

## **Doctoral Engineering Grant Writing Experience to Prepare Future Professionals and Faculty**

**Katherine Smith, Nathapon Siangchokyo, Erika Gamarra, Ashish Tamhane and Anthony W. Dean**

*Old Dominion University*

### **Abstract**

While there have been many efforts to broaden opportunities for all STEM students by engaging in interdisciplinary endeavors and education focusing on professional development, there are particular problems facing students pursuing doctoral degrees in engineering disciplines. Doctoral programs of the future need to become better equipped to prepare students for future careers as engineering professionals or faculty. It has been noted recently that many doctoral degree recipients are turning to jobs outside of academia but increases in undergraduate enrollment and the average age of the professoriate indicate an increase in demand for new faculty. Both future faculty and professionals can benefit from experiential preparation in the grant proposal writing process. While the benefits of grant writing experience for future faculty during graduate school may seem self-evident and there are courses that teach the mechanics of grant writing, there are not many programs that follow this course with an experience where the student develops a full proposal. This activity requires students to present and justify the merit of their ideas in writing; collaborate and compromise with other researchers; and understand logistics and restrictions on budget and resources. Additionally, each of these activities translates into professional development skills including relating individual work to a broader purpose; communication and teamwork; and project, funding, and resource management, respectively. This paper represents a call to action for current and future doctoral engineering programs. We will discuss how a grant writing experience composed of a proposal writing course and follow-up mentored grant writing experience can be developed to prepare both future engineering professionals and faculty.

### **Keywords**

Engineering education, Graduate education, Faculty preparation, Professional development

### **Introduction**

Recently, there has been a focus on efforts to support professional development for STEM students at all levels<sup>1</sup>. However, there are particular challenges for students pursuing doctorates<sup>2</sup>. Whether students eventually become engineering professionals or faculty, there is a need for better professional development during their doctoral program. Given increases in the average age of professors and rising undergraduate enrollments, there is a need to produce new faculty that are competent not only in teaching and research, but also in the process of planning research projects and securing funding<sup>3</sup>. Success in procuring funding is usually heavily weighted in the tenure review process and is considered to be a quantitative measure of a faculty's productivity and overall career potential<sup>4</sup>. Professionally, the skills used in grant writing correspond to a range

of professional development skills including communication, project management, and relating work to a broader purpose. Indeed, programs to develop teaching (e.g., Preparing Future Faculty (PFF)) and grant-writing abilities currently exist at many institutions. However, there is a lack of experiential educational interventions that allow doctoral students to not only learn grant writing skills but also observe and implement these skills in the context of responding to a real program solicitation<sup>2</sup>. An example is a course for graduate students in biology that requires students to write a proposal, but the proposal developed is a dissertation research proposal<sup>5</sup>.

To address the relative dearth of integrative grant writing interventions, we propose an experiential educational program that consists of three integrative sequential components: (1) a grant proposal writing course, (2) a formal mentorship, and (3) a grant proposal writing experience. The grant proposal writing course is a one-credit hour course designed to introduce the student to the overall grant-writing process and specific skills. The formal mentorship will pair each student with an active researcher who shares a research interest with the student. During the grant proposal writing experience, this mentor will guide the student as they identify a funding opportunity and prepare and submit a proposal in response.

The remainder of this paper will be organized as follows. The approach section will discuss in detail the components for the proposed experiential educational program. Then, conclusions and future work will summarize the paper and elucidate the path forward.

## Approach

Figure 1 illustrates the proposed three-part educational experience program. The program is designed to enhance doctoral students' ability to not only perform high quality research but also to procure funding.



Figure 1. Three-part educational experience designed to introduce students to the skills needed for proposal preparation in response to active funding solicitations.

The first component of this intervention is the grant proposal writing course. This course is a single semester, one-credit hour course designed to introduce students to the overall process of grant-writing while simultaneously drawing on the knowledge and experience of more senior researchers to elucidate common pitfalls. The primary goal of the course is to impart to the students' basic skills in all components of the grant-writing process including identifying and evaluating sources of funding, comparing and contrasting elements of the proposal preparation and review process, and articulating strategies for managing grants and contracts. The course is ideally taken during the student's last semester of coursework as they prepare to transition to focus solely on research for their dissertation.

The second component of this intervention is mentorship. Approximately halfway through the course, each student is paired with a formal mentor. Through this mentorship process, students will be guided to identify funding opportunities and develop ideas for proposals. Additionally, the mentor will be able to serve as a principal investigator on any proposals co-written with the student. The final project for the proposal writing course will be a white paper or quad chart, developed by the student and supervised by the mentor, which outlines the proposal they plan to develop and submit in response to the identified funding opportunity.

The third and final component of the intervention is the preparation and submission of a full proposal. The student and mentor will work together to draft the initial proposal, build a qualified research team, develop a budget, and collaborate with administration from the office of sponsored programs. If possible, the mentor should recruit several colleagues to review the proposal and provide feedback before submission. Once completed, the proposal will be submitted to the funding agency that issued the opportunity. Mentors and students will be encouraged to remain in contact and discuss reviews from the funding agency after the proposal has been reviewed.

## Conclusions and Future Work

While courses on grant writing are offered at some institutions, this intervention extends those experiences by adding a formal mentorship and grant writing experience. It is hypothesized that this intervention will result in better preparation for doctoral engineering students, regardless of whether they eventually become engineering professionals or faculty. Future work includes the implementation of the educational intervention over the next several years as well as tracking the students and collecting data to determine the efficacy of the intervention. Additionally, program materials will be documented in a way that will make the program easily transferrable to other educational institutions.

## References

- 1 National Research Council. (2012). Assuring the US Department of Defense a strong science, technology, engineering, and mathematics (STEM) workforce. *National Academies Press*.
- 2 Taylor, M. (2011). Reform the PhD system or close it down. *Nature News*, 472(7343), 261-261.
- 3 Wendler, C., Bridgeman, F., Cline, F., Millett, C., Rock, J., Bell, N., & McAllister, P. (2010). The Path Forward: The Future of Graduate Education in the United States. *Educational Testing Service*.
- 4 Bloch, C., Graversen, E. K., & Pedersen, H. S. (2014). Competitive research grants and their impact on career performance. *Minerva*, 52(1), 77-96.
- 5 Kahn, R., Conn, G., Pavlath, G., & Corbett, A. Use of a Grant Writing Class in Training PhD Students. *Traffic*. 17(7), 803-814.

**Katherine Smith**

Katherine Smith received B.S. degrees in applied mathematics and mechanical engineering from Old Dominion University (ODU) and an M.S. in Applied and Computational Mathematics from ODU. Ms. Smith is currently a senior lecturer in the Department of Mathematics and Statistics at ODU and is pursuing a PhD in Modeling and Simulation. Her research interests include serious games for STEM education, scientific and big data visualization, and augmented and virtual reality. Prior to teaching at ODU, she worked as an Aerospace Engineer at NASA Langley Research Center.

**Nathapon Siangchokyoo**

Dr. Nathapon Siangchokyoo is currently a visiting Assistant Professor of Management in the Strome College of Business (SCB) at Old Dominion University (ODU). He received his Ph.D. and M.E.M. from the Department of Engineering Management and Systems Engineering, and a B.S. in Computer Science, from ODU. His previous appointments include instructor and research assistant in the Department of Engineering Management and Systems Engineering at ODU, and an Assistant Operations Manager at Eastland Food Corporation. Currently, his research is focused primarily on topics related to leadership and leadership development.

**Erika Gamarra**

Erika G. Ardiles Cruz is a Ph.D. Candidate in Modeling and Simulation at Old Dominion University (ODU). Currently, she is Research Assistant at the Batten College of Engineering at ODU. Her previous appointments include Research Assistant at the Virginia Modeling Analysis and Simulation Center and the Center of Excellence in Cyber Security sponsored by the Air Force Research Laboratory. Her research focuses on human behavior modeling using agent-based modeling and simulation.

**Ashish Tamhane**

Dr. Ashish Tamhane is currently an adjunct faculty at the Batten College of Engineering and Technology (BCET), Department of Mechanical and Aerospace Engineering at Old Dominion University (ODU). He has previously been a tutor for the Stern2STEM program. His research interests include Artificial Intelligence, Computational Fluid Dynamics and Optimization. He received his Ph. D. and M.S. from the Department of Mechanical and Aerospace Engineering, ODU and a B.S. in Mechanical Engineering from the University of Mumbai, India.

**Anthony W. Dean**

Dr. Anthony W. Dean has had several roles in academia. He is currently Assistant Dean for Research, Batten College of Engineering and Technology (BCET) at Old Dominion University (ODU). His previous appointments include Associate Professor of Engineering Technology and as Associate Director of the Institute for Ship Repair, Maintenance, and Operations at ODU. His research has focused mostly on control systems (integration and testing) and the reliability and maintainability of complex systems. He has been selected as both a NASA and an ONR Faculty

**2019 ASEE Southeast Section Conference**

Fellow. He regularly teaches courses in Marine Engineering and in Maintained Systems. Most recently Dr. Dean was on the Headquarters Staff the American Society of Naval Engineers. He received his Ph.D. from the Department of Engineering Management and Systems Engineering, and a B.S. in Nuclear Engineering Technology, from the Batten College of Engineering and Technology at ODU. Additionally, Dr. Dean received an MBA from the College of William and Mary. Prior to his academic career Dr. Dean was Director of Operations and Business Development for Clark-Smith Associates, P.C., and served as an Electrician in the US Navy aboard the USS South Carolina and the USS Enterprise.