/feedback roles. In general, they valued these roles as opportunities to further advance their inquiry skills (with support from Workshop staff), but also were clear that they still needed continued support and opportunities to practice the approach. Two third year participants described their experiences:

Being a lead facilitator in the inquiry was key. Being able to make decisions on my own, but then check with them (or usually checking with them first) helped me learn a lot. Candice also seemed truly concerned that we feel comfortable with everything we were doing. This helped to relax me a bit.

Implementing the design activity showed me I could design and make it work!

Professional Community

- The collegial community, along with the professional interaction and dialog that occurred formally and informally during the Workshop, were viewed by participants as one of the most valuable aspects of the experience. Eleven participants (37%) reported that it had "some positive effects on the value" while 19 participants (63%) felt that it had a "strong effect on the value" of their experience. Two participants' comments were:

It's a community of learning, just as discussed in Principle 7! The support of the community is what enables the entire learning process.

The opportunity to discuss impressions and experiences with everyone (facilitators and participants) was critical to the value and learning taking place.

- On a separate survey item, participants were asked to rate the opportunity to engage in useful dialog with other participants. Over three quarters (65%) rated this aspect "excellent" while the remaining 35% rated it "good."

Future Plans

- When asked to rate how influential the Workshop would be on the way that they planned to proceed with their education and careers, 42% of the participants reported that it would be “very influential” while 52% predicted that it would be “somewhat influential.” Two individuals stated that it would be “minimally influential.”

My involvement in activities to this point and my view of possible career paths has definitely been shaped by the CfAO's EHR activities and its commitment to education training for its grad students.

Lessons Learned and Planning Considerations

The 2003 Workshop clearly achieved its major goals. The Workshop program, now entering its 4th year, is has expanded and is becoming more polished. Data from the surveys shows that participants at all levels gained familiarity with current educational research, inquiry-based teaching approaches, and curriculum development. The inclusion of alumni from 2001 and 2002 as co-instructors, observers, mentors, and models has greatly strengthened the peer support and modeling components of the Workshop. These new roles for returning alumni deepen their experiences and give them opportunities for structured observing, mentoring, and teaching their peers throughout the week. Because the formal program is only five days, it can't address the spectrum of training and practice teaching that a standard teacher credentialing program offers. Therefore, it is important to delineate the scope and limitations of the program and to offer to serve as a broker of information and resources as participants continue to evolve their teaching practices. The enthusiasm is high in the Workshops and it is important to keep up the momentum after the Workshop is over and to continue to cultivate the pool of talented participants. With the long term goal of reforming the way that science is taught at the University, the program has set itself on an ambitious course that will require strategic planning and systematic collection and use of research and evaluation data to help the program chart its course.

Building networks and a sense of community among participants and instructional staff is an important goal of the Workshop and of the CfAO as a whole. This has been strength of the design and of the instructional staff in each of the three years that the Workshop has been offered. Participants report that the environment and tone of the Workshop are conducive to collegial exchange and building personal relationships that they can continue to rely on as they launch their teaching practices. Inviting local representatives from the business, educational, and scientific sectors in Maui further extends participants opportunities to create professional relationships and exchange. The sense of community in the Workshop is clearly visible and is a strong asset for accomplishing the longer-term goals of the program.

Workshop staff continues to solicit feedback through formal evaluation strategies and ongoing dialog to identify the Workshop design elements and support structures that are the most essential for preparing graduate students for future teaching roles. They should be commended for their efforts, and for working consistently to solidify the Workshop model and support structures.

This section concludes with some general observations and recommendations for staff to consider in planning. More detailed recommendations from the evaluator and program participants are contained in the September 2003 Highlights reports.

- An issue mentioned in last year's report was the need to carefully target and select participants who are the most likely to have faculty teaching or educational outreach roles in the future. Participants without opportunities for extended teaching assignments, while they clearly benefit, are less likely to help CfAO achieve its longer-term goals. While recruitment is challenging for all programs with underrepresented students as a primary audience, CfAO needs to continue to do targeted recruiting to assure a diverse group of qualified participants.

- A challenge facing many of the participants is finding a suitable setting and adequate support in their institutions to implement inquiry experiences. In comparison to traditional instructional approaches that rely on lecture and labs, inquiry can demand increased time and instructor skill to manage the construction of students' knowledge. These new skill sets take multiple years of training and opportunities to practice them in authentic situations. In addition, several participants were in research positions and did not have immediate opportunities to teach. CfAO has begun to address this issue by structuring more opportunities for participants to try out their inquiries and being more stringent with their selection process. The 4-week COSMOS program continues to be a good teaching lab for participants, but is difficult to replicate in other locations.
- Participants expressed interest in learning about a broader range of teaching strategies to help round out their preparation. Since inquiry models are only one of the many strategies instructors will use, it would be helpful to incorporate a broader range of information and opportunities to explore the range of teaching approaches appropriate for University settings.
- Daily discussions were designed to assist participants in integrating their learning experiences and resolving issues and questions. A little less than half of the participants (45%) indicated on the survey that the time provided for synthesis and closure of activities was insufficient and that the discussions—which they highly valued—were frequently cut short. This was also an issue last year.
- Members and Exploratorium staff facilitators are continuing to refine an innovative and promising model for the preparation of graduate and postdoctoral students for responsibilities as educators in institutions of higher education and for roles in education and outreach efforts within the community and public educational system. While still in its early years, this work has the potential to broadly influence the fields of graduate education and the quality of University-level teaching nationwide.

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