Reflections of a Department Head on Outreach Mathematics

John B. Conway

Several years ago my department committed itself to hiring tenure-track faculty who would be outreach mathematicians, faculty whose scholarly activities would consist of interacting with K–12 mathematics teachers and facilitating the department in its desire to influence the teaching of mathematics in the schools. Last year we hired two such people. In this article I will describe the process by which I and my colleagues brought this about and some of the rewards and difficulties. The companion article contains the reflections of one of our outreach mathematicians.

My purpose in writing this article stems from the same deep-seated belief that led me to advocate hiring outreach mathematicians. The mathematics profession will greatly benefit from having mathematicians involved in K–12 mathematics. I encourage others to join my department in this undertaking.

The University of Tennessee is a land-grant institution, so public service is an integral part of our mission. Our mathematics department has a tradition of involvement with K–12 teachers, starting long before my arrival here as department head in 1990. A point of pride here is that future teachers complete a five-year program, with the first four years spent getting a major in their subject area. So immediately, as a byproduct of our major program, my department is involved in training future teachers. Following a series of NSF (National Science Foundation) grants in the 1960s and 1970s,

the department started an MM (Master's of Mathematics) degree program to improve the mathematical knowledge of K–12 teachers. Because of this same tradition, when I arrived there were two professors (since retired) whose main activities were connected with outreach and education. Though the department did not have faculty who did research in mathematics education, the presence of these two colleagues set the stage for recruiting in outreach.

Another pertinent fact is that our College of Arts & Sciences has a long tradition of commitment to academic outreach. Again, that started as the concept—formulated by more than one dean—of the role of a land-grant university. There were staff people who did outreach. There have always been some faculty in the college who have participated in a serious way in outreach either as a modification of or an addition to their research careers. This aided the department when it approached the dean about hiring outreach mathematicians. Still, hiring untenured faculty who do outreach presented some problems at the college level, as I'll discuss later.

This is a good place to emphasize a distinction between outreach mathematics and mathematics education. Educational research involves discovery of how students learn and how to improve that learning. My outreach mathematicians are not directly involved in research in education, though it would not surprise me if, during the course of their careers, they occasionally do become involved. Rather they are committed to interacting with teachers and influencing the content of what is taught in K–12 mathematics. They are also

John B. Conway is professor of mathematics and head of the mathematics department at the University of Tennessee at Knoxville. His e-mail address is conway@math.utk.edu.

involved in the examination of how future teachers are taught. As mathematicians, we know content. Examination of pedagogy is in the realm of the College of Education.

Why Should a Mathematics Department Become Involved in Outreach?

There is so much criticism of mathematics education in this country. In our calculus classes we all see unprepared students, and K–12 mathematics instruction and curriculum seems a ready focus for blame. In my view, I have met the enemy and he is us. Research mathematicians have for many years divorced themselves from what happens in K–12 mathematics. This means that we cede the entirety of the preparation of future college students to people with limited mathematical expertise and experience. If we want to pluck ripe fruit from the tree, we really should spend some time watering the roots. Some research mathematicians are beginning to influence curriculum and standards. But there continues to be a need for individual mathematics departments to work on the local level.[1]

So I believe that the participation of mathematicians in teacher training and deliberations about K–12 education is crucial. Our participation will ultimately result in better teaching and learning throughout the spectrum of American mathematics.

Persuading My Department

Convincing my department to commit to outreach was easier than one might think. I have a small advantage in that my personal research record inclines my colleagues to listen to what I have to say. Perhaps the history of the department was a factor too. In any case, the vast majority of my colleagues supported recruiting outreach mathematicians (OMs). Yes, there were some objections and many questions. It isn't that we have positions to burn; when there is a vacancy, there is as much jockeying by the various research groups to claim the right to fill it as in any department. But in principle they saw the need for and advantages of becoming involved in outreach. They also clearly bought the need for two OMs, since being a solo trailblazer can be a lonely occupation. Also, a single OM would be more like lip service than a commitment.

On the other hand, there was wide disagreement as to exactly what an outreach mathematician should do. Work with students or teachers? High school, community colleges, or middle school? Should we insist on a Ph.D. in mathematics or admit the possibility of hiring someone with a

---

[1] *Two recent instances of a call for increased outreach involvement are: W. E. Kirwan, Mathematics departments in the 21st century: Role, relevance, and responsibility,* Amer. Math. Monthly **108** *(2001), 1–9; Presidential views: Interview with Hyman Bass,* Notices **48** *(2001), 312–315.*

doctorate in mathematics education? There was debate—a very healthy event. The prevailing opinion was to concentrate on K–12, but there was a divergence of opinion as to whether this should be middle or high school. (A focus on elementary school mathematics had few if any proponents.)

Recruiting

Last year (1999–2000) we conducted our third search to find an outreach mathematician. In our first attempt the administration canceled all searches because of budget difficulties. We had already interviewed two candidates, and the department was equally divided between hiring one of the two and hiring neither. Part of the problem was that the search exposed a lack of departmental focus on some crucial points. Some basic questions had not been answered. The total newness of the undertaking meant we had no available road map, but I'll take the load of responsibility for not better vetting the concept of outreach.

Before we started the second search, we decided to open the pool to people with an Ed.D., provided they had a master's in mathematics. We had not done this the first time around and had found the pool of applicants too limited. The ideal way to start such a venture would be to recruit an associate or full professor to do outreach, but budgetary realities precluded this. The rub is that few people get a Ph.D. in mathematics with the intention of doing outreach, so restricting the search to Ph.D.'s in mathematics produced an unusual collection of candidates, few of whom seemed suitable.

In the second search we interviewed several candidates, made an offer, and got our first choice—someone with a Ph.D. in mathematics. He came but, for many reasons, did not work out. Why? Here, like in a divorce, one will get a different perspective depending on whom one talks to. One difficulty was that the OM was alone. Another was that the department's stated expectations lacked focus: even though the first search had revealed weaknesses, we hadn't formulated anything that gave the OM and the faculty a clear idea of the nature of the job. Still another was that the department had not properly laid the foundation with the College of Education. When the OM's desire to do research in mathematics education led him to give a graduate seminar in it, all the difficulties converged, and what had been a wart exploded into an open sore. Giving mathematics credit for a course in education was the realization of the worst fears of many mathematics faculty. Our College of Education colleagues were truly incensed. They became firm believers in the mathematics department's ultimate aim of taking over mathematics education.

The third time worked like a charm. The search produced three good candidates. We hired two

assistant professors, both with Ph.D.'s in mathematics. It is pertinent, however, to underline that neither of our outreach mathematicians is fresh from graduate school. Both have several years' teaching experience. One, who wrote the companion to this piece, had worked as an instructor doing outreach at the University of Colorado. The other had less experience, though he had given some summer workshops funded by Eisenhower grants at the University of Tennessee and had successfully organized our first statewide mathematics contest.

Though several candidates we interviewed in the last two searches had doctorates in education, my faculty did not react positively to them. Many of my colleagues had strong doubts that these candidates could do the range of teaching that was expected. This last point may be a cultural problem, but for me it is essential that any outreach mathematician have the trust and full respect of the rest of the faculty. Someone who teaches only lower-division courses would be viewed as a second-class faculty member. In addition, we have a graduate degree aimed at teachers, and teaching courses in the program calls for some mathematical expertise. I bow to my colleagues' collective wisdom here.

Defining the Position

Defining the duties of an outreach mathematician is a dynamic process. I am a person who likes to have matters and rules and processes tied down, neatly wrapped, and fixed. I don't like dynamic processes in running a department. But in this case it's the best course. I think this is one of those situations where if one waited until one answered all the questions and dotted all the i's, defining the duties of an outreach mathematician would never get done. On the other hand, when we recruit research mathematicians, we specify only in the broadest of terms the kind of research we expect them to do. Nevertheless, the description of the expectations of an outreach mathematician is somewhat more ambiguous. But this ambiguity has a virtue. Let the people define themselves.

The department did adopt a formal statement of expectations for an outreach mathematician, modeled after a similar document we had to formulate in connection with our university entering into a posttenure review procedure. The accompanying sidebar contains the guts of that statement as it differs from what is expected of other mathematics faculty.

Originally there was no requirement of publishing other than what appears in the penultimate paragraph. My dean objected to this. My faculty was not so interested in publishing as in influencing mathematics teaching in the schools. But the dean's point was that the original draft requirements made little distinction between an outreach mathematician and various staff hired by the university and doing outreach; to get tenure one must contribute to knowledge on a broad front. She is right on this point.

I was a bit surprised to discover that many outlets for outreach publishing exist. So the publishing stipulation has not been an onerous requirement for either me or my outreach mathematicians. Many mathematicians have a skepticism about research in mathematics education. All seem to have their favorite example of some nonsensical research in mathematics education. We should realize, however, that this is an unthinking attitude. Certainly we understand the laws of logic sufficiently to know that the existence of examples does not prove a universal truth. Also, I know a few examples of mathematics research papers whose quiet death in a darkened mathematics department would have benefitted the world far more greatly than their publication.

Anything can profit from study. Can anyone possibly believe that all ways of teaching middle school mathematics are equally efficacious? In addition, if the research mathematics community is to become involved with school mathematics, as I think it should, certainly a record of the experiences, successes, and failures of those involved will have value. Outreach publication has merit.

In the mathematics culture it might seem unusual to require the outreach mathematicians to get external funding. In mathematics, unlike the natural sciences, one can indeed do the work without external funding. But being an effective outreach mathematician—one who conducts workshops and reform and who has a wide impact—requires funding. Thus an outreach mathematician is expected to get funding, although a research mathematician is not.

The College of Education and Outreach

Some people in my College of Education (COE) have been enthusiastic supporters. Others have felt, apparently, that there is a threat to their turf. So I, as department head, try to soothe and reassure those who feel a threat by averring that we are interested only in content questions and want to cooperate. I tell them that we are their allies and seek theaters of cooperation.

We had someone from the COE on our search committee for an outreach mathematician, and this was a good bridge. Not surprisingly, that faculty member is one of the enthusiastic supporters of outreach mathematics. So the lesson here is one that reiterates a basic fact of human behavior when one engages in activity that affects people besides one's self: the more informed people are, the higher their comfort level. The more they become involved, the more they become enthusiastic supporters. People in the COE are vital, significant contributors to any conceivable

project for improving school mathematics. We should not ignore them or try to bypass them; rather, we should incorporate them into our projects.

The Future

I see many encouraging developments connected with our program in outreach mathematics. Our outreach mathematicians are making good contacts, and we are getting good feedback from a variety of sources. They are learning some background in mathematics education and becoming acquainted with people on and off campus who have a role to play in any reform. They have already begun what I feel will be an extremely important part of their job: facilitating the involvement of the rest of the department in K–12 mathematics. There are more demands for the time of our outreach mathematicians than they can accommodate. I constantly worry about them spreading themselves too thinly and I periodically raise a cautionary note.

I will have a more complete picture of the state of outreach in a few years. In the meantime, I invite you to contemplate outreach at your own institution. The road is not smooth, straight, or well posted. There are risks, but the payoff for success is enormous.