

Reflections of an Outreach Mathematician

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The mathematics department of the University of Tennessee at Knoxville has recognized the benefits of an outreach program and has made a strong commitment to outreach activities by hiring two faculty members whose job title is “outreach mathematician”. The exact nature of this post is still being defined by the actions of these new faculty members.

The new outreach position follows the usual model for a tenure-track post: typically 40 percent teaching, 40 percent research, and 20 percent service. However, the research expectations are replaced by the requirement that the outreach mathematician develop a funded outreach program, act as liaison with the College of Education, offer mentoring to teacher trainees, and publish in scholarly outreach journals. Outreach for the University of Tennessee mathematics department is loosely defined as any activity that enhances the teaching and learning of mathematics outside the department, in particular in K-12 education and community colleges. The official description of the expectations is included in the companion article written by my department head.

I was hired in the fall of 2000 for one of the new positions. My colleague Reid Davis was hired at the same time for the other position. I brought extensive experience gained while developing outreach programs at the University of Colorado, Boulder. I had worked in several engineering departments for many years as an applied mathematician and produced related publications in the mechanics literature. However, I maintained a deep interest in quality mathematics teaching and felt more at

home when I finally obtained a post in a mathematics department.

The new position at Tennessee offers much freedom within the job parameters, and the opportunity exists to define the role according to the particular strengths and interests of the incumbent. This is one of the first such posts in a research mathematics department in the nation, and it offers much potential for innovation.

Why Outreach?

There are many reasons for mathematics departments to engage in outreach. The state of mathematics education at the K-12 level is important to all college mathematics teachers. It is appropriate that faculty from a major university mathematics department be involved. Outreach to the community is often the source of fruitful collaboration between different departments on campus, and outreach activities lead to greater visibility for a mathematics department. This increased visibility can be part of a valuable recruiting strategy, and outreach plays an important role in attracting new students. Finally, participation by mathematics departments in K-12 and community projects offers valuable opportunities for graduate students to gain beneficial teaching experience.

Challenges

A variety of subtle and interesting challenges have appeared in my new job. In many ways these challenges reflect a clash of cultures. The research mathematician often lives in a specialized culture, while the outreach mathematician must understand and interact with many different cultures. The following paragraphs describe the challenges associated with the education culture, the humanities/liberal arts

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culture, the public school culture, the team research grant culture, the local community culture, and the campus administrative culture.

The kind of outreach work that I do is more common in colleges of education than in colleges of arts and sciences. Because relations between mathematics departments and education schools have often been strained or almost nonexistent, a mathematician feels wary when dealing with mathematics education. Moreover, a mathematician is hesitant to get involved in traditional mathematics education work if departmental colleagues do not value such work and feel that it belongs in the education school.

Outreach work is more of a community-based and sociological endeavor than is mathematics research. Reflecting this difference, scholarly publications in outreach include much description of planning, motivation, outcomes, and reflections on experiences. Faculty from the humanities and liberal arts are well versed in this type of writing. But faculty from mathematics, science, and engineering are a product of a different kind of research culture. We have a different approach to conducting and reporting our research. For example, a mathematician might want to publish in a scholarly journal a report on educational activities. However, the mathematician may lack the background knowledge and be unwilling to spend the time on the literature review required for such a publication.

The main focus of our outreach is in K-12 education, and I am currently paying special attention to elementary and middle schools. Achievement of American middle school students is low, and there are many reasons for this. It is not clear how the problems may be tackled, and the magnitude of the task can be overwhelming. There is a danger of trying to solve all problems at once, which is not possible. Many of the issues are political in nature and are related to school boards and local curriculum on one level and to teacher training and certification on another level. These are all beyond the power of the mathematics faculty member. Furthermore, there is often little enthusiasm within the schools and districts where there is greatest need. Some states have education as a low priority and then try to make up ground by demanding high-stakes testing, which is often opposed to sound pedagogy.

A recent report (TIMMS, 1999) suggests that American schools are often run as businesses which happen to have education as part of their role. My own observation is that education in the school often takes a back seat to school lunches, class photos, flu shots, band practice, etc. Classes are regularly interrupted by public speaker announcements. It is often difficult to arrange class visits because students are going to the zoo or on some other field trip. Mathematics class seems to be a low priority for school administrators. Perhaps

the most frustrating of all is when we make a classroom presentation and the teacher decides to use that time to grade homework rather than participate. What message does that send to the students? This environment is foreign to me, for the schools I attended as a child in Ireland were primarily places of learning.

A major challenge in outreach work is the need to obtain funding. We teachers of mathematics like to study mathematics and do mathematics research, but most of us do not want to be entrepreneurs and administrators: we do not want to spend our time writing grant proposals. Dedicated individuals with few resources can accomplish significant mathematical research, but outreach is a different story. Although one may not need grant money to visit schools, sit on committees, and write articles and reports, often effective outreach work requires large teams of participants. The only way to create these teams is to obtain funding for salary support. Moreover, there are costs associated with organizing events such as teacher workshops and meetings for parents, and grant money is needed to cover these costs.

Another subtle challenge that I faced in developing an outreach program was adapting to the local community. Mathematical or scientific work is usually independent of the surroundings and the community. All that is required is some solitude and occasionally some equipment. Outreach work depends essentially on making contacts in the local community and beyond. Thus, it takes much longer to initiate an outreach project than a traditional mathematical research project. Although traditional research is performed at all times of the day or week, active outreach is restricted to the school hours.

A final point about outreach scholarship is worth noting. Because there is already a body of literature and a community of practitioners in outreach, college and university administrators may have preconceived ideas about what an outreach mathematician should do. However, my primary responsibility is to the mathematics department. As my department sees the role of "outreach mathematician", the word "outreach" is only the descriptive adjective. Tension occurs because the outreach mathematician also needs to satisfy the college as a whole in order to achieve tenure. This observation may help other mathematics departments in developing outreach positions while remaining independent of preconceived outside ideas.

Activities

In this section I describe some concrete activities that I have undertaken as an outreach mathematician. One of the most important of these is a series of classroom presentations that have been described as "model" teaching. These presentations include

game playing and interactive teaching in a manner that is different from what the students usually encounter. This style of teaching brings enthusiasm and content knowledge to the classroom, which act as motivation for the regular teacher. The feedback from these presentations has been very positive. Two important points have to be made here. First, it is critical that the university mathematician enter the classroom as a collaborator and colleague, not for the purpose of “fixing” the teacher or doing a research study. Second, we must make sure that we provide assistance without becoming immersed in a particular school situation. The outreach mathematician is a university faculty member with a faculty role and must not become a special version of a middle or high school teacher.

“Service learning”, a component of some college courses, means that students perform community service, which enhances their own learning in the course (Kraft, 1996). In our lower-level undergraduate courses we offer students the opportunity to assist in local K-12 classrooms. This strengthens our relationship with the teachers and also increases the awareness of outreach among our students. It is hoped that these activities will give us greater visibility in the teaching community and increase our own awareness of K-12 issues. All of this should give us greater credibility if later we wish to speak out on important curricular and pedagogical issues.

Building respect within the department for my role is also important. I have facilitated school visits by my faculty colleagues. The average mathematics faculty member is happy to visit schools occasionally and to reach out with his or her expertise, but not to make the arrangements or to deal with the logistics. The outreach mathematician’s role in facilitating these visits is therefore very welcome. Gaining respect for my work throughout the entire campus is equally important, and dialogue across college boundaries is also greatly enhanced by this new position. Especially important is to foster good relations with the College of Education, which is a natural ally in raising the standards of mathematics teaching.

One of the primary ways to make an impact on K-12 mathematics education is to raise the content knowledge of teachers. We have already presented some seminars and are proposing a series of classes and workshops aimed at teachers from first to eighth grade. It is important not only that these classes contain substantial mathematics content but also that enthusiasm for mathematics is conveyed. Our philosophy that there is a beauty in the conceptual understanding of mathematics must be passed on. This is one area where mathematics faculty can have a very positive outreach role.

In collaboration with the College of Education we have submitted a proposal to the National Science Foundation for a Center for Teaching and Learning. We have also begun to identify some

foundations and corporations that may be able to fund some of our local projects. The optimum use of funds is in the area of personnel costs, as good teachers and visionary facilitators are the keys to the success of our projects. For this reason we hope that we can hire some postdoctoral workers to assist and develop programs. The personal beliefs, enthusiasm, and energy of the outreach facilitators are crucial to progress in these ventures. There is definitely some sense that this work is personality driven.

One important role of an outreach mathematician is that of representing the views of mathematicians in the world of mathematics education. Very often education committees lack adequate representation from the world of mathematics. We cannot complain when decisions are made that do not reflect our views if we have not bothered to take an interest in these matters. It is my intention to represent the mathematics department in several such roles.

The Way Ahead

I strongly believe in the importance of outreach, and I will continue to pursue the activities described in the previous section. Although for the moment this will mostly be at a local level, I hope that what we do at the University of Tennessee can offer insights to other colleges and universities as they develop their own outreach programs. Recent articles (Holland, 1999; Keener, 1999) address many of the issues facing institutions as they try to develop criteria for recognizing faculty participation in outreach. These challenges are common to many institutions across the nation. Here at the University of Tennessee there is senior support for outreach, and this support has now translated into the creation of tenure-track outreach mathematician positions and formal recognition of outreach as a scholarly activity. I look forward to sharing our experience with colleagues around the nation as other mathematics departments begin to undertake similar ventures in outreach.

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