ON THE CUTTING EDGE: LEADERSHIP DEVELOPMENT IN THE GEOSCIENCES

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The National Association of Geoscience Teachers (NAGT) seeks to create a thriving community of educators working together to create a broad understanding and appreciation of Earth (NAGT Strategic Plan, 2004). As one way of addressing this goal, NAGT sponsors the On the Cutting Edge professional development program for current and future faculty in the geosciences. This program helps geoscience faculty stay up-to-date with both geoscience research and teaching methods. The workshop series and website http://serc.Carleton.edu/NAGTWorkshops provide professional development opportunities, teaching resources, and mechanisms for faculty to interact on-line and in person with colleagues who are focused on improving their teaching. An integral aspect of the project is the development of an expanding community of geoscience educators with a strong and diverse leadership.

An explicit goal of the program is to develop the leadership needed to sustain the program into the future as an important step towards ensuring the overall health and vitality of geoscience education. Through this program, we are currently developing a network of people who are willing and able to offer workshops, develop web resources, and assume leadership roles in creating future professional development opportunities. The number of leaders in geoscience education is currently fairly small, and the future success of professional development nationwide will be enhanced if this number increases. In this context, we recognize important aspects of leadership development in contributions of small activities, papers, discussion groups, and ideas that contribute to the collective good and set an example of participation in the geoscience education community. These activities form a continuum leading to more traditional leadership activities such as developing and sharing a vision of the future or as running workshops, programs, meetings or sessions.

Our model for leadership development involves three major components:

- Providing a wide range of activities that allow individuals to participate in the geoscience community. These activities purposefully involve varying time commitments, leadership responsibilities, and skills.
- Providng instruction and mentoring for faculty taking on these responsibilities.
- Providing encouragement and guidance to help faculty take on increasing leadership in opportunities that are aligned with their strengths and interests, including leadership that moves them beyond the scope of the On the Cutting Edge program.

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The integrated workshop series and website is an excellent environment for nurturing leadership. Workshops are exciting and intense experiences where participants become enthused about the workshop content and its impact on their teaching and their students learning. Even more important, workshops build a strong sense of community among the participants and encourage a sense of collective action. In this environment, participants are often inspired to participate more fully in the geoscience education community. This may mean carving out time to do something at their home institution or at a professional society meeting, participating in workshop follow-on activities, contributing to the website, or helping with a future workshop. Our goal is to nurture leaders by encouraging and supporting these aspirations.

Recognizing the diversity of interests and skills, as well as the variety of constraints faculty face, On the Cutting Edge seeks to provide a wide range of leadership opportunities. These include:

Opportunities to develop leadership skills within the workshop

All workshop programs include opportunities for participants to moderate small discussion and to summarize and present conclusions from a group discussion that reflect the breadth of the group's opinion. These fundamental skills are essential to effective communities. They are learned skills that can be improved with practice. Nurturing them in workshop participants not only increases the effectiveness of our workshops and develops essential skills for workshop leaders, it increases the ability of the geoscience community to learn from one another, build consensus, and make strong collective decisions.

In some workshops, we also invite faculty recognized for their expertise and leadership to design sessions and make presentations. This provides an opportunity for faculty to learn that good teaching practice is as effective with faculty as it is with students and to refine their presentation skills. Workshop activities must engage the learner, allow for construction of new knowledge, support reflection and transfer. The workshop leaders model this practice, provide instructions of what is expected, and work with participants to encourage the development and delivery of excellent activities. The invited presentations give presenters recognition within the geoscience community and at their home institution.

One of the benefits of leadership opportunities within the workshop is that they capitalize on the excitement and energy that faculty bring to preparing for a workshop. The work is done prior to and at the workshop.

Opportunities for leadership in workshop follow-on activities

Half of the workshops offered each year by On the Cutting Edge are designed to move new geoscience content or teaching methods forward into the mainstream of geoscience teaching. The success of these workshops depends on the engagement of participants in follow-on activities. Opportunities for continued involvement include:

- presentations at local, regional or national venues, including the home department and campus. Presentations may highlight workshop results or present the participants own work on the workshop topic.
- contributing, creating or reviewing materials for the workshop website. Our websites bring workshop content to the full geoscience community through collections of resources for faculty, summaries and tutorials, and discussions. Much of the material is contributed by participants.
- leading or contributing to small group projects emerging from the workshop. Participants frequently decide to collaborate long distance on the development of materials, activities, or ideas in which they share a high interest. This provides a mechanism for moving forward many workshop recommendations.
- incorporating recommendations or ideas from the workshop into the participant's professional activities. For example, one workshop participant obtained funding to

develop and distribute teaching materials recommended by workshop participants. This work built on his existing research and was funded via a supplemental grant. Other participants have developed new proposals for professional activities inspired or facilitated by workshop discussions.

Enthusiasm for such activities is always highest at the workshop and ebbs as everyday work commitments intrude after returning home. On the Cutting Edge provides a host of help and services to facilitate continued participation and to nurture leadership. These include discussion lists, tools for sharing information (see for http://serc.carleton.edu/NAGTWorkshops/petrology/instruments.html and http://serc.carleton.edu/NAGTWorkshops/visualize04/contribute.html), and the ability for faculty to easily author webpages for our site from their home institution through a web interface. However, there is no question that one of the most important roles played by the project PIs is to constantly follow-up with past participants encouraging them to both contribute and take on leadership for moving the group's agenda forward. In each workshop, new leaders emerge and past-participants become more refined in their ability to focus their commitments in areas where they can follow through.

Opportunities to collaborate with the project leaders on workshops and website

Finally, On the Cutting Edge offers a series of opportunities for faculty who want to learn more about leading and organizing workshops or communicating workshop themes via the website. Each workshop engages geoscience faculty with demonstrated leadership skills in planning and leading the workshop. This provides an opportunity to work extensively with the project PIs in developing the program and activities for the workshop. Each workshop is developed around a set of goals. A tested set of principles of design http://serc.Carleton.edu/NAGTWorkshops/conveners.html are used as a basis for developing a program that is an active learning experience for the participants. Evaluation is an integral part of the workshop. At the workshop, the project evaluator meets with leaders each day to provide feedback and enable mid-course corrections. Thus, each workshop demonstrates to leaders the application of teaching that integrates goal setting and evaluation to guide the development of successful activities.

The breadth of workshop types in the program lends itself to different roles for leaders

- Several of our workshops are offered each year. In this setting new leaders are engaged in detailed planning of individual sessions, as well as in half- to full-day, step-by-step walkthroughs of the workshop. New leaders become acquainted with the detailed planning that leads to a smooth and successful delivery of these established programs as well as the team decision-making that underpins workshop success. These sessions also help to ensure the success of the new leaders by clarifying their responsibilities and providing an opportunity to share strategies for keeping groups on task, ensuring the contributions of all group members, and other common leadership issues.

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- Three workshops each year address new topics and must be designed from scratch. Faculty leaders in the topical area are an essential part of developing a strong workshop program. These faculty become engaged in the full workshop design process around a topic that is at the core of their professional lives. Each topical workshop has a co-convener and a planning team providing opportunities with differing levels of commitment and responsibility. A project PI responsible for the workshop works side-by-side with the workshop co-convener to lead the planning team in creating the program. This structure provides opportunities for established leaders in the geoscience community to work together and learn from one another while introducing new leaders onto these teams. This is a teaching strategy very similar to that used in research labs that form teams of faculty, senior graduate students, junior graduate students and undergraduate students.
- The workshop series moves from location to location to engage faculty around the country. This provides opportunities for faculty to become involved in the logistical planning that underpins any successful event.
- Just as the On the Cutting Edge program complements its workshop program with the development of a website for a broader audience, so to do we complement our opportunities for workshop leadership with opportunities to work on the website. Again our strategy is one of multiple levels of commitment:
- All workshop participants and the broader geoscience community are encouraged to contribute to the website. This can be as simple as recommending a reference be added to the site.
- The primary focus of our work with faculty on the website is development of teaching materials for the site. Participating in this way requires that faculty reflect upon the goals, methods and evaluation of a teaching activity or course and present the materials in a manner that facilitates use by other faculty.
- For faculty who are particularly interested in working with the website, a series of sabbatical opportunities are available. Visiting fellows can spend up to four months working in the Science Education Resource Center at Carleton College to develop on-line materials that bring the content of a particular workshop to the broad geoscience community. Fellowships immerse faculty in an office focused on web-site development with expertise in design, development, testing and evaluation.

Reflections

The development of a wide range of opportunities for leadership that allows for the variety of faculty interests, expertise, and commitments appears to be a strong strategy. While the results of a rigorous evaluation are not yet available, it is clear that the cadre of leaders involved in the workshop program is expanding and workshop participants are increasingly involved in follow-on activities, particularly convening sessions and making presentations at professional society meetings. Faculty are finding ways to contribute in many ways, while the level of discourse and action at the workshops increase as both leaders and participants gain more experience. Most importantly, workshop participants are moving forward with their own ideas.

As we reflect on the development of a self-sustaining leadership for geoscience education, the parallel to teaching is evident. Our program motivates faculty to take on new roles and engages them in learning new skills required for success. The workshops and their design process model good process. The workshop planning process involves leaders in making decisions and leading sessions so that they learn by doing. The project PIs play an important role in providing feedback, fostering reflection, and encouraging and mentoring faculty in their learning. We provide multiple opportunities involving a range of responsibility to scaffold leadership development. And, just as we do with our undergraduate students, we aim for a place where the learner becomes independent and we are no longer needed.

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This program adds to the suite of workshop opportunities that have supported the geoscience community in coming together to work, developing a commonly held set of values for workshop leadership and participation, and practicing the skills needed to facilitate such an experience. Looking back over a decade of community building in the geosciences, the importance of repeated opportunities to work and learn together are clear. The On the Cutting Edge program has its roots in workshop opportunities offered by NAGT, the Keck Consortium, and others, as well as a series of large meetings that developed reports and recommendations for Earth System Education (Stout et al., 1994; Ireton et al, 1997; Manduca and Mogk, 2000). The current program offers new opportunities for this community to collectively bring its strongest ideas into the mainstream of geoscience education while developing the leaders needed for the future.

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