Review Of Researcher Experience in a Collaborative Research Program – Phase 1

Dr. Anne M Lucietto, Purdue University at West Lafayette (PPI)

Dr. Lucietto has focused her research in engineering technology education and the understanding of engineering technology students. She teaches in an active learning style which engages and develops practical skills in the students.

Monita Hollis Mungo, The University of Toledo
Mia Marie Rodriguez
Jason Xi Yang, Purdue University at West Lafayette (COE)
Joshua Archer, The University of Toledo
Dr. Revathy Kumar

Ph.D. in Education and Psychology from the Combined Program in Education and Psychology, University of Michigan. At the graduate level, she teaches courses in Adolescent Development, Motivational Theory and Application, Cultural Perspectives in Learning a

Dr. Lesley M Berhan, The University of Toledo

Lesley Berhan is currently the Associate Dean of Student Success and Strategic Initiatives for the College of Engineering and an Associate Professor in the department of Mechanical, Industrial, and Manufacturing Engineering at The University of Toledo.

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Abstract

This study, funded by the National Science Foundation (NSF) in 2023, aimed to investigate the motivations behind students' preference for engineering technology over other engineering and STEM disciplines. Our primary goals were to understand these motivations and provide insights that could better inform educational policies and practices to support underrepresented groups in STEM fields.

Throughout the project, we accomplished several key objectives. We successfully engaged diverse stakeholders, including graduate and undergraduate students, faculty members, and community partners. This collaboration enriched the research process by integrating various perspectives and expertise. We also navigated the complexities of interdisciplinary collaboration, addressing challenges related to differing work and communication styles, and established clear communication channels and shared goals early in the project.

Our core findings revealed that several factors, including the perceived practicality and applicability of the discipline, the availability of role models and mentors, and the supportive learning environments within engineering technology programs influence students' preference for engineering technology. Additionally, our research highlighted the importance of cultural competency and trust in building strong relationships with research participants, which was crucial for collecting meaningful data.

This paper provides a comprehensive view of the collaborative research process by documenting our experiences and the explicit contributions of each team member. We offer valuable insights into the dynamics of interdisciplinary collaboration, the importance of adaptability and responsiveness to participant needs, and strategies for fostering trust and rapport with underrepresented students. Our findings and reflections aim to equip future researchers with the knowledge and tools to navigate similar projects effectively, ultimately contributing to advancing diversity and inclusion in STEM education.

Keywords: engineering technology, interdisciplinary collaboration, communication, researcher

Introduction

In 2023, a research initiative funded by the National Science Foundation (NSF) aimed to investigate why Black students tend to favor engineering technology over other engineering and STEM fields. This paper outlines the experiences and insights gathered by the researchers, offering valuable guidance for future teams undertaking similar studies. The objective of the

research is to illuminate the distinct factors that influence the educational decisions of Black students, thereby enhancing the understanding of diversity within STEM disciplines. By exploring these motivations, the study aims to inform educational policies and practices that could better assist underrepresented groups in their pursuit of STEM careers.

Literature Review

The dynamics of researcher interactions during collaborative grant projects have been extensively studied, revealing critical insights into the nature and impact of these collaborations. Bian et al. [1] emphasize that collaborative research grants serve as a foundational framework for understanding the interactions among researchers, as these grants often necessitate sustained engagement throughout the project lifecycle, from proposal writing to project execution further support this sustained interaction by highlighting the complexity of collaborative research grants and their role in fostering networks among investigators, particularly within the Clinical and Translational Science Awards (CTSA) framework [2]. Their analysis of grant management data illustrates how these collaborations evolve over time, reflecting a shift in interaction patterns pre- and post-CTSA implementation.

The role of interdisciplinary collaboration is increasingly recognized, with Brandenburg et al. [3] noting the significant contributions of librarians in research projects, which enhances the collaborative environment by integrating diverse skill sets. This interdisciplinary approach is echoed by Nakajima et al. [4], who explore the phenomenon of "rich clubs" in collaborative research, where institutions that engage in multiple collaborations tend to form dense networks that enhance research productivity. Such findings underscore the importance of strategic partnerships in maximizing the effectiveness of collaborative efforts.

In community-based participatory research, Louis et al. [5] discuss the significance of cultural competency and trust in facilitating authentic collaborations between academic researchers and community stakeholders. This highlights the necessity of building strong interpersonal relationships to ensure the success of collaborative projects. Similarly, King et al. [6] describe a structured approach to grant writing that fosters collaboration between community organizations and academic institutions, emphasizing the importance of mutual understanding and shared goals in enhancing research outcomes.

The evaluation of collaborative efforts is also crucial, as demonstrated by Hall et al. [7], who suggest that collaboration can significantly enhance scientific impact, measured through citation rates and other metrics. This notion is supported by the work of Hughes et al. [8], which indicates that the frequency of collaborative papers and grants has increased, particularly within institutional boundaries, suggesting that fostering internal collaborations may be a strategic focus for enhancing research productivity [9].

The literature reveals that effective collaboration in grant projects is multifaceted, involving sustained interactions, interdisciplinary partnerships, and a focus on community engagement. These elements are essential for fostering a productive research environment leading to significant scientific advancements. Rather than providing research questions and a more formal document, the team dynamics are shared by the researchers and overview provided for others doing work in teams consisting of a variety of individuals.

Generalized Research Methodology

The project exemplifies a collaborative research experience that brings together a diverse group of stakeholders, including faculty members, graduate students, and undergraduate students, each contributing unique perspectives and skills. This diversity enriches the research process and fosters an inclusive environment where knowledge and experiences are shared freely. For researchers embarking on similar projects, it is crucial to recognize the value of such collaboration. Engaging a range of stakeholders enhances the depth and breadth of qualitative research, as each participant brings different insights that inform the research questions and methodologies employed.

The research methodology adopted in this project involves several key components essential for effective qualitative research. Recruitment and management of interview participants require careful planning and ethical considerations, ensuring that the voices of all participants are heard and respected. For those new to qualitative research, it is important to develop clear protocols for participant recruitment and maintain open communication lines throughout the process. This not only facilitates smoother interactions but also builds trust with participants, which is vital for obtaining rich, meaningful data [10].

Focus group facilitation is another critical aspect of the methodology, allowing for dynamic discussions that reveal nuanced perspectives on the research topic. Researchers should have facilitation skills to guide conversations effectively while allowing participants to express their thoughts freely. This can be particularly beneficial in generating diverse viewpoints and fostering a sense of community among participants [11]. For example, to ensure that participating engineering technology students in this project felt comfortable and free to share their experiences, Black graduate students were recruited at one university and a Black undergraduate student at the other to conduct the interviews.

The research methodology for this project was also specifically designed to capture participants diverse perspective and give voice to their concerns. We adopted an exploratory mixed-methods approach, we have developed a survey to be administered in the second year of the project that is based on what interview participants shared with us in the first year of the project.

The qualitative analysis of the collected data is where the collaborative efforts truly come to fruition. Involving multiple stakeholders in the analysis process leads to a more comprehensive understanding of the data, as different interpretations and insights are shared and debated. For researchers, it is advisable to establish a systematic approach to data analysis, such as developing a codebook collaboratively, which helps in organizing themes and ensuring that all relevant data is considered [12].

Sharing experiences from this project highlights the importance of collaboration among diverse stakeholders in qualitative research. By fostering an inclusive environment, employing effective recruitment and facilitation strategies, and engaging in collaborative data analysis, researchers enhance the quality and impact of their work. This approach supports individual researchers and contributes to the broader academic community by sharing best practices and lessons learned [13].

Collaborative Dynamics

The collaborative nature of the project required a concerted effort among researchers with varying goals and expertise. Each campus group brought unique insights and levels of expertise, enriching the research process and posing challenges. Navigating different work and communication styles was often challenging, highlighting the need for clear communication channels and shared goals.

The research team includes tenured faculty, graduate students, and undergraduate students. The following are summaries provided by the authors focused on their personal interactions with each other and the subject of the research. This team consists of faculty from the two participating universities, graduate students at one, and undergraduate students at the other. The team consisted of two universities working together and independently. However, the structure of the researchers is as follows:

University of Toledo – 3 Faculty, 2 Graduate Students (one recently graduated)
Purdue University – 1 Faculty, 2 Undergraduate Students

The following input was provided in the order received and does not necessarily reflect the university nor team they were a part of.

Faculty 1. *In my experience, faculty interactions are crucial for fostering a collaborative academic environment. These interactions, which include mentoring, collaborative research, and interdisciplinary projects, are essential. However, I've noticed that faculty members often face challenges in understanding and integrating knowledge from different disciplines, which can*

hinder effective collaboration and progress in the completion of the project. Interdisciplinary understanding is vital for addressing complex problems that require multiple perspectives, yet faculty members facilitating these programs often encounter structural barriers such as conflicting policies and budget models. Despite these challenges, successful interdisciplinary collaborations can lead to innovative solutions and advancements in various fields.

Collaborations with graduate students from other institutions significantly enhance research quality and provide diverse perspectives. These interactions, through joint research projects, conferences, and exchange programs, often result in co-authored papers and shared resources. From my observations, interactions between faculty and students, both undergraduate and graduate, are vital for academic success. These interactions include mentoring, research supervision, and classroom engagement, leading to positive outcomes such as improved student performance, higher retention rates, and successful research projects.

The quality and quantity of published papers often measures the success of academic interactions. I've found that collaborative efforts between faculty and students and interdisciplinary projects can lead to high-impact publications. These successes contribute to the academic reputation of the institutions involved and advance knowledge in various fields.

Faculty interactions can vary significantly, with some interactions being smooth and productive, while others may feel forced and stilted. This variability often stems from differences in individual communication styles, levels of engagement, and institutional cultures. In my experience, the interaction with graduate students was initially limited, which impeded project progress. It became evident that these students were unaware of their ability to collaborate with faculty from other universities, highlighting a gap in communication and coordination. Over time, however, as awareness increased and efforts were made to foster better communication, the quality of faculty interactions improved across all levels, regardless of the institution involved.

The initial lack of interaction between graduate students and faculty from different institutions slowed project progress and underscored the need for clearer guidelines and encouragement for cross-institutional collaborations. Addressing these issues has led to a more collaborative environment where faculty members from diverse backgrounds can effectively contribute their expertise. This improvement has facilitated more dynamic and interdisciplinary approaches to research, ultimately enhancing the overall quality and impact of academic projects.

Faculty 2. *Sharing our experiences on this research program fostered active listening among us all. This project uniquely combined interdisciplinary and inter-university collaboration. The exposure to diverse viewpoints and approaches was rewarding. I particularly enjoyed observing*

the students' cross-institutional collaborations and found the Zoom coding interview sessions a gratifying mentoring and learning experience.

For collaborative projects such as this, I believe, we need to set aside time at the beginning of the project (e.g., 2 months) to support and train graduate students to conduct interviews and use software for conducting analysis.

As a psychologist, I encountered challenges when integrating perspectives on methodologies and ways of thinking that were different across disciplines. This was evident during the survey finalization process. While cross-disciplinary and inter-institutional projects are crucial for impactful research, sometimes power imbalances may lead to the dominance or exclusion of certain viewpoints. This multifaceted project, designed to examine the experiences of Black Engineering Technology students in predominantly White institutions, underscored the significance of balanced communication, teamwork, and negotiation when addressing issues of equity and social justice.

Faculty 3. *Interdisciplinary research collaboration used to explore some of higher education's most pressing issues is imperative to understand the complexities of students' lived experiences. Numerous successes can come from such a collaboration, such as discipline-specific analyses of the same data, potentially exposing overlooked factors or numerous publications posing new theoretical lenses. However, there are several challenges to overcome when fostering a collaborative academic research environment. For instance, project management is an important skill required in any collaborative setting where goals need to be met by several people, especially when the project crosses state lines and academic disciplines. Beyond subject matter expertise, researchers must be proficient at leading, organizing, delegating, following up, and conflict management. Relying on each other to organically take the lead when a specific project management skill is needed complicates an already challenging endeavor.*

In our experience, organization and delegation did not occur at the beginning. Using our collective input, we relied on the PI to set the pace, create the schedule, and delegate tasks. Once we began experiencing hurdles, such as not getting the email list for research participants on time and not having access to it once the PI received it, the schedule fell apart, and we struggled to maintain the plan. Additional challenges set us back because there was not an initial plan for who was responsible for what tasks. To contend with this challenge, delegating early and often is key.

Time management is another challenge potential collaborators should consider. I am not referring to one's ability to handle their time, but the time that is out of our control. In my discipline, we call the family a greedy institution as it demands so much of our time, more so if the researcher is female. Increasingly, colleges and universities are becoming greedy

institutions, relying on faculty to do more administrative tasks in addition to teaching and research. Not being able to control the timeliness of a familial problem or an emergency request from the dean impacts researchers' ability to manage their time in a manner that allows them to meet project goals. To contend with this challenge, it is crucial to consider time and flexibility as part of the project planning process, allowing for more time than you think is needed.

Supervising graduate student assistants can be challenging when there is an established working relationship with one researcher and not the others. When giving graduate students some of the critical functions of a research project, a learning curve must be considered and added to the schedule. In our experience, more training with the other researchers should have occurred.

Graduate Student 1. *Thus far, my overall experience with the NSF project has been enlightening and enjoyable. I have assisted in conducting interviews and focus groups at Purdue University and UT. My experience traveling to Purdue with Dr. Mungo and working with Dr. Lucietto and her students was invaluable, they were all hospitable and informative. I also worked on coding with Mia Rodriguez and Ronald Zallocco, this process was new and interesting. Mia was professional and very helpful. Ron was diligent and consistent. I learned a lot from Dr. Kumar about validity in research and the appropriate methods for looking at qualitative data and recording a phenomenological perspective of a sample group. Dr. Mungo was very helpful during all interactions and Dr. Berhan was a joy to work with. Both of them were professional and helpful.*

I want also to mention that I have some small critiques and I hope that these are not received as negative or slanderous. The interviews/focus groups at Purdue were very well done but having the interviewee's professor present in the room while discussing their program could negatively impact the validity of their statements. I also think that there could have been an increased level of collaboration between the different disciplines. Specifically, the PhD. Faculty are experts and should have equal say in the direction and perspective of the research. I also feel there was a sense of haste or a need to rush certain portions of the study. These critiques are likely due to my naivety or ignorance and I appreciate this opportunity. Thank you for hearing me out.

Undergraduate Student 1. *Collaboration with graduate students from the University of Toledo has been a pivotal aspect of the research process, particularly in developing codes and creating a comprehensive codebook. This collaborative effort has fostered an environment where team members feel comfortable sharing their ideas and discussing various interpretations of the data. By effectively dividing the workload, the team has been able to check in with one another regularly to monitor progress and ensure that all voices are heard in the coding process.*

The collaborative writing of codes and themes has not only enhanced the richness of the analysis but has also strengthened the overall quality of the research outcomes. In addition to working

with graduate students, the research team has revised papers and coded transcripts, ensuring the findings are robust and well-articulated.

Team members have independently been responsible for coding transcripts, formulating a detailed codebook, and writing the findings section of the research papers. This independent work is subject to review and feedback from the professors overseeing the project, which adds layer of rigor and accountability to the research process.

The combination of collaborative and independent efforts has proven to be an effective strategy in advancing the research objectives while maintaining high academic standards.

Undergraduate Student 2. *During my time on the NSF project, I contributed primarily to the paper writing phase.*

Since I joined the team after the interviewing portion of the research was completed, my focus has been on synthesizing information for the literature review. Collaborating with the team was an invaluable learning experience, mainly as I worked closely with others to ensure my writing aligned with the broader research findings and goals. I appreciated how the team analyzed and shared insights from the interviewing process, which deepened my understanding of the research findings.

This collaboration helped me grow in integrating diverse ideas into a cohesive narrative. It was fascinating to see how each part of the team's work came together to shape the final paper, and I am grateful to have been part of this process.

Notes to Clarify Comments

Interviews. The research conducted at the University of Toledo involved only faculty members and students from that institution. They faced challenges with participant recruitment and conducted only individual interviews. In contrast, the interviews at Purdue University comprised two sessions, each with two to three participants. One of these participants was known to the faculty and assisted in recruiting additional participants due to the poor response to the initial invitation. Input from Graduate Student 1 indicated that the faculty member from Purdue University was an instructor for those being interviewed. However, this was inaccurate; only one of the interviewed students was enrolled in that faculty member's program, and they were not in that class until a later semester than when the interviews occurred.

Openness. All researchers were asked the same question: to provide a high-level description of their experiences in this project, particularly insights that would be helpful to those working on similarly structured projects. Some comments were received with hesitation, and one researcher

inquired whether the information could be shared openly. Later, they submitted a brief document that lacked depth. The request for brevity may have influenced their responses.

Discussion

The collaborative research project involving two universities, each contributing faculty and students, has yielded significant insights into interdisciplinary and inter-institutional collaboration dynamics. The findings highlight the team's challenges and successes, providing valuable lessons for future projects of similar structure.

Challenges and Solutions

One primary challenge was the initial lack of interaction and communication between faculty and graduate students from different institutions. This gap hindered early progress and underscored the need for more explicit guidelines and encouragement for cross-institutional collaborations. Over time, increased awareness and efforts to foster better communication improved the quality of interactions, leading to a more collaborative environment. This improvement was particularly impactful in studying engineering technology students, as it facilitated the sharing of diverse perspectives and experiences, enriching the research outcomes.

Faculty members faced difficulties integrating knowledge from different disciplines, often due to structural barriers such as conflicting policies and budget models. Despite these challenges, successful interdisciplinary collaborations led to innovative solutions and advancements in various fields. Addressing these structural barriers and promoting interdisciplinary understanding is crucial for future projects. In the context of engineering technology students, overcoming these barriers allowed for a more holistic approach to understanding their motivations and experiences, ultimately contributing to more effective educational strategies.

Project management and time management emerged as significant challenges. The lack of initial organization and task delegation led to delays and setbacks. To mitigate these issues, delegating responsibilities early and often and incorporating flexibility into project planning to account for unforeseen circumstances is essential. Effective project management was particularly important in studying engineering technology students, as it ensured that the research process remained focused and productive, leading to timely and relevant findings.

Successes and Best Practices

The project demonstrated the importance of faculty interactions in fostering a collaborative academic environment. Mentoring, collaborative research, and interdisciplinary projects were identified as key components of successful academic interactions. These efforts resulted in high-

impact publications and contributed to the academic reputation of the institutions involved. In studying engineering technology students, these interactions were crucial in developing a comprehensive understanding of the factors influencing their educational choices.

Graduate and undergraduate students played a pivotal role in the research process, particularly in developing codes, creating a comprehensive codebook, and writing the findings section of the research papers. The combination of collaborative and independent efforts proved effective in advancing the research objectives while maintaining high academic standards. The involvement of students in the study of engineering technology students provided valuable insights into their perspectives and experiences, enhancing the overall quality of the research.

The project also highlighted the significance of balanced communication, teamwork, and negotiation when addressing equity and social justice issues. Its interdisciplinary nature, which examined the experiences of engineering technology students in predominantly White institutions, underscored the need for diverse perspectives and approaches. This focus on equity and social justice was particularly impactful in understanding the unique challenges engineering technology students face and developing strategies to support their success.

By incorporating these impacts into the study of engineering technology students, the project advanced our understanding of their motivations and experiences and provided valuable lessons for future research endeavors.

Conclusion

In conclusion, the collaborative research project between two universities provided valuable insights into the complexities of working across disciplines and institutions. The challenges encountered, such as communication gaps, structural barriers, and project management issues, were addressed through increased awareness, improved communication, and effective task delegation. The successes achieved, including influential publications and enhanced research quality, demonstrate the potential of such collaborations to advance knowledge and tackle complex problems.

Future projects should build on these lessons by promoting interdisciplinary understanding, addressing structural barriers, and incorporating flexibility in project planning. Academic institutions can continue to achieve innovative solutions and advancements in various fields by fostering a collaborative environment that values diverse perspectives and approaches.

References

[1] L. Bian, S.-J. Leslie, M. C. Murphy, and A. Cimpian, "Messages about brilliance undermine women's interest in educational and professional opportunities," *Journal of Experimental Social Psychology*, vol. 76, pp. 404–420, May 2018, doi: https://doi.org/10.1016/j.jesp.2017.11.006.

[2] T. Locklear *et al.*, "Advancing workforce diversity by leveraging the Clinical and Translational Science Awards (CTSA) program," *Journal of clinical and translational science*, vol. 7, no. 1, Nov. 2022, doi: https://doi.org/10.1017/cts.2022.489.

[3] M. D. Brandenburg, S. A. Cordell, J. Joque, M. P. MacEachern, and J. Song, "Interdisciplinary Collaboration: Librarian Involvement in Grant Projects," *College & Research Libraries*, vol. 78, no. 3, p. 272, Apr. 2017, doi: https://doi.org/10.5860/crl.78.3.272.

[4] K. Nakajima, Kazuyuki Shudo, and N. Masuda, "Higher-order rich-club phenomenon in collaborative research grant networks," *Scientometrics*, vol. 128, no. 4, pp. 2429–2446, Jan. 2023, doi: https://doi.org/10.1007/s11192-022-04621-1.

[5] K. S. Louis and J. Murphy, "Trust, caring and organizational learning: the leader's role," *Journal of Educational Administration*, vol. 55, no. 1, pp. 103–126, Feb. 2017, doi: https://doi.org/10.1108/jea-07-2016-0077.

[6] K. M. King *et al.*, "A Community-Academic Partnered Grant Writing Series to Build Infrastructure for Partnered Research," *Clinical and Translational Science*, vol. 8, no. 5, pp. 573–578, Sep. 2015, doi: https://doi.org/10.1111/cts.12327.

[7] K. Hall, B. A. Stipelman, A. L. Vogel, and D. Stokols, "Understanding Cross-Disciplinary Team-Based Research: Concepts and Conceptual Models from the Science of Team Science," in *The Oxford Handbook of Interdisciplinarity*, 2nd ed., R. Frodeman, Ed. Oxford, UK: Oxford Univ. Press, 2017, pp. 338–356.

[8] M. E. Hughes, J. Peeler, J. B. Hogenesch, and J. Q. Trojanowski, "The Growth and Impact of Alzheimer Disease Centers as Measured by Social Network Analysis," *JAMA Neurology*, vol. 71, no. 4, p. 412, Apr. 2014, doi: https://doi.org/10.1001/jamaneurol.2013.6225.

[9] R. A. Luis, E. Pinheiro, and R. Luiza, "Barriers and facilitators of universityindustry collaboration for research, development and innovation: a systematic review," *Management Review Quarterly*, vol. 74, no. 3, pp. 1841–1877, 2024, doi: https://doi.org/10.1007/s11301023003491.

[10] J. W. Creswell and C. N. Poth, *Qualitative inquiry and research design: Choosing among five approaches*, 4th ed. Thousand Oaks, CA, USA: Sage, 2017.

[11] D. L. Morgan, *The Focus Group Guidebook: Kit 1*. Thousand Oaks, CA, USA: Sage, 1998.

[12] J. Saldaña, *The coding manual for qualitative researchers*, 4th ed. Thousand Oaks, CA, USA: Sage, 2021.

[13] K. Charmaz, *Constructing Grounded Theory*, 2nd ed. Thousand Oaks, CA, USA: Sage, 2014.