Improving Graduate-Student Mentorship by Investing in Traineeship Grants

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Summary

Graduate students are more likely to persist in their academic decisions if engaged in positive mentoring experiences. Graduate students also cite positive mentoring experiences as the most important factor in completing a Science, Technology, Engineering, Math, or Medicine (STEMM) degree. In the United States, though, these benefits are often undermined by a research ecosystem that ties mentorship and training of graduate students by Principal Investigators (PIs) to funding in the form of research assistantships. Such arrangements often lead to unreasonable work expectations, toxic work environments, and poor mentor-mentee relationships.

To improve research productivity, empower predoctoral researchers to achieve their career goals, and increase the intellectual freedom that young scientists need to pursue productively disruptive scholarship, we recommend that federal science funding agencies[1]:

1. Establish traineeship grant programs at all federal science funding agencies.

2. Require every PI receiving a federal research grant to implement an Individual Development Plan (IDP) for each student funded by that grant.

3. Require every university receiving federal training grants to create a plan for how it will provide mentorship training to faculty, and to actively consider student mentorship as part of faculty promotion, reappointment, and tenure processes.

4. Direct and fund federal science agencies to build professional development networks and create other training opportunities to help more PIs learn best practices for mentorship.

Challenge and Opportunity

Over the last several decades, research effort in the United States has risen substantially even as research productivity has sharply declined. Data suggests that fundamental scientific progress could slow if quantitative growth of scientific endeavors (in terms of researcher numbers and research funding amounts) is not accompanied by mechanisms to foster disruptive scholarship, focus attention on novel ideas, and empower predoctoral researchers via effective mentorship.

[1] Here, the term "federal science funding agencies" refers to those federal agencies that disburse $100 million or more in research grants annually.

At the same time, graduate students are suffering from stress and burnout. Nearly one-third of doctoral students report experiencing moderate to severe anxiety or depression, and about half of all doctoral students quit their programs. The Council of Graduate Schools found that poor mentor-mentee relationships are among the top factors contributing to the graduate mental-health crisis. Minority graduate students report lower levels of satisfaction with mentors and advisers than their White counterparts, and the National Academies documented systemic issues and sexual harassment driving women out of academia. Overall, a graduate student's relationship with their primary advisor is the factor most directly correlated with retention, timely degree completion, sense of inclusion, career aspirations, and overall satisfaction with their graduate experience.

Congress is actively debating legislative approaches to solidify U.S. science and technology leadership by significantly increasing appropriations for scientific research and expanding the research-funding apparatus. Congress should simultaneously institute reforms maximizing return on these investments. Improving training and mentoring of predoctoral researchers will do this by helping retain talent in higher education, giving young scientists the freedom and support they need to push fundamental progress forward in science and technology, and ensuring that a robust, diverse STEMM workforce exists to tackle challenges of the future.

Plan of Action

Funding training grants is a proven way to strengthen graduate-student mentorship in STEMM fields. The Ruth L. Kirschstein Institutional National Research Service Award (NRSA) program at the National Institutes of Health (NIH) provide eligible institutions funding to develop or enhance research training opportunities preparing pre- and postdoctoral individuals for careers in specified areas of biomedical, behavioral, and clinical research. A report by the National Research Council found that doctoral students funded by NRSA grants (also known as T-32 Institutional Training Grants) outperformed their peers on several short- and long-term outcome measures, such as time to degree completion and likelihood of remaining in research positions over the course of their careers. The NRSA grant program has also yielded standards that guide mentorship and training not only for NRSA awardees but for all trainees, regardless of their financial support mechanisms. Yet despite these benefits, no other federal science funding agencies provide traineeship grants at the scale NIH does—and even the NIH has not kept growth of the NRSA program on pace with growth of the agency overall.

To support STEMM graduate students and strengthen the overall American research enterprise, the federal government should build on the success of the NIH's training-grant program by doing the following:

1. **Establish traineeship grant programs at all federal science funding agencies.** Modeled on the NIH's NRSA/T-32 grants, these grants would increase scientific returns on federal investments in STEMM fields. Funding for the NRSA program itself should also be increased to match recent increases in the NIH budget.

2. **Require every PI receiving a federal research grant to implement an Individual Development Plan (IDP) for each student funded by that grant.** The NIH already requires PIs to create IDPs for each federally funded student. A provision in the House-passed "NSF for The Future Act" would establish this practice at the National Science Foundation as well. The logical conclusion is to expand the IDP requirement to all federal funding agencies.

3. **Require every university receiving federal training grants to create a plan for how it will provide mentorship training to faculty, and to actively consider student mentorship as part of faculty promotion, reappointment, and tenure processes.** NIH requires each institution receiving an NRSA grant to develop recruitment plans for enhancing diversity of its student body. Traineeship grant programs could similarly be accompanied by requirements for developing mentoring plans. Such requirements would align with recommendations from the National Academies' 2018 report on Graduate STEM Education for the 21st Century.

4. **Direct and fund federal science agencies to build professional development networks and create other training opportunities to help more PIs learn best practices for mentorship.** An existing example of such a network is the National Research Mentoring Network established by the NIH.

Conclusion

As has been documented time and again, intensifying research effort in the United States has not translated into greater research productivity. One cause of this problem is a domestic research ecosystem that ties mentorship and training of graduate students to funding in the form of research assistantships. This arrangement is stifling growth, causing severe stress and anxiety, and leading to burnout among our nation's next generation of scientists. To improve the graduate-student experience and maximize scientific returns on federal investments in STEMM fields, the federal government should expand and increase support for traineeship grants (and related initiatives) at federal science funding agencies. Taken together the actions recommended in this memo will foster productively disruptive scholarship, recruit and retain a diverse pool of predoctoral STEMM researchers, and set those researchers up for later-career success.

Frequently Asked Questions

1. Is there an existing model of training grants currently in place at a federal funding agency?

Yes, the NRSA training grants at NIH were implemented as part of the National Research Service Award Act of 1974, and are widely regarded as one of the best avenues for learning the theories and techniques of biomedical and behavioral research. These programs are overseen by awardee institutions rather than by individual PIs, and this allows for the implementation of trans-institutional standards on enhancing diversity, mentoring and research conduct, career development, and counseling programs. Institutional training grants assure institutional ownership of, and responsibility for, the quality of trainees and their training programs as well as making available professional and career development services that may not otherwise be accessible to trainees on individual fellowships. NIH also encourages recipient institutions to develop a policy requiring that an IDP be implemented (reportable on the progress report) for every graduate student supported by any NIH grant, regardless of the type of grant.

2. How successful have existing federal training-grant programs been?

The National Research Council report found that NRSA-funded researchers took less time to graduate than either students without NRSA support at the same institutions or students at institutions without any NRSA grants. Nearly 58% of NRSA-funded students had received their doctorate by the age of 30, versus 39% and 32% for non-supported doctoral students from NRSA and non-NRSA institutions, respectively. About 37% of NRSA recipients held faculty positions seven to eight years after receiving their doctorates, versus 16% of doctoral recipients from non-NRSA institutions. Furthermore, 87% of NRSA recipients were in research-related positions (compared to 72% of doctoral recipients from non-NRSA institutions), and a larger share of NRSA recipients applied for and received NIH grants within 15 years of receiving their doctorates than non-NRSA-supported doctoral students.

3. What are the benefits of IDPs?

Research indicates that IDPs can enhance mentoring support for and career preparedness of doctoral students and postdoctoral researchers. Cross-sectional studies looking at postdoctoral and predoctoral researchers have also found that IDPs help a significant fraction of mentees in making progress towards their career goals. Finally, IDPs can strengthen relationships among trainees and mentors, resulting in a rewarding positive feedback loop that improves lab productivity and lab culture.

4. Why should federal agencies get involved in mentorship practices at individual universities?

Federal science funding agencies have a stake in the education, training, and success of predoctoral students. Nearly one-third of all doctoral students report having moderate to severe levels of anxiety or depression, one in ten students have had suicidal thoughts, and half of all doctoral students quit their programs mid-way. Many of these students funded at some point through a federal research grant. To maximize return on taxpayer-funded federal investments, and to ensure that our nation is tapping into all available STEMM talent to create a workforce for the future, it is crucial for the federal government to ensure that best mentorship practices are being implemented at grant-receiving institutions. Precedent for such involvement exists. NIH already requires institutions to develop plans to enhance diversity in recruitment and establish standards for responsible research conduct. The House Science Committee, through the NSF For The Future Act, instructs the NSF Director to study how NSF must reform its funding processes to keep pace with evolving structures in academia and address systemic issues contributing to talent loss. Finally, recommendations from the National Academies clearly emphasize the importance of STEMM mentorship.

About the Author

Divyansh Kaushik is a PhD student in the School of Computer Science at Carnegie Mellon University, where he is an Amazon Graduate Research Fellow studying artificial intelligence. He currently serves as the President of Carnegie Mellon University's Graduate Student Assembly. In this role, he has led advocacy efforts on higher education, science funding, and immigration issues at all levels of government. His work has been featured in prominent national media outlets including Politico, Chronicle of Higher Education, and PBS Newshour.

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