

Undergraduate mathematics majors: We need more of them

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Editor's Note: The following article is the second part of a two-part article. The first part appeared in the Spring, 2002 issue of the MER Newsletter.

Précis of Part 1

With the goal of increasing the number of mathematics majors, readers were challenged to confront the question of whether mathematics departments function primarily as service departments or as professional schools, as engineering departments do, for example. Mathematics faculty were advised on practical ways to counsel students to think of being a math major as preparing for a career as a professional mathematician.

Now that we have decided that there is a need and a desire to increase the number of mathematics majors, we should also ask: why would a student choose to major in mathematics? I am embarrassed to say that this is not a question that I have asked the many mathematics majors that I have known over the years. I can give my impressions as to why some of the students have chosen this major.

1. There are students who have chosen mathematics for the same reason that we have. It was interesting.
2. The student has planned to be a high school mathematics teacher.
3. The student started in engineering or some other science major and the material was not to his/her liking. This major required mathematics and since the student has already taken some mathematics, a major in mathematics is a possibility. Furthermore, mathematics is viewed as a technical degree with more job prospects than a non-technical degree.
4. The student met a mathematics professor who was inspiring.

5. Since mathematics is a liberal arts degree, the student has more freedom in selecting a course of study, while still selecting a technical major.
6. Mathematics keeps one's options open. An undergraduate degree in mathematics, together with a supporting minor, can gain entrance to a graduate degree program or a professional degree program (law, medicine, MBA).
7. Mathematics is often viewed as a hard subject. There is a sense of pride in being a mathematics major.

It would be helpful to better understand the reasons why students choose mathematics for their major to aid us in developing programs that would increase the number of mathematics majors.

The many benefits to increasing the number of majors in a department include: Large numbers of majors give a sense of vitality to an undergraduate program. Advanced courses are well populated, making it easier to run the advanced courses. Having lots of students in advanced classes makes it more comfortable for those students. There are peers with whom to discuss problem sets. It makes for a more lively class. The university administration will also take notice of this increased activity and increased resources will be allocated to the department.

There are also some monetary gains that will eventually come to the department. Periodically we hear about someone who has contributed large sums of money to a

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university, a department. Rarely do we hear about those funds being directed specifically towards a mathematics department. There are loads of engineers and chemists who graduate each year from our universities. Compare this to the relatively small number of mathematics majors. When we see more students majoring in mathematics and choosing the business and engineering world instead, we will see more of these individuals wishing to contribute back to the department. It really is in our best interest to have more mathematics majors.

Who ultimately has the responsibility to increase the number of mathematics majors? And once a student has decided to major in mathematics, what can be done to keep this student in the major? I believe that the current situation is rather a hit-and-miss affair. A few students are attracted to the subject and for a variety of reasons stick with the major. This is much too important a topic just to be left to chance. I would like to suggest that we have a very natural mechanism for attracting students to the deeper study of mathematics. It is our calculus classes. Every science and engineering major has to go through our calculus classes, and it is here that I suggest that we consider adding a component to attract students to our major.

When I teach a mathematics class, I am always on the lookout for interesting applications of mathematics and new career opportunities to pass on to the student. *Science*, the weekly publication of the American Association for the Advancement of Science is a great source of articles about careers and applications of mathematics. Geared to the general layman, the articles are comprehensible to the students in the calculus class. When I find an article, or a job announcement, I give copies to the student, and make a few remarks about the article. I look for short articles, rather than in-depth articles, that present the ideas in a comprehensible fashion, and for human interest articles about recent achievements of mathematical scientists. Some recent examples of articles I have handed out to students are: *Death by the Numbers*, *The Art of the Orbit*, *Bioinformatics in the Information Age*, *The Quandary of Quantum Information*.

It would be very useful if a periodical dedicated to helping teachers of calculus recruit students to the study of mathematics were published under the auspices of one or more organizations. This periodical might contain interesting applications of calculus, career opportunities, problems that mathematical scientists are addressing, information about graduate programs, summer internship information, ideas for REU (Research Experiences for Undergraduates) projects, new scientific endeavors that intimately use mathematics, like bioinformatics.

Recruiting students to the study of mathematics is one thing, keeping them is another. We need mechanisms to help students stay in the major, and to help faculty in

these efforts.

At the departmental level I believe that there should be an office, with a staff, specifically dedicated to the undergraduate mathematics major. This office would be responsible for keeping track of the majors, *including keeping track of these students after they graduate and leave the university*. Former students can be an important source of employment opportunities for future students. Besides bookkeeping chores, this office would also have the responsibility of organizing the professional development activities that are so vital to students' careers. Resumé writing and interviewing skills workshops, the posting of summer internships, regular lectures aimed at undergraduates, graduate school opportunities, opportunities for employment in the department and the university. This office would have the responsibility of turning the undergraduate mathematics major into a marketable and professional degree.

The national organizations, AMS and MAA, could do more to increase the attractiveness of the undergraduate mathematics major. There are very few activities for undergraduates at regional and national meetings. In particular, very few recruiters from industry show up at our national meetings. Certainly, there are large numbers of students who receive a master's degree in mathematics and will not pursue a Ph.D. Besides the bachelor's degree recipients, these master's degree students are also looking for employment. Recruiters should be at our national meetings.

In closing, I would like to return to the theme at the very beginning of this article. What is my function as a teacher of mathematics, in particular, as a teacher of calculus? If that function is simply to present the material in some impersonal manner, then I fear for our profession and for our departments. Calculus is our bread and butter. Calculus provides employment for our graduate students and it should give us the opportunity to showcase the beauty and utility of mathematics. Recently I saw an advertisement for calculus lectures on video. I believe that the time will come when a video calculus course would present the material in a manner more interesting and relevant than any of us could possibly do, since technology could be incorporated in clever ways to exemplify the ideas. If that comes to pass, why should a university hire us to give boring and impersonal lectures? What a video cannot presently do is to look into a student's eyes and say:

"You are an amazing student! I am very impressed by your question, by your solution, by your remarks. Have you thought of becoming a mathematics major? I recently heard of a summer internship opportunity that would be perfect for you. Stop by my office today so that I can tell you about it." ■