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Lauren Abbott
Boston University

Amy Andes
The Ohio State University

Aneri Pattani
Kaiser Health News

Patricia Ann (Pam) Mabrouk
Northeastern University

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AN AUTHORSHIP PARTNERSHIP WITH UNDERGRADUATES STUDYING AUTHORSHIP IN UNDERGRADUATE RESEARCH EXPERIENCES

Lauren Abbott, NOYCE Fellow, Boston University

Amy Andes, Ph.D. Candidate, The Ohio State University

Aneri Pattani, National Correspondent, Kaiser Health News

Patricia Ann (Pam) Mabrouk, Professor of Chemistry, Northeastern University

Introduction

Pam: Over the past 30 years, I have chosen to do much of my scholarly research with undergraduates. I have partnered with one hundred undergraduate students from many colleges and universities. My choice is admittedly unusual for a tenured Professor at a private research university, but it has been a conscious choice born of the transformative experience I had in college. Undergraduate research changed my life—I found my passion. I developed self-confidence and experienced the joy, grief, wonder, and frustration that embodies scholarly research. Providing my students with the opportunity to take their own journey is one reason I partner with undergraduates. I also choose to partner with undergraduates because authentic partnership requires me to be more deliberate, present, and reflective in my work. I believe it makes me a better teacher, researcher, and person.

For the last few years, my work has investigated the impact or lack thereof of the training programs for undergraduates in the responsible conduct of research (RCR) (Mabrouk, 2013; Mabrouk, 2016). The issue of authorship, in particular, seemed to be problematic for the undergraduates, so I decided to conduct a grounded study of authorship in undergraduate research partnerships to identify the factors that were preventing students from understanding authorship. This paper highlights my partnership with three talented undergraduates over five years to carry out and publish the results of that study.

Student Voices on the Research Experience

Aneri: During my time at Northeastern, I studied journalism with a minor in Spanish. Almost all my classwork focused on an application—interviewing city officials and writing articles on deadline or debating current events in Spanish. I had no academic research experience, and I didn't truly understand what the research process entailed.

When I learned of a job opening for an undergraduate research experience with Pam, I didn't think I was qualified. I'd previously worked with Pam updating a website she ran about undergraduate research, and she suggested I consider this new opportunity. She saw the potential for me to learn new skills and use my existing journalism background to contribute to the project.

Over an academic year, I helped Pam develop the original interview scripts, collect data from the faculty-student dyads, and analyze the data. At first, our partnership was that of a student and professor. I was new to research and had a lot to learn. In our weekly meetings, Pam would explain the research process and answer my questions about everything from literature reviews to the peer-review system. I'd walk away with assignments to read papers on the topics of authorship and undergraduate research. The next week we'd discuss what I had learned. Instead of simply teaching me how to do a task, Pam made a point to ensure I understood the concepts. For example, when it came time for us to analyze the data, Pam handed me a book about grounded theory to learn how it was developed, its strengths and weaknesses, and why it would apply to our project. This type of foundational learning was key in making me feel more invested in the project.

The interview aspect of the project played to my strengths as a journalism student. I spent most of my days trying to get people to open up, speak with me on various topics, and elaborate on their views. Pam recognized this and invited me to be an active participant in the data collection phase. I reviewed the interview scripts she developed and proposed questions to add or rephrase. Seeing my ideas incorporated into the project made me feel a true sense of ownership. I was no longer simply helping Pam with her project. This was *our* project. That feeling only grew months later when Pam suggested I present our research at RISE, Northeastern's research expo. I had never pictured myself in that type of scholarly setting, but after months of learning about and engaging in research, I felt qualified to stand there among my peers.

The partnership Pam and I developed was based on recognizing each other's respective strengths, actively seeking the others' opinions, and asking questions of one another and the project. In doing so, my role evolved from that of an assistant to that of a partner. This was only strengthened by the way Pam and the other team members kept including me as the project progressed, even beyond my time at Northeastern.

Amy: At Northeastern, I studied chemistry, where there was a tight-knit network of students and professors. When it came time to find a professor to work with for my senior project, I decided I wanted to branch out from traditional lab work and find a more relatable topic. I sent an email to Pam after I found that she did some social science research, and we had a meeting to talk through potential projects. I was drawn to the study that Pam and Aneri had started, especially because I was looking to apply to graduate school during the time that I would be conducting this senior research. I was eager to find out what was occurring in research labs and hope that I could become a better future graduate student with this research.

Pam and I met once a week to discuss, brainstorm, and interview participants during my senior year. These meetings not only helped shape our study but helped shape my thoughts on graduate school. Pam pushed me to be my best researcher self, and her constructive criticism and comments on my edits have made me a critical writer. We had discussions after interviews about the reality of the situation in most research labs. We coded for commonalities and overall themes in the interviews using coding software. As I listened to and transcribed each and every audio file from our interviews, I listened over and over to the lack of knowledge and ambiguity relating

to the ethics of authorship, and it continued to shock me.

I had an interesting “study-within-a-study” pop up during my time interviewing participants. One research lab had three different dyads participate. It was fascinating to see the diverse opinions or lack thereof about RCR, authorship opportunities, and more within a single research lab. Many undergraduates claimed they “didn’t know what they didn’t know” about many of the barriers to undergraduate research and authorship. We attended the American Chemical Society’s annual conference and shared our work. Then we published my first paper (Andes & Mabrouk, 2018). It is a phenomenal experience to see our work out there, impacting and starting meaningful conversations in STEM research groups.

Being the researcher in between Aneri and Lauren’s work has taught me a lot about partnership. Partners may never meet or see each other, but that does not make collaboration impossible. Pam facilitated a wonderful four-person partnership across many years, time zones, and geographical areas. This was beyond what I had ever imagined my senior project would be, and I am grateful to have seen this partnership flourish.

Lauren: I majored in chemistry with a minor in psychology for my undergraduate degree. As I was reaching out to various professors searching for a lab to work in for my senior research project, I ended up connecting with Pam. Although I was a chemistry major, my passion did not lie in working in a traditional wet lab. I loved learning science and had toyed with the idea of going into education. When Pam explained her qualitative study looking at the negotiation of authorship in undergraduate research partnerships, I couldn’t believe my luck! I could work on a senior research project that would utilize my psychology knowledge and incorporate my interest in education. I had very little prior research experience and no experience with the peer-review and publication process, so I can say that my time with Pam opened up a whole new world for me.

I worked with Pam to continue a project she had been working on for a few years with both Aneri and Amy. Pam was incredibly helpful and supportive from the start, explaining her project to me and providing me with papers and books to read. Our research began with interviewing triads of faculty, graduate, and undergraduate students. Pam showed me the script that they had used for their initial interviews and asked for feedback or suggestions on the questions. For the first few interviews, I listened while she conducted the interview, but Pam had me conducting the interviews myself very quickly. I transcribed each interview and coded it in NVivo. Pam and I would eventually compare our codes and discuss any differences until we agreed.

Throughout the entire process, it felt more like a collaborative partnership than me being Pam’s assistant. Although I had no prior publication experience, Pam walked me through every step and made sure I was included in any decision making. While I was a Northeastern student, we met regularly to discuss our plan and go over any questions I had. After I graduated, we would Skype weekly while working on our first draft of the paper. She also continually included Amy and Aneri in any revisions and decision making as well. She did a fantastic job of consistently including all four of our voices throughout the entire process. Pam always asked for our insights and encouraged us to take the lead on tasks, rather than simply telling us what needed to be done.

We were able to coordinate and work together despite having graduated and moved across the U.S. for various post-graduate work and school opportunities.

The Publication Process

Pam: Usually, when a project appears to be yielding results that are interesting and novel, I begin to broach the idea of publication with my students. As my students partner with me on different aspects of an emergent project at different points in time over an extended period, I offer them the opportunity to be more or less engaged in the actual writing process. Everyone reviews and approves the paper as it moves through review. As Aneri and Amy were actively involved in other professional pursuits when the authorship study was ready for primetime, I asked Lauren to write the draft with me. The four of us circulated the draft, and then Lauren and I worked together to submit the manuscript online.

I had high hopes for a quick and smooth publication of our work. I emailed everyone outlining the review process's norms and telling them we would likely receive reviews within a month. Four months passed. I contacted the journal. The Editor left the journal. We finally received a set of reviews. As often happens, the reviews varied in terms of their perceptions and evaluation of our manuscript. Recognizing that my student co-authors likely had no basis for evaluating the feedback we had received, I emailed everyone to provide context for the diversity of opinions. Lauren and I worked together to revise the manuscript and prepare a point-by-point "response to the reviewers" document that we iterated through Aneri and Amy. Our study was accepted two revisions later, and this past month it was published (Abbott, Andes, Pattani, & Mabrouk, 2020). Throughout the protracted submission and review process, I found myself bemused at times by my lack of critical self-reflection, stubbornness, and even lack of vision for myself and my co-authors. Upon reflection, I now see that my desire was for a speedy, aseptic publication process in which we received a single set of congratulatory reviews and were sent on our way to "Articles As Soon As Publishable." Thank goodness for the flawed journal staff, the tardy reviews, and the request for a second, and yes! A third set of revisions! I see these now as productive disruptions challenging me to lead my students deeper into responsible authorship and publication practices. I have realized how important it is for journals to have clear, thoughtful authorship policies explaining authorship's responsibilities. These policies should explicitly call out the role and responsibilities of student co-authors. This experience led to one very personally, very satisfying, and productive outcome; I wrote an authorship policy for a peer-reviewed journal focused on the scholarly practice of undergraduate research that was recently adopted by that journal's Editorial Board.

Present Day

Aneri: In the three years since working with Pam, I've worked primarily as a health and science journalist at various media outlets. I'm not doing academic research, but what I learned as a partner in the process has undoubtedly shaped the way I approach my work. For one, I now read all scientific papers with a critical eye. Research is incredibly valuable to society, but because Pam encouraged me to use a critical lens on our project and ask her and our team questions, I

have to come to understand that it is an imperfect process. The public needs to understand that conclusions can't be based on any single study. Whenever I'm writing about a new study, I use the skills I learned with Pam to find previous research on that topic. Although I can't include a literature review in a news piece, I can still provide context and help readers see how this study fits into the broader research realm. In this way, my role with my readers echoes Pam's role in our partnership: exposing me to other sources and broadening my view of research. Lastly, my experience working with Pam has given me a deeper appreciation for research. As a member of a collaborative process spanning many years, geographies, and time zones, I've come to understand the teamwork that goes into papers, and I carry that into my interviews with scientists. While this appreciation may not translate into the article itself, it helps me accomplish a goal I'm always striving toward: being a more empathetic journalist.

Amy: As I continue in my third year as a Ph.D. Candidate in food science at The Ohio State University, I am always reflecting on this project. My own undergraduate research student in my lab definitely gained a mentor who communicated freely about authorship ethics, RCR. Because of this research, we spoke early and often, and he will be included as a very happy second author on two projects he helped me conduct. From the research interviews with Pam, I know a great deal about research experiences where authorship conversations and credit assignment go unfavorably. As a co-coordinator for The Ohio State's Food S.U.R.E.TM (food science undergraduate research experience) program (Elisar, 2019), I help make sure that undergraduate students receive support and hopefully have the most meaningful research experience possible. We provide monthly seminars about finding the right faculty advisor, writing research proposals, reading scientific papers, and even presenting at a research forum. We also offered a seminar to graduate/postdoc mentors this year about "how to be a meaningful mentor." Without this study, I am unsure I would have the answers I give at all those seminars.

I feel gratitude for Aneri and Lauren for their valuable portions of this work, and of course, Pam for her unwavering support. Pam came to a conference at The Ohio State University, focused on undergraduate research, and we got to visit during that time. Pam will be a lifelong mentor due to this study, which ironically assesses the do's and don'ts of mentorship, and I will, without a doubt, be a better confidant and mentor, paving the way for others.

Lauren: After I graduated in May 2018, Pam and I continued our work together. Once we had worked through coding and discussing all of the data we had collected, we began drafting a paper together. Pam also provided me with the opportunity to present our research at the National American Chemical Society Meeting in the Fall of 2018. Although this was a partnership, she wanted me to gain this valuable presentation experience and gave me the option to present our findings alone. This is the point where I truly felt a sense of ownership for our work, and it has only grown stronger since. Pam and I also presented at the Northeastern Teaching and Learning Conference in April 2019. Pam truly wants the best for us and has provided me with any possible opportunity to publish or present. I feel very lucky because this is rare for an undergraduate research partnership (as shown in our study).

My time working with Pam has been truly formative for me. She opened me up to the realm of science education research, which helped me realize I did not want to work in a lab. I have since applied and been accepted to graduate school for education. I am currently attending Boston

University for my Master's in Teaching in Science Education as part of the Noyce Fellowship. My work with Pam not only gave me research and publication experience, but through it, I developed a stronger identity and sense of what I want to do in my own career. Pam was always incredibly transparent, honest, and flexible, making us partners rather than teacher and student. You can also tell that Pam truly cares about her students' success, which is why she has included us in so many opportunities rather than focusing on her career development. I have grown as a researcher, presenter, and writer. Research is such a fundamental aspect of science, and having this level of comfort and familiarity with the process will only help me as I move forward in my career path.

Pam: Working on this reflective essay with Aneri, Amy, and Lauren has been an amazing experience. It has given me a rare gift: the opportunity to learn about my students' perceptions of our research partnership and hear how our collaboration has affected them. Most of the feedback I receive as a faculty member is focused on research productivity and funding or classroom teaching. Research is a private, personal, and very social enterprise where many faculty "live" in the Academy. It's a truly precious gift to gain insight into how my opening up this very personal and important area of my professional life and how sharing it with my research students has impacted their minds, hearts, and lives. I find myself taking a deep sigh after reading my students' reflections: I know that I have passed the torch and that it is burning clean and bright.

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