

We can better prepare students for success in graduate school and beyond by making formal instruction in general professional skills a standard part of graduate training programs.

Survival Skills for Graduate School and Beyond

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Part of our responsibility toward graduate students is to provide them with a strong background in their field and to teach them how to design and carry out experiments. If, however, we are to ensure their success in graduate school and beyond, this is not enough. Students must also acquire many other “survival skills”—skills such as how to communicate their ideas and results, obtain jobs and funding, and attract students and staff (Bloom, 1992; Bird, 1994; National Academy of Sciences, 1995). In developing mechanisms for providing this training, faculty must make two key assumptions: one concerning the nature of the students’ backgrounds when they enter the program, and the other regarding what awaits them when they leave. If the assumptions now being made are not correct, we may need to consider changing the nature of doctoral training.

Who are we training, and where do they go on graduation? A cursory examination of graduate training programs today suggests that doctoral students in the United States are a very heterogeneous group. Graduate school is no longer the exclusive province of native-born, unmarried, 22-year-old white males; many entering graduate students now are women, members of underrepresented minority groups, or students for whom English is not their native language. In addition, whereas it once may have been reasonable to assume that most doctoral students would secure tenure-stream positions at research universities soon after the completion of their dissertation, this is no longer the case.

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Among the students who received their doctoral degree in science and engineering in 1983–1986, only 43 percent are now in academia, a figure that includes both tenure-stream and non-tenure-stream positions in four-year colleges, universities, and medical schools (National Academy of Sciences, 1995). Although accurate statistics are hard to come by, one has the impression that the competition for many types of jobs has increased; certainly it often is very high. A single advertisement for a faculty position often is reported to generate some 250 responses, and notices of jobs in industry may result in a similar number of inquiries. Moreover, getting a job is only the beginning of the competitions that must be won.

In short, many of the students entering graduate school are unfamiliar with the culture of an American university, its jargon, and its conventions (Etzkowitz, Kemelgor, Neuschatz, and Uzzi, 1992). They may find themselves without peers to whom they can easily relate; they may have responsibilities to others that place strains on their time as well as their finances; and their interests, as well as the realities of the job market, may dictate that they will take a very different career track than that of their principal role model, the tenure-stream faculty member at a research university (National Academy of Sciences, 1995; Varmus, 1995). Thus, although there has always been a need for survival skills training, we believe that the recent changes in student populations and job opportunities dictate that even more attention should be paid to providing trainees with adequate instruction in these abilities.

The survival skills needed to succeed in graduate school and beyond can be divided into four categories: (1) basic skills, including how to be a successful graduate student; (2) communication skills, specifically, being able to convey the results of one's work through publications and oral presentations; (3) job skills, for finding and maintaining employment; and (4) advanced skills, including teaching, grant writing, and personnel management. Integral to each of these skills is a core survival skill, the ability to behave as a responsible professional. We base our recommendations concerning survival skills on our experiences with graduate students, particularly through our co-directorship of the University of Pittsburgh's Survival Skills and Ethics Program.

Basic Skills: Surviving Graduate School

Learning to Create

When asked what the evidence was for a particular statement, the student said simply, "It's written in the textbook."

Although on the surface the transition from college to graduate school seems similar to the many steps in rank that have come before it, this transition is

vastly different and requires a significant shift in attitude. To paraphrase Dr. Indira Nair of Carnegie-Mellon University: Throughout the pre-college and undergraduate years, students are primarily “consumers” of knowledge; however, during their graduate training, individuals are expected gradually to assume the role of “creators” of new knowledge. Thus, their tasks as graduate students are more similar to those of a practitioner than to those of traditional students: They must go beyond what is known, asking questions, seeking answers, and disseminating their results.

Furthermore, as part of their new role, graduate students must advance past the study skills that may have served them well in high school and college. They must learn to question assumptions and critically evaluate the literature rather than just memorize facts. In addition, graduate students must recognize that they are now, more than ever, responsible for the development of their own career. The attitude and motivation they bring to this process is crucial. Again, what is necessary is significantly different from what was required of them as undergraduates. The task is no longer to work hard enough to complete an externally imposed assignment and get a good grade. Graduate students need to realize that to become successful professionals, in many ways they must begin to set their own “assignments.” Thus, they themselves, not the system, must push them to excel.

Think Ahead and Plan Backwards

A fifth-year student in the biomedical sciences said, “I can’t even begin to think about a postdoc until after I’m done with my thesis. I was planning on taking a month off then anyway—that should give me plenty of time.”

Graduate school is a means to an end, not the end itself. Yet, many graduate students spend little time thinking about where they will be five to ten years after completion of their degree. High school led to college and college led to graduate school without too much independent planning. Traditionally, the goals seemed obvious—usually a tenure-track position at the research university—and the route seemed straightforward, too. Moreover, advisors, committees, and graduate requirements provided a safety net.

The graduate students of today need to confront the future more actively. They must begin by understanding the changes in career options, not in the negative sense of a “Ph.D. glut” but in the positive sense of broadened opportunities. They must come to appreciate the increased competition for jobs and resources. They must begin to set achievable long-term goals. Then, with their goals in mind, students should plan backwards—that is, plot out what they will need to learn and do in order to obtain and succeed in the position they desire, setting milestones to track their progress on the way. Indeed, planning with their goals in mind is an essential first step in taking an active role to ensure that their training program provides them with relevant and efficient preparation.

Choosing an Advisor

One day a graduate student's advisor told her that he was going out of town for a week and that when he returned he expected her to be gone from his lab. When she expressed shock and indicated that she hadn't been warned of any problems during the two years she'd been in his lab, her advisor indicated that this was her own fault because she never asked if there were any problems. The student chose not to continue graduate studies.

One of the first tasks that a graduate student faces is frequently one of the most critical—choosing an advisor. New graduate students may not realize the variables involved, the choices they have, or what they can (and cannot) expect from a good advisor. In addition to talking to prospective faculty advisors, students also need to talk to present or former students of the faculty to find out what their experiences have been.

Students need to be certain that their advisors are suitable and have a temperament that is compatible with their own. All too often students are willing to pursue work with a suboptimal advisor on the assumption that they can tough it out for those five or so years of graduate study. Students need to recognize that their advisor will be an influential part of their career for many years after the receipt of their degree. Letters of recommendation from one's advisor are frequently required not just for obtaining employment, but for securing grants and promotions as well. Thus, students should choose an advisor with the understanding that they will need to maintain a long-term relationship with that individual.

As part of the process of selecting an advisor, the trainee should take into consideration some critical variables, variables that may not be known to most incoming graduate students. These variables include the role of the student in generating research questions; ownership of ideas and authorship on publications; financial support for living expenses and travel to professional meetings; the amount of time to be spent on research; and the definition of an adequate doctoral dissertation. Investigating these issues at the outset helps to safeguard the trainee by protecting the student from becoming invested in a research project, only to learn that their advisor's policies are not compatible with their needs, with the result of being forced to accept irksome policies or abandon their work to date on a project.

Finally, with regard to choosing an advisor, students need to realize that no one person can satisfy all of their educational needs. For this reason, faculty should encourage and students should seek to build a group of mentors who can cumulatively address the needs of the trainee. This tactic may be particularly important for trainees who come from underrepresented populations and are not able to find adequate role models among the individuals in their field.

Developing a Plan of Study

"I've been told that the best plan is to complete my thesis research before I hold my first committee meeting," said the student with some conviction. "That way

they won't be able to ask me to do something different from what I've planned, and I'll get out of here quicker."

The next step is to develop and get approved a plan for studies—whether such a plan is required or not. This plan should outline the courses that the individual will take and the examinations that are part of the milestones that students must pass to receive their degree. We encourage students to include the dates on which they will have completed each of these steps, setting interim deadlines as an aid to meeting those larger milestones that may be several years away. This also provides benchmarks for progress so that students can make adjustments along the way if necessary. In preparing the plan of study, students would do well to remember two principles: First, not all the rules that are written down need to be followed; second, not all the rules that must be followed are written down. Reading the graduate handbook is not enough. Students must talk with their graduate program's academic advisor, their own research advisor, and other students in the program.

Selecting a Dissertation Topic

"I'm interested in forest ecology," stated the graduate applicant. "I know that there aren't any faculty members here in that area, but that's okay. I already have experience in the field. All I want is a place to do my work and get a degree."

A thesis topic must deal with the testing of a hypothesis of interest to the student, the advisor, and a significant number of people in the field. Students will not be able to do their best work unless they find the issues they are studying to be compelling; advisors will not be able to provide adequate oversight unless the topic is of interest to them, too; and the final product will attract little attention if the matter at hand is not of interest to others in the field. Selecting a thesis that is driven by a hypothesis rather than being simply descriptive adds a further dimension to the level of interest it will generate. But one must take care not to set out to prove their hypothesis, but merely to test it; indeed, one should actually endeavor to disprove the hypothesis, tentatively accepting it when all efforts to disprove it have failed.

In selecting a topic for their research, students also need to consider the feasibility of the project (with regard to time and resources, available expertise, budget, and equipment). Students tend to propose to do too much for their dissertation, but this is the time to be conservative. There will be time to be more expansive after the plan has been approved. After all, no one has ever failed their thesis defense because they accomplished too much! Finally, students should choose a project that will be interesting enough to merit a Ph.D., whether the experiment "works" or not. That is, obtaining a degree should not be contingent on getting a certain result.

Establishing and Using an Advising Committee

When advised that she should pick her thesis committee carefully, the student told us that this was not an issue at her institution, since committees were established for the students. When asked on what basis the committees were organized, she indicated that it seemed as though assignments were used to equalize the responsibilities of faculty members, since the faculty who were selected frequently had no students of their own and did little research. She was surprised to learn that this was not standard practice.

At some point in their graduate training, students must establish an advising committee. Sometimes this does not occur until it is time to propose a thesis topic, but we encourage students to form their committee within the first few weeks of graduate school. The committee can be modified as the student's interests change. In the meantime it provides a range of advice, the initial kernel of a professional network, a forum for informal presentations and discussions, and protection against the occasional overbearing advisor. Once the committee is formed, the students should provide members with regular progress reports and should call meetings every six months or so.

Communication Skills

Frequently, graduate students misjudge the importance of writing, speaking, and networking skills to the development of their career. Many students enter a research-oriented field because they are much more comfortable working with objects and data than they are with other people and descriptive prose. Yet communication skills are essential for researchers. Researchers must be able to communicate effectively with colleagues, professionals in other fields, policymakers, and the lay public. The need for communication skills has recently been underscored by documents such as *Reshaping the Graduate Education of Scientists and Engineers* (National Academy of Sciences, 1995), in which leaders from industry cite the importance of researchers being able to communicate their results and interact effectively with nontechnical professionals.

Written Communication

The student was surprised to learn that he would not get paid for publishing a research article. Moreover, when it was explained that he might even have to pay page charges, he was incredulous.

Frequently, students (and faculty) do not enjoy writing. They may not understand their responsibilities with regard to publishing, the conventions of writing technical documents, or even what the peer-review process entails. Yet, the ability to communicate effectively in writing is an extremely important skill, one that is often central to advancement as a professional. In addition to learning how to improve the quality of their writing, students also need to learn about the con-

ventions of writing for publication, including how to determine authorship, select an appropriate journal for their manuscript, and deal with reviewers' comments.

Oral Communication

After hearing us emphasize the importance of preparing slides that were readily visible from even the back of an auditorium, two students approached us. "Is what you said about designing slides really correct?" one of them asked. The other then commented, "We were just at an all-day symposium in which you couldn't read even half of the slides!"

Graduate students need to develop their oral communication skills, as a variety of types of presentations will be required of them in their career. Not only may they be called upon to present their research and ideas in seminars to colleagues, but they also need to be able to convey the importance and implications of their work to professionals in other fields, and to lay audiences and policymakers. Moreover, in addition to formal presentations, many informal oral communications are required of successful professionals. The ability to discuss one's work informally with another individual may be even more essential to one's professional success than skill at giving a formal research talk.

Language Skills

An international student came in one day to say that he had been unable to find one commonly used word in his Russian-English dictionary. The word was *gunnabe*, as in "It's gunnabe difficult to solve this problem."

Oral communication is a particular problem for many students who are not native speakers of English. Frequently, students from outside the United States associate with individuals from their native country while abroad. This is easy to understand—in a foreign land, it is comforting to have the camaraderie of individuals who speak your language and come from the same background. Unfortunately, however, we have actually witnessed students' proficiency in English decline over the course of their studies because they associated almost entirely with individuals from their native land and thus had limited opportunities to practice their English. Therefore, visiting scholars need to make an effort to interact daily with native speakers of English. Being able to speak the language is absolutely essential to receive the most benefit from their training program and the opportunity for networking it affords.

Networking

"I can't go to the special reception for people interested in wetlands conservation," said a graduate student who was attending his first professional meeting.

“I already promised my labmates that I’d go drinking with them. Besides, I hate going to events where I don’t know anyone.”

For most students, graduate school represents the first real push to develop their professional network. Certainly the most immediate need students will have for a network comes when they are applying for positions. They will need to have cultivated relationships with faculty who will be able to provide strong letters of recommendation—but the need does not end with the acquisition of employment. Students will also need letters to get promoted, to obtain funding, and so forth. The time to begin developing a network is not at the point one is required to submit letters of recommendation. That is, students should immediately begin to build their network.

Graduate students often do not realize how critical a strong network can be in the development of their career. Even if the importance of networking is brought to their attention, very junior people may think it a rather cynical and distasteful perspective on the realities of professional life. Nevertheless, the need exists, and one of the techniques that students must learn if they are to be successful is the ability to network and to promote themselves. Moreover, a strong network can be one of the joys of professional life: A worldwide network of colleagues can be a source of intellectual and moral support as well as friendship.

Job Skills

Considering a Range of Options

At the start of our workshops on career planning, we usually ask participants where they hope to be in a few years. The majority of graduate students and postdoctoral fellows at research-oriented universities tell us that they want a tenure-stream faculty position at a similar institution.

Traditionally, most students in doctoral programs set their sights on obtaining a tenure-stream position at a research-oriented university. Despite the decline over the past decades in the availability of such positions (National Academy of Sciences, 1995), many faculty still encourage their students to seek such positions (Zigmond, 1996). Students’ desire for such positions may be partially due to limited information about and role models on careers outside of academia. Students need to investigate actively the broad range of positions that are available to them and actively seek role models and mentors outside of academia.

Applying for a Job

The applicant had no idea how to prepare for a job interview, and it showed. When asked how much space or start-up money he would need, he said that he

had no idea. When asked what salary he would expect, he thought for a while and then replied that his postdoctoral stipend was \$21,000 and he would like to make at least that much as an assistant professor.

Students must develop an understanding of how to apply and interview for positions. This means learning how to create a résumé or curriculum vitae (which includes knowing that there is a difference!), write a statement of interests, get letters of recommendation, prepare for interviews, and conduct oneself during an interview. Perhaps one of the most surprising discoveries to students is learning that they should be interviewing their prospective employer as well as being interviewed by them.

Advanced Skills

A research associate submitted his first grant application to the National Institutes of Health. He attached his full curriculum vitae in place of the standard two-page biographical sketch, included a thirty-one page research plan despite the twenty-five page limit, provided no budget justification, and attached the table of contents at the end of the proposal. When it was pointed out that there were hardly any guidelines that he had actually followed, he said: "I never read instructions. And besides, those are just some bureaucrat's recommendations." His application was not funded.

Depending on what position the trainee eventually hopes to obtain, development of certain additional skills may be essential. Students can develop skills in teaching by providing an occasional lecture or running a course at their institution, a community college, or other such venue. Students should invite others to attend their lectures and provide feedback. They also should assemble lecture outlines, syllabi, and teaching evaluations into a portfolio to be used later in their job search. Students also can take part in workshops offered by their local faculty development office.

The development of grant-writing skills can begin upon entry to graduate school. Students may first try their hand at applying for a fellowship. In later years, they might write a research grant or, at the least, assist someone else who is writing such an application.

Supervisory skills can be developed starting with the supervision of a high school or undergraduate student researcher, work-study students, or laboratory aides. It is never too early for students to start mentoring. They can begin by mentoring high school students, undergraduates, or even fellow graduate students.

Responsible Conduct

"Why don't we just send our research article to a couple of journals at the same time?" the student asked. "Then publish it in whichever one accepts it first."

Ethical behavior is essential to the research enterprise, and as a professional in training or in practice, one must adhere to standards for responsible conduct of research. What is ethical is not always obvious, however. Standards of responsible conduct for practitioners in a discipline often derive from a combination of values central to that profession and conventions that that field has adopted. Thus, individuals need to make a concerted effort to determine what the rules are and then to follow them in their daily practice.

Knowledge of what is acceptable conduct is not enough. One must have a system for resolving conflicts that arise when needs or obligations conflict, thus creating an ethical dilemma. In such situations, one frequently must make a hard decision between two or more imperfect solutions. It is essential that students gain practice in making such decisions through the study of cases and discussion of scenarios.

Survival of the Fittest: An Unworthy Approach to Graduate Education

One faculty member told us, "Spending time on professional development is nothing more than coddling poor students. At my institution we simply place students in a lab, close the door, and see what they're like five years later. The good ones always survive."

Graduate students may not develop a complete set of survival skills. Yet without them, individuals will have difficulty publishing manuscripts, obtaining research grants, or teaching, and therefore they will have difficulty being hired and promoted at most institutions that provide employment to researchers. Consequently, many trainees will be "underemployed" or will leave their field altogether. Some have argued that given the oversupply of Ph.D.s in most areas of research, attrition is not bad, but leads to survival of the fittest. We believe that this reasoning is inaccurate. First, it assumes that those who leave research are less capable of making important contributions than those who remain. Yet there is no reason to believe that a strong correlation exists between intellectual capacity and a native ability to communicate, teach, prepare a curriculum vitae, or formulate a research article. Indeed, much talent is wasted through attrition. Second, high attrition is dispiriting. It reduces the willingness of students to enter training and it reduces the collegiality of those who do. Third, the financial loss resulting from even a small percentage of trainees' dropping out of the system is staggering. For example, we estimate that approximately \$250,000 is spent to train each doctoral student in the sciences. Given the current state of federal funding for research and training in the United States, attrition represents a tremendous waste.

Special Populations, Special Concerns

"If you go ahead with your plans to get married," the student's advisor told her, "it'll take you at least two more years to get your Ph.D. And if you're going to start worrying about your husband's career as well as your own, then you might as well quit now."

Whereas we believe that most survival skills are useful to all professionals, we also postulate that the need for explicit instruction is particularly high for certain groups, including women and minorities in addition to first-generation preprofessionals and older students. Many of these individuals are faced with additional demands, such as the ability to function without an ethnic support group, obtain “knowledge of how to negotiate the academic system” (Etzkowitz, Kemelgor, Neuschatz, and Uzzi, 1992), or obtain access to the informal networks through which much important information is communicated (Hensel, 1991; Olmstead, 1993). These challenges may be partially responsible for demographic disparities such as the great underrepresentation of minorities in graduate training programs and the relative sparsity of women in the higher academic ranks (Etzkowitz, 1992; Zigmond and Spear, 1992). Whereas long-term improvements in the broader social system may be desirable, we must offer these individuals strategies for coping with the present demands of scientific life if we are to increase their participation in all fields of research (Henkart, 1990; Brush, 1991). The survival-of-the-fittest model advocated by some faculty places a disproportionate burden on groups that are underrepresented in a discipline, and thereby postpones the day on which the demographics of that field is comparable to that of society as a whole.

Not only is there a need among special populations for explicit instruction or some other access to information traditionally disseminated through the “old-boys’ network,” but a need also exists for a forum for discussing concerns unique to special populations. Such issues may include balancing work and family, or dealing with backlash from affirmative action.

The Need: Explicit Instruction in Survival Skills

“Life is less bleak. I am more confident about finding a job. Your workshops gave me tools to improve my chances of succeeding.”

Given the significant limitations of traditional mechanisms for acquiring survival skills, we encourage the implementation of programs that provide explicit instruction in these essential abilities. Elements of successful programs frequently include some combination of lectures, discussions, readings, written exercises, and practical experience. At the University of Pittsburgh we offer a series of eight seven-hour workshops, one per month in the fall and spring terms. Each workshop is devoted to providing instruction in a specific survival skill, and instruction in research ethics is an integral part of the program. For example, we discuss issues of honorary authorship, plagiarism, and confidentiality in review in our workshops on writing research articles; and topics such as scholarship, responsible use of time, and integrity in designing graphics in our workshops on oral presentations. These sorts of issues are emphasized throughout the lectures, and over lunch, small groups discuss an ethical dilemma related to the workshop topic.

Our workshops are not designed to develop proficiency in these abilities; to do so requires much effort and practice on the part of the individual. Rather,

we aim to provide trainees with an introduction to the essential elements of these skills, and then offer them information on a wealth of resources (on-campus services, print and on-line materials) that they can use in developing proficiency in these skills. What is at least as important, through our workshop we encourage students to take an active role in designing their training program and their future.

These programs ensure that all students receive training in a broad range of survival skills while reducing overlap in faculty effort. Such instruction is costly. It requires both time and money. Yet we believe that part of our professional obligation as trainers of graduate students is to provide instruction in the skills necessary for success in graduate school and beyond.

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