

and shift research focus if the opportunity arises, because high paper counts are often not so important. Maybe you want to move to a field with more undergraduate research opportunities. Maybe a new emerging field is particularly interesting. Maybe you recently discovered a connection between your prior research and another area of mathematics. Working at a PUI may afford you the space to wander in your research which, at least from my experience, has led to a much richer research career.

During my first year at Grinnell, I got an email invitation out of the blue from a mathematician in Chile, Dr. Anita Rojas. She had found out about my research from an anonymous referee who had pointed out similarities between her research and mine, and she had some funding to invite other researchers to Chile. Despite not speaking Spanish and never having been on a plane flight over four hours, I took her up on the offer. That was the beginning of my major ongoing collaborations with the Geometry at the Frontier research group in Chile.

So wander geographically as well. There is beautiful mathematics being done all over the world and such opportunities may come from unexpected places. That one trip to Chile led to further invitations, and even a three-month visit this past spring through the Fulbright program. None of those opportunities would have been possible if I hadn't been willing to try a new, unexpected research opportunity. Accept invitations whenever possible even if they involve long flights to places that you have no familiarity with. (And, my eternal gratitude for the anonymous referee who connected our research.)

A research career at a PUI probably won't look like a research career at a major research university, but that isn't necessarily a bad thing. Mine has been helped along by having a particular skill which I can bring to different research teams, and a willingness to try different areas of mathematics (often arising in serendipitous ways). Both of these approaches might have stymied my career if I had been at a major research university, but at a PUI they've helped my research flourish.



Jennifer Paulhus

Credits

Author photo is courtesy of Grinnell College / Justin Hayworth.

Analysis and Differential Equations at Primarily Undergraduate Institutions

William R. Green and Katharine A. Ott

Analysis and Differential Equations at Primarily Undergraduate Institutions (PUIs) is an umbrella title that encompasses a set of professional development activities that we have initiated over the past three years. In this article, we'll detail the work that we've done to date with the hope that others will join us or create similar initiatives. Ultimately, we would like to bring more visibility to the varied and excellent body of mathematical work coming from faculty at PUIs and to create long-lasting networks to combat the feelings of professional isolation. For early career faculty who work at primarily undergraduate institutions, we want to emphasize the importance of building a variety of professional networks.

The idea for these activities began in 2019 over lunch at the JMM in Baltimore. We were inspired by an AMS Special Session focused on number theory at undergraduate institutions. We thought it was a great idea and we wanted to see something similar for our own research area of analysis and differential equations, so we organized a Special Session in 2020 under the name of Analysis and Differential Equations at Undergraduate Institutions. Since this initial Special Session, there have been four similar AMS sessions, altogether featuring more than 30 speakers from PUIs. We also organized a series of virtual panels in Summer 2021 focused on various categories of professional development: supervising undergraduate research, maintaining an active research program, avenues for professional growth, and how to best prepare students for future study and careers, all through the lens of analysts working at PUIs. Finally, we have a message board hosted by MAA Connect for members to communicate online.

Recognizing a Need

We feel strongly that there is a need for these types of professional activities tailored to professionally active faculty at PUIs. There is a wealth of research-focused programs that include cohort building and professional development run through the AMS and the math institutes. These programs are often targeted toward or attract mainly mathematicians from R1 institutions. Simultaneously, the Mathematical Association of America (MAA) runs great professional

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development programs that focus primarily on the teaching side of the profession. We know that these programs are beneficial and help foster long-term support networks and collaborations. We met through the MRC (Mathematics Research Communities) program offered by the AMS, were further connected through MAA Project NExT (New Experiences in Teaching), and these programs directly led to our continuing collaboration.

These experiences among others showed us how important and rewarding it is to maintain and expand a professional network, but we discovered that it was much more difficult to do this once we transitioned to full-time positions at undergraduate institutions. Gone were the hallway conversations with colleagues in our research area, and the seminar talks and lunches with research visitors, for instance. At a PUI, it is possible (even likely) for you to be the only faculty member in your research area. In our experience, this isolation meant fewer research conversations, a drop-off in invitations to speak or collaborate and less awareness of professional opportunities such as conferences and networking in our field.

On the other hand, there are multiple avenues and opportunities for scholarly and professional growth outside of the traditional path of research articles and conferences, such as outreach efforts or pedagogical work. Colleagues within our institutions have been helpful guides and mentors, but we have also benefited greatly from perspectives of those outside our institutions on longer-term, big picture items. In particular, we have found that learning about the pathways that other faculty at PUIs have forged, and how their professional lives have connected with the mission of working at a PUI, has provided motivation and inspiration for our careers.

Motivation and Challenges

There were several different factors motivating us to try to build this network of analysts at primarily undergraduate institutions. On the practical level, many schools require external letters of recommendation for promotion and tenure processes. In some cases you have the opportunity to suggest letter writers for the institution to contact. It can be quite helpful to have the perspective of an active scholar, who works under similar time constraints due to heavy teaching, student advising, and institutional and professional service commitments, to help provide context for a college-wide tenure committee. Having a well-developed network helps facilitate this process.

On a broader scale, there are many challenges that come along with maintaining an active scholarly agenda when teaching at a PUI. Along with the potential for a sense of academic isolation, there are large teaching, service, and advising responsibilities for faculty at PUIs. Trying to keep up with research and/or develop other scholarly pursuits while teaching several different classes, advising students, and serving on committees is not easy. Faculty at PUIs don't

always have TAs or graders, and can spend hours outside of our scheduled class times or office hours helping students in their classes who are struggling with the homework or stressed about upcoming exams. The immediacy of student needs often takes center stage, and with limited time our scholarly work tends to be pushed aside. In addition, there isn't always as much financial support or institutional infrastructure available. Resources such as start-up or travel funds or access to extensive library resources are limited compared to an R1 institution.

In one of the virtual panel events hosted by the MAA this past summer, we had discussions with mathematicians who are active in research and other scholarly work whose faculty positions are primarily teaching focused. It was motivating to see how colleagues in similar jobs are producing high-level scholarship and developing impactful professional lives through outreach, mentoring, and other activities. Hearing them discuss the strategies and techniques they employ to remain professionally engaged in spite of all the demands on their time was helpful. It was encouraging to hear the perspectives and stories of colleagues who are achieving the teacher-scholar ideal that we strive towards.

Our final motivation was to try to provide more exposure and recognition for faculty at PUIs who are making valuable contributions to the mathematical community. There is a lot of great work being done by faculty at PUIs, including (but not limited to!) traditional research, undergraduate research, and other scholarly writing and outreach. Hosting Special Sessions and other events that list speakers' institution is one way to bring attention to PUIs, but there is much more work to do to in order to influence the external and internal roadblocks to recognition.

Externally, the vast majority of research funding goes to faculty at R1 institutions, and some research grants explicitly disqualify anyone at a non-PhD-granting institution. In more encouraging news, there are some current funding opportunities from the National Science Foundation, such as the Research at Undergraduate Institutions, Research Opportunity Awards¹, and the new Launching Early-Career Academic Pathways program², that explicitly target faculty at PUIs. The AMS has also recently announced the AMS-Simons Research Enhancement Grants for Primarily Undergraduate Institution (PUI) Faculty³. While we cannot change the priorities of funding agencies, we hope that we can increase awareness among faculty at PUIs of these types of initiatives and encourage broad participation.

There are additional roadblocks to recognition within our own institutions, as excellence in mathematical

¹<https://beta.nsf.gov/funding/opportunities/facilitating-research-primarily-undergraduate-institutions>

²<https://beta.nsf.gov/funding/opportunities/launching-early-career-academic-pathways-mathematical-and-physical-sciences>

³<https://www.ams.org/ams-simons-pui-research>

research is not always well understood or rewarded at PUIs, particularly if it does not involve undergraduate students. This internal lack of recognition can provide motivational challenges, especially post-tenure as the incentives and expectations change. Our efforts thus far have focused on connecting faculty at PUIs with each other to learn strategies for both maintaining motivation and finding rewarding scholarly pursuits. It has been enlightening to meet and learn from our colleagues at PUIs over the past few years on these issues.

Opportunities for Engagement

Thus far we have relied on existing structures to help build our professional network in an efficient manner. Rather than planning an entire conference, we have used Special Sessions at AMS Meetings (the JMM and sectional meetings) as a gathering for research talks. In a similar vein, last summer we hosted a series of virtual panels through the MAA Virtual Programming series. These panels were focused on four separate topics (undergraduate research, keeping research alive, professional engagement beyond research, and connections to graduate school and industry) and each featured five distinguished professionals in our network. Also through the MAA we maintain a MAA Connect⁴ community for *Analysis and DEs at Undergraduate Institutions*. This is an online message board that MAA members can join that we have used to share conference and funding announcements, and also to share and solicit teaching tips, and other relevant professional information.

Opportunities like these offered by professional societies have been crucial to our effort. Many mathematicians in our target audience are members of at least one of these societies, and so they receive announcements and discounts for registration. The AMS and MAA widely advertise their programs and provide other support such as technical assistance that saves us a great deal of time and effort. We've found that hosting a Special Session at JMM is particularly beneficial to speakers since it is common, in our experience, for undergraduate institutions to require one to speak at a conference in order to receive travel support.

One shortcoming we are working to overcome is that we have only been able to reach a small cohort of faculty at PUIs with our efforts thus far. The people who have participated in the Special Sessions and virtual panels are mostly people already in our orbit, whether that is by geography, by research area, or by type of institution. We are seeking ways to expand the group, and especially to include faculty from a broader range of types of institutions.

Future Steps

We hope to continue to see this work grow and evolve over the coming years. For our own community, we intend to continue having Special Sessions at the Joint Meetings,

and maybe see more sessions occur at sectional or other regional meetings. We would like to explore connections with graduate programs as a means to both help our undergraduate students who are interested in further study, and to encourage current graduate students who are considering a career at a PUI. We especially hope to engage more early career faculty to help combat the feelings of isolation and to demonstrate the wide range of possible scholarly development opportunities that are available. In closing, we have found many benefits to forming this community around a research area, and so we want to encourage other research groups to consider initiating or partaking in similar network-building efforts. If you're considering joining in these types of efforts, please reach out to the authors via email.



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Photo of William R. Green is courtesy of Robby Green. Photo of Katharine A. Ott is courtesy of Katharine A. Ott.

Important vs. Urgent: Balancing Teaching and Research

Allison Pacelli

It seems like we are bombarded daily with urgent matters that need our attention, but urgent is not the same as important. Everyone is busy, but it's so easy to be busy on the wrong things. Starting a career at an undergraduate institution that values both teaching and research may seem like a constant struggle between too many responsibilities vying for our attention. Distinguishing between what is important and what is merely urgent can play a crucial role in your success.

What you consider important will depend on both your and your institution's goals and priorities (hopefully these are not too disparate!). When I started at Williams College, fresh out of grad school and having won multiple teaching

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⁴<https://connect.maa.org/>