

into trouble with your department. The safest policy is not to tutor students at your institution at all. The point is that you are already being paid a salary by your school to educate the students at that school. To further accept tutoring money from the students constitutes double dipping.

Even having to recommend tutors can put you in a position of conflict of interest. Most math departments maintain a list of qualified people who can tutor for math courses. This is done as a service for the students, but it is also done as a service for the faculty. When a student asks you about tutors, send that student to the departmental office and the official list. It really is the best policy.

2.19 On Being a TA

Being a Teaching Assistant (TA) provides some experience in being a teacher. But it does not provide much, and the background that it provides can be misleading.

When you are a graduate TA at a big state university, you are probably not your own boss. In most cases you work, alongside several other TAs, for some professor who is delivering lectures to a large audience. On alternate days, the class will be broken up into smaller "quiz sections" or "problem sessions", and you will be asked to teach one or more of these. You will also be asked to help with grading, with other assigned activities, and (primarily) you will be asked to do what you are told.

Being told what to do lifts a great deal of responsibility from your shoulders. But this also means that a TA has never really taught. You've had some experience standing in front of a group, organizing your thoughts, answering questions, developing blackboard technique, and so forth. But you will have never made up an exam, written a syllabus, designed a course, given a course grade, or any of the dozens of other activities that figure significantly in the teaching process.

However, if you have never been a TA (either because in graduate school you were on a fellowship that had no formal duties attached to it, or perhaps because you were educated in another country), do not despair. At least you are entering this profession with possibly fewer prejudices than are held by those who have stood as a TA before a hostile audience in this country. Perhaps reading this book will provide you with better information and a better outlook than having served as a TA under a professor who doesn't even care about good teaching.

Let me put an amelioratory note here. Some professors are well aware of the down side of being a TA and attempt to compensate for it. They give their TAs more responsibility. For instance, such a professor might write the first midterm exam for a class himself and then let the TAs write subsequent midterms (under close supervision). This is positive psychological reinforcement for the TAs, and good experience for them as well. Likewise, the TAs can be allowed to set the curve for grading (under supervision) and to perform the other ordinary functions of the instructor. The professor is not being lazy here. Rather, he probably has to expend more effort than if he were doing these tasks solo. But it provides

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awfully good experience for the graduate student TA.

At some schools, the TA is more autonomous. It is possible that the TA will be a free-standing teacher, creating his own exams and constructing his own grading system. If this description applies to you, then this section of the book does not. But the rest of the book does, and you may benefit from reading it.

For more information about the day-to-day duties of being a Teaching Assistant, see Section 2.14.

2.20 Advising, Letters of Recommendation, and Graduate School

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Of course a substantial amount of your undergraduate teaching duties will consist of classroom contact hours and office hours. But that is not the whole enchilada. If you are a senior member of the department, then you may be asked to help with undergraduate advising. Apart from your official duties as an advisor, students may ask you for advice about their curriculum or about graduate school. And you will be asked to write letters of recommendation. (As you read on, refer to Section 4.9 about Advice and Consent.)

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You are well qualified—indeed nobody is better qualified—to give your undergraduate students advice on what courses to take, or on how to prepare for various mathematical careers, or on how to select a graduate program. If a student wants to be an actuary, then one course of action is appropriate. If instead the student wants to be a software engineer then different advice would be the order of the day. Even if the conversation wanders beyond your area of expertise, you can surely direct the student to another faculty member, or to a guidance counselor, who can help. Too many undergraduates get the bulk of their advice from fellow students. Sadly, that advice is often based largely on rumor, innuendo, and misinformation. You really perform a great service when you take the time to provide an undergraduate student with expert advice.

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Of course the advice you give students may be no better than what they can glean from their peers if you do not take the trouble to find out what you are talking about. Before you tell students to take this class rather than that, or this flavor of the math major rather than that, or to take an incomplete rather than a drop, *find out what the rules are*. Become acquainted with the requirements for the math major and minor. What are the rules for drops? For incompletes? What are the mathematics requirements for the physics, engineering, chemistry, and other majors? You can do a lot of damage if you offer advice without knowing whereof you speak.

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Most undergraduate students don't have a clue about graduate school. They don't know how one gets in, how one pays for it, how long it takes, what it entails, what a Ph.D. is, how a Ph.D. differs from a Masters degree, what is involved in writing a thesis, and so forth. In general, their parents and their friends will know even less than they do. So, again, you perform a great service if you are willing to share your expertise. Once a student knows that he wants to get an advanced degree, he will need some real help in choosing a school

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5.1 The Role of the University Professor

A distinguished mathematician—well-known to us all—joined the University of Chicago Mathematics Department, as an Assistant Professor, in the early 1960s. As he was settling into his office, the chairman came by and chatted him up for a few minutes. When the chair departed, he wagged his finger at the new faculty member and said, “Remember: Our job is proving theorems.”

In retrospect, one wonders why the chairman felt moved to make such a statement. Chicago is and was one of the pre-eminent mathematics departments in the country. In the early 1960s, the teaching reform movement was still a twinkle in somebody’s eye. Teaching evaluations had not yet been invented. Everyone agreed with Paul Halmos that proving theorems was not just the main thing—it was the only thing.¹

If we were to make a sequel to this movie, filmed in 1999, then the scene (at least at many universities, and especially public institutions) would be a bit different. The chairman would still drop by to chat up the new faculty member. He would remind the newcomer that he was hired for his ability with mathematics, and for his achievements in research. (Proving theorems, and learning new mathematics, is the highest and finest thing that we do. This fact has not changed, and I hope it never will.) But as the chairman departs, he will now waggle his finger and say, “But don’t forget: It’s teaching that pays the bills around here. Undergraduates come here expecting to be taught. And parents pay tuition because they want their children to be educated. I expect you to do a creditable job with your teaching. And I don’t want to hear any complaints from students or parents. If I do, you will be making my job more difficult, and I in turn will make your *life* more difficult. A word to the wise should be sufficient.”

Again, I am not trying to sound sappy. And I am also not endeavoring to sound draconian. If you are new to the mathematics profession, then you may as well know what sort of world we now inhabit. You have a choice: You can prove the Riemann hypothesis or you can learn how to teach.

If you have been in the profession for a while, and have never given any thought to teaching, then perhaps it is time you had better do so. You no doubt have your own ideas about the subject, but perhaps viewing the ideas presented here will give you food for thought.

My own experience is that my teaching meshes rather nicely with my research. I’ve had good ideas (for a research problem) while preparing a calculus class, and I’ve gotten inspiration for my calculus class from serious mathematics that I was working on. I suppose that this is the way it is supposed to be, and I believe that a part of the reason that these different facets of my professional life interact so well is that I am open to such interaction. I encourage you to foster this symbiosis in your own life.

¹Personal communication.

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5.2 Closing Thoughts

Sometimes the easiest way out, when we are faced with some difficult or distasteful task to perform, is to resort to cowardice. We are all guilty of this sort of avoidance. At one time or another we have all lied or engaged in subterfuge to avoid unpleasantries.

Our students, of course, suffer from their own shortcomings. One of my colleagues had a student knock on his door and ask for some help with calculus. The professor said, "I haven't seen you in class for three weeks. Why do you come to me now?" The student replied that he didn't need to go to class—he had the book. "Well, do you read the book?" intoned the impatient professor. The student replied, "Well, I could."

What are you going to do? I would tell the student that when he wanted to have a serious conversation he should phone me up for an appointment. Until then, he should not darken my doorstep.

I do not wish to dwell here on human frailties. But I think that the method of teaching that many of us use—and I have been guilty of this to a degree with certain classes that I really did not want to be teaching—is a form of cowardice. We just skulk into the room, write the words on the board, and convey with body language and voice and attitude that we are not interested in questions or in much of anything else connected with this class. Then we turn tail and skulk out of the room. I was once told (tongue-in-cheek, I think) that the secret to success in undergraduate teaching is, "Never let a student get between you and the door." Not an admirable attitude, but one that many of us have held from time to time.

How to Teach Mathematics has been an effort to fight this form of cowardice, both in myself and in others. Teaching can be rewarding, useful, and fun. To make it so does not require an enormous investment of time or effort. But it does require that you have a proper attitude and that you be conscious of the pitfalls. It does require being sufficiently well prepared in class so that you can concentrate on the *act* of teaching, rather than on the epsilons. And it requires a commitment.

We must believe that being a good teacher is something worth achieving. We must provide some peer support to each other to bring about this necessary positive attitude toward teaching. The last thing I want is for mathematicians to spend all day in the coffee room debating the latest pedagogical techniques being promulgated by some well-meaning educational theorist. I want to see mathematicians learning and creating mathematics and sharing it with others. But those others should include undergraduates. That is what teaching is about.