

The Formation of Scholars: Rethinking Doctoral Education for the Twenty-First Century

Reviewed by David Manderscheid

The Formation of Scholars: Rethinking Doctoral Education for the Twenty-First Century

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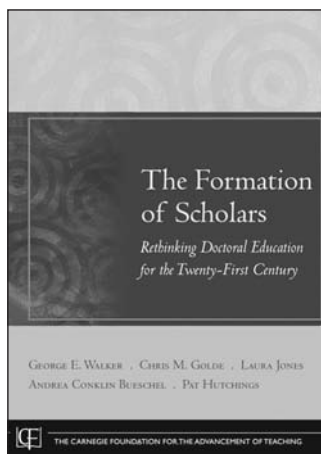
Doctoral education in the mathematical sciences in the United States is the envy of the world. When reforms are suggested, a common reply is, "If it ain't broke, why fix it?" Witness the controversy that the NSF-DMS VIGRE program stirred up. (VIGRE stands for Vertical Integration of Research and Education, a program of the Division of Mathematical Sciences of the National Science Foundation.)

Is all well, however? Outside the top programs there is often a scramble to get enough good graduate students. Moreover, even the top programs, not to mention the others, often have trouble attracting well-qualified U.S. citizens, especially those from groups underrepresented in the discipline. Shouldn't we be concerned? Aren't we losing our best and brightest to other fields?

This book begins with an epigraph that is often attributed to Will Rogers: "Even if you are on the right track you will get run over if you just sit there." The authors argue that the academy is just sitting there when it comes to doctoral education in the United States, and they provide suggestions on how to avoid getting run over.

The book is an outgrowth of the Carnegie Initiative on the Doctorate (CID), a program that ran from

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2001 to 2005. The CID concentrated on the disciplines of chemistry, education, English, history, mathematics, and neuroscience, with eleven mathematics departments represented among the eighty-four programs overall. The purpose of the project was primarily to encourage the participant departments to improve

the effectiveness of their programs, but it also contained a research agenda, the determination of where problems might be nationally, and how these might be addressed. Further background on the initiative can be found at <http://www.carnegiefoundation.org/cid> and in a *Notices* article by Allyn Jackson [Jackson, 2003]. The website includes information about outcomes of the initiative at many of the participating institutions. It also includes thought pieces written by Hyman Bass, University of Michigan, and Tony Chan, then University of California, Los Angeles, and now NSF, for the CID. These pieces also appeared in the *Notices* [Bass, 2003], [Chan, 2003].

The title *The Formation of Scholars: Rethinking Doctoral Education for the Twenty-First Century* was carefully chosen. The authors chose the word "formation" to emphasize the scholar's professional identity in all its dimensions, as opposed to just the acquisition of specialized, perhaps even esoteric, knowledge.

The authors identify three key themes in the formation of scholars: scholarly integration, intellectual community, and stewardship. By scholarly integration they mean close ties between teaching and research. Put more baldly, they employ the catch phrase “scholarship segregated is scholarship impoverished.” By intellectual community the authors mean more than social activities; they mean “the hidden curriculum” that sends powerful messages that determine, among other things, roles and the extent to which true creativity is welcomed. With stewardship the authors emphasize a moral and ethical duty of scholars both to their own work *and* to their discipline. These three themes are weaved throughout the discussion.

The authors argue that a key first step in reform is reflection. A department should discuss the purpose of its graduate program and how well they are meeting that purpose. For example, do you define your mission to be preparing researchers of the highest caliber? If so, do all of your students go on to positions at AMS Group I departments? If not, then should your statement of purpose include, for example, more scholarly integration of teaching and research? Maybe you would go so far as to include scholarly analysis of learning outcomes in a Ph.D. dissertation, as the Department of Chemistry at the University of Michigan has done.

The authors emphasize that there is no one purpose of graduate education, but whatever a department’s purpose is, it should be well defined and decisions should flow from that purpose. Once you know what your goal is, the next question to ask is how your current program helps you achieve that goal.

For example, you might ask how your qualifying or comprehensive exams serve your purpose. If, for example, part of your purpose is to train broadly educated mathematicians, then what do the qualifying exams do toward that end that tests in courses do not? Perhaps they only increase time to degree. If the answer is to fail-out students who should not go on to get the degree, then one might ask whether that purpose could be better accomplished in course work. You might also ask whether the time qualifying exams consume could be better spent. For example, perhaps students could start work on a research project and present on that in either an exam format or a portfolio. Would that better suit your purpose?

The above examples of alternatives to current practices are taken from the book, and there are many more based on practice at departments studied, both mathematics and otherwise. They are often examples of what the authors call *authentic practices*, that is, training that better emulates what will be expected of the graduate as a member of the profession.

An example of a practice that is suggested but that to my knowledge has yet to be fully

implemented in a mathematics department comes in considering the role of the dissertation advisor. The relationship of the dissertation advisor to the advisee is often described as one of apprenticeship. The authors argue that this tends to be a reproductive model that leads to both intellectual and social conformity. They argue that apprenticeship to a faculty mentor should become apprenticeship to several faculty mentors. They reason that scholarship and research of the future will involve many people, seldom the isolated scholar. Of the disciplines in the CID, mathematics students identified having the fewest number of mentors, with the exception of chemistry students (page 95). Is this a good thing? Does it serve the purpose of your program?

This model of apprenticeship to several is part of a sense of a community of scholars. This is more than a community of mathematicians founded around annual picnics, holiday parties, or softball and volleyball teams—things that, I hasten to add, I am all for. Rather, it is an intellectual community with a shared responsibility among faculty members, the authors argue. Faculty should hold one another accountable for the education of students.

I would take this one step further than the authors. I believe that students must be viewed as a more important part of the intellectual community. This is something the authors do not stress. As future stewards of the discipline, graduate students should be trained to help their fellow students succeed. Peer-to-peer mentoring can often be successful where a faculty member was unsuccessful. Moreover, it spreads the intellectual burden further, thus requiring less of faculty. Contrary to this, we often hear arguments for more and more fellowship money for students so that they can spend more time on research. This can often work counter to integration into the intellectual community.

The authors point out that academic administrators have a key role to play in implementing the changes departments might come up with as a part of their reflection. They go on to say that, for CID participants, “The changes that took place in departments might be characterized as incremental changes rather than radical reforms. Moreover they were implemented at a measured pace, with respect for departmental decision-making traditions, rather than being quick fixes slapped into place. In part because the Carnegie Foundation gave no money to departments (although some programs received modest institutional support for travel, graduate students, research assistants, or surveys), programmatic changes were a response to locally defined needs. Historically, there have been many reform initiatives in which the (often laudable) activities have been entirely predicated on external funding, but many do not persist or become

institutionalized once the seed money disappears [Bacchetti and Ehrlich, 2006]. We believe that changes prompted by the CID will stick because these were choices made by the department itself, rather than as a response to an external agent" (page 165). As a dean I view this as the "if they really want to do it, they can do it on their own and thus they don't need the college's scarce resources" approach.

On the other hand, there is, for example, the approach of the NSF Division of Mathematical Sciences through its workforce program. So where does the truth lie?

Of course the truth is somewhere in between. I agree that reform needs to be a grassroots movement from faculty, staff, and students as a fundamental cultural shift is necessary. But oftentimes these shifts require more than just will. So how do you convince your administration or the NSF? I think the answer is similar for both. Further, most deans think alike on this point and it is no secret—but it is amazing to me at least—how few department chairs provide us the information we want/need to invest scarce resources in a department. We are looking for evidence that you have done your homework, that you have reflected on the issues, that you have well-thought-out plans, and that you have ways to evaluate the success of these plans if you are able to implement them. We are also looking for evidence that you have done all that you can do on your own. Everyone could use more resources, but what have you done to conserve the resources that you have? How high a priority is this to your department, as evidenced by a serious investment of your own time and resources? These issues can require serious and often delicate discussions, but progress is made not just by adding on but sometimes also by cutting back.

I'll step off my soapbox now and return to the book at hand. I highly recommend it to all faculty members interested in improving their graduate programs. It is a relatively quick read. Indeed, portions most relevant to other disciplines can often be skipped, although the cross-cultural enlightenment these sections can provide can be both amusing and worthwhile. The authors and the Carnegie Foundation for the Advancement of Teaching are to be commended.

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- [2] TONY F. CHAN, "The mathematics doctorate: A time for change?", *Notices Amer. Math. Soc.* **50**, no. 8 (2003), 897–904.
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About the Cover

Real analysis in polar coordinates

The cover image shows Ken Golden (author of the article on the mathematics of sea ice in this issue) measuring the fluid permeability of first year Antarctic sea ice. He writes about it:

"The fluid permeability of porous sea ice controls brine drainage, melt pond evolution, surface flooding, and snow-ice formation. Melt pond evolution, for example, in turn controls sea ice reflectance, a key parameter in understanding the dramatic decline of the summer Arctic ice pack. Snow-ice formation, a dominant process in the Antarctic, may well become more prevalent in the Arctic as the ice pack thins. The permeability also controls microbial colonization and nutrient fluxes, which are important in gauging the response of polar ecosystems to climate change. The permeability measurements I made on this expedition were the first such measurements done in the Antarctic ice pack. The photograph was taken by Jan Lieser."

—Bill Casselman, *Graphics Editor*
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