Unveiling the mystery: A capacity development framework for early-career STEM educators pursuing external funding

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Unveiling the mystery: A capacity development framework for early-career STEM educators pursuing external funding

Abstract

Across the United States today, public institutions are operating with drastically reduced state funding; and private institutions are closing at an alarming rate. Universities are more reliant than ever on tuition revenue and external funding to survive and thrive. While R1 universities maintain the infrastructure to offer training and other resources for educators pursuing grants, these resources are not as consistent or sustainable at non-R1 universities.

Numerous challenges in pursuing and securing external research funding are faced at an individual level by new STEM educators. In this paper, the term “educators” refers to university-level faculty on both the teaching and research tracks, consistent with ASEE’s definition. Educators feel overwhelmed by the mystery of funding processes, especially for their first award. Because there is no “road map” for educators to follow, the locus of control to improve processes can remain with institution administration instead of the educators themselves.

A mixed methods survey was administered to STEM educators at three non-R1 universities in the South (two public and one private). The survey explores relevant resources, milestones, barriers, and advice from participants as they pursue external funding. Follow-up interviews were held with a smaller sample of STEM educators and graduate students from the same universities, providing deeper examples and detailed recommendations regarding the processes and outcomes of individual capacity development when pursuing external funding.
Drawing upon educator feedback and two international development capacity frameworks, the authors developed a comprehensive "collabo-gleaning" framework that delineates both process and outcome factors, unveiling the mystery of the external funding landscape for STEM educators at non-R1 institutions.

Rationale

Institutional Challenges

Since the 2008 Great Recession, higher education institutions, both public and private, have grappled with an unprecedented funding crisis. Public universities have experienced dramatic reductions in state and federal support, forcing them to rely heavily on student enrollment and tuition revenue—effectively shifting the financial burden to students. Tuition costs have surged at a rate "two to three times higher than inflation" [1]. Compounding these challenges, the "starkly declining" number of high school graduates has further reduced the pool of potential college students [1].

Private institutions are self-funded, not receiving financial support from the state government. These institutions rely on tuition, endowments, and alumni donations to fund their operations. With the nationwide decrease in student enrollment, private institutions are increasing the discount rate of scholarships, 56% in the 2023-2024 academic year, for first-time undergraduates, decreasing the funds received by and to support the institutions' operations [2]. Private higher education institutions experienced an alarming closure rate of one campus per week, with 16 degree-granting colleges and universities closing annually between 2020 and 2023 [3], [4], [5].

Financial deficits have compelled higher education institutions to pursue creative approaches to diversify their revenue streams [1], with federal research and development funding as a viable external source. Nationwide, university research and development funding from federal sources increased by 10% in the 2022 fiscal year [6]. Among the top ten universities with the highest research expenditures, nine hold the Research 1 (R1) classification, while the tenth is categorized as a special focus institution ineligible for R1 status [6], [7]. The Carnegie Classification of Institutions of Higher Education employs a tiered system to categorize universities based on research expenditures and doctoral degrees awarded [8]. The prestigious R1 classification, representing the highest research tier, is highly coveted by institutions as it enhances their ability to attract elite researchers and secure competitive grant funding. However, achieving this status presents significant challenges for non-R1 institutions that lack the established infrastructure needed to support competitive research activities, putting these institutions at a disadvantage [9].

Individual Challenges

Educators across academic ranks face significant challenges in securing external funding, regardless of their tenure status. New educators often struggle with balancing workloads of teaching, research, and service while navigating unclear promotion requirements [10], [11]. When seeking institutional support, many educators report feeling inadequately backed by their organizations. These challenges, combined with other systemic pressures, frequently lead to burnout, prompting talented educators to leave academia altogether [12].

Motivation for Paper

In the authors' "dream world," STEM educators at all institutions, particularly those at non-R1 universities, would feel empowered and supported to pursue external funding. They would clearly understand the sources and processes of external funding. Then embodying the landmark psychology concepts of high self-efficacy [13] and internal locus of control [14], they would be confident in their own ability to pursue this funding regardless of their university's current research infrastructure. Early-career STEM educators would find all the support they need through an ecosystem that provides personalized guidance, addresses institutional barriers, and increases the educator's own capacity. This empowerment-focused approach would enable educators to confidently navigate funding processes and increase their likelihood of securing external support for their research initiatives.

Example Capacity Development Frameworks

In order to realize this dream world, the authors sought to **better conceptualize the capacity development** of the STEM educator pursuing external funding. The ultimate goal was to focus not on improvement opportunities for research offices and administrators, but rather on what the individual educator has the power to do in building their own capacity. The authors began with two existing frameworks created for use in international development and later adapted to evaluate organizational capacity development in STEM education [15]. One framework was used as an example of the processes of capacity development, and the other as an example of its outcomes.

The example framework for the **process** of capacity development was Pact's framework [16], [17]. Pact's definition of capacity development is: "a continuous process that fosters the abilities and agency of individuals, institutions, and communities to overcome challenges and contribute towards local solutions... Though often developed in response to an immediate and specific issue, capacities are adaptable to future opportunities and challenges." According to Pact, the following activities can be used to build participants' capacity: consultancy services, training, mentoring/coaching, information/resources, and peer exchange and learning.

The example framework for **outcomes** of capacity development was the World Bank's Capacity Development Results Framework [18]. According to this framework, learning outcomes in capacity development can include: raised awareness, enhanced skills, improved consensus/teamwork, fostered coalitions/networks, formulated policy/strategy, and implemented strategy/plan.

Example Research Questions

Building upon the existing process and outcomes frameworks, this study sought to answer the following research questions:

1) What are the largest barriers for STEM educators at non-R1 universities when pursuing external funding?
2) Based on educators' experiences, which aspects of the example capacity development frameworks apply?
3) Based on educators' experiences, which aspects of capacity development are new or different considering the situation of STEM educators pursuing external funding?

Methodology

The study's approach is presented in **Figure 1** below. The mixed-methods study adapted two established capacity development frameworks to create a STEM educator-centered model. Through a survey and one-on-one interviews, researchers gathered direct input from educators to adapt these existing frameworks, resulting in a tailored approach that specifically addresses educator needs and experiences.

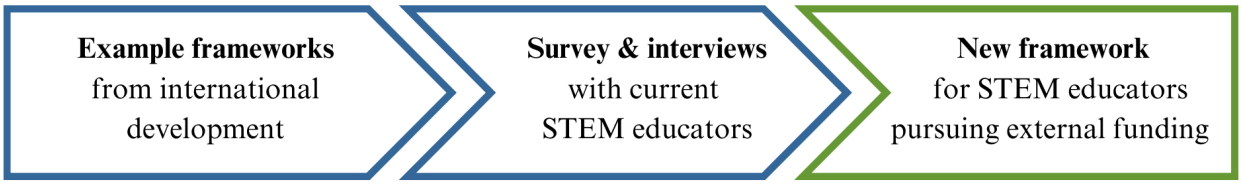

Figure 1: Study Approach

The study gathered data from STEM educators and graduate students across three institutions, detailed in **Table 1** below.

Institution	Institution type	Research classification	Location type
Louisiana Tech University	Public	R2	Rural
University of Louisiana Monroe	Public	R3	Small urban
Houston Christian University	Private	Predominately undergraduate	Metropolitan

Table 1: Universities Represented in Study

The survey collected information regarding educators' funding experiences, available resources, capacity development factors, challenges, and desired support mechanisms (See Appendix B). Distributed through institutional listservs, the survey garnered responses from 40 STEM educators across three participating institutions. A large majority of participants were experienced (more than 5 years) and/or tenured. Data collection and analysis were conducted using the Alchemer and Dedoose online platforms. This systematic approach enabled comprehensive examination of educators' experiences and needs in pursuing external funding.

A majority of survey respondents had submitted over five proposals, so researchers employed purposive sampling for the interview phase in order to gain more perspectives from educators with less grant experience. Each of the three university-based researchers recruited three STEM educators who would be considered junior faculty by rank and/or possessed limited funding experience and then interviewed three participants from institutions other than their own, minimizing bias while ensuring diverse perspectives from junior educators.

The nine interview participants represented various STEM disciplines - including engineering, mathematics, computer science, engineering education, and biology. The semi-structured interviews consisted of six guiding questions exploring participants' external funding proposal experience levels, initial approaches to pursuing funding, and the role of collaboration and mentorship in their funding journey (See Appendix C).

With participants' consent, interviews were conducted and recorded via Zoom, with transcripts coded for key themes using Dedoose qualitative analysis software.

Results

Survey and interview data are presented in aggregate below. In order to preserve participant anonymity within a relatively small population, neither institutional nor demographic information was collected in the survey. In interviews, the three universities were evenly represented with three participants from each. However, demographic data did not relate to the research questions and was not collected. The researchers also did not explore institutional trends within the small sample size. Planned future work will increase the number of institutions and individual participants in order to validate results and analyze trends specific to institution type, STEM field, gender, and/or ethnicity.

The new "collabo-gleaning" framework presented in **Figure 2** below was developed to address the research questions and their corresponding findings, which are examined in detail throughout this section.

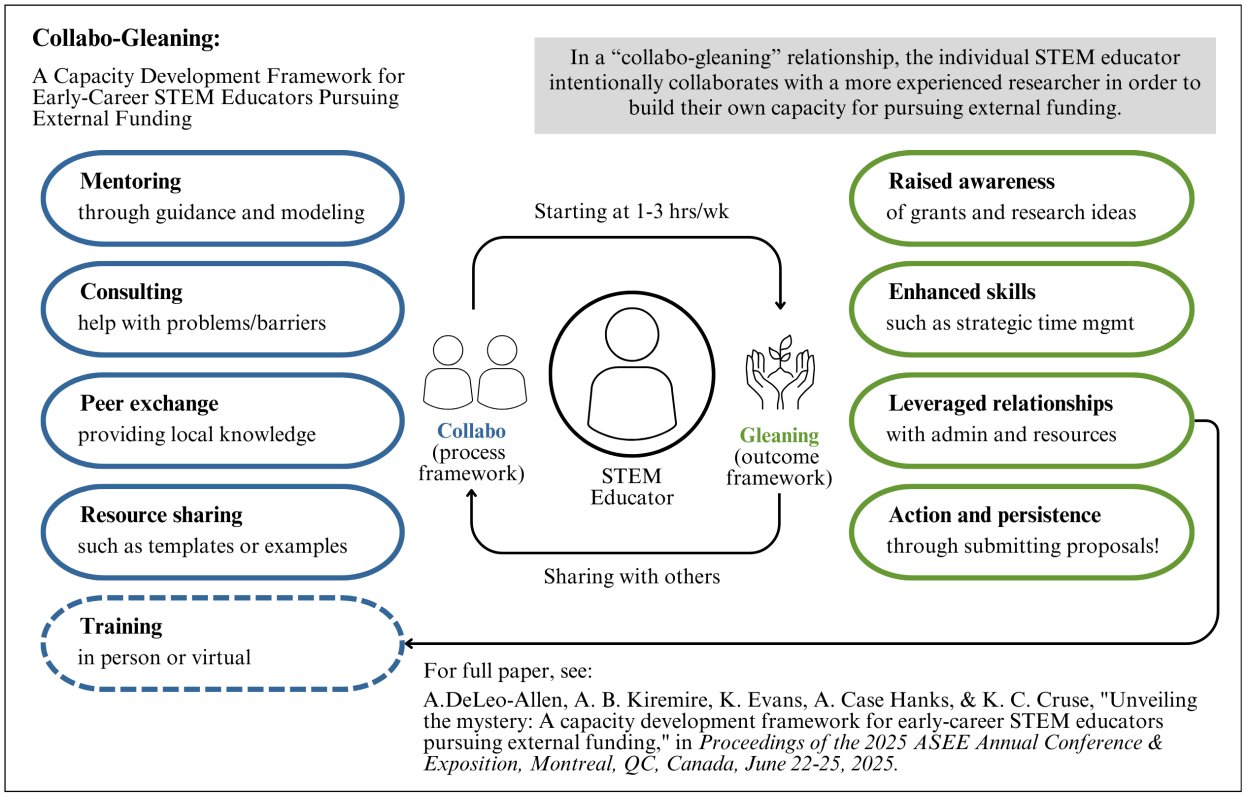

Figure 2: Collabo-Gleaning Framework

Answering Research Question 1

According to open-ended survey responses, STEM educators' **largest barriers** when pursuing external funding are:

- Lack of time due to other responsibilities
- Lack of university resources such as support, help, facilities, name recognition, etc
- Lack of experience or knowledge

Of survey respondents who answered this question, 90% (or 27 of 30) cited one or more of these barriers. Example survey responses are shown in **Figure 3.**

> "I have little experience in grant writing and have been kept very busy with teaching and the large advising load."
>
> "Institutional support and resources [are not] up to par with what is expected from the [funding] agency."

Figure 3: Example Survey Responses

Answering Research Question 2

Data showed that many of the same **aspects of the example capacity development frameworks** also apply to STEM educators pursuing external funding.

Process dimensions: All five of the Pact framework's methodologies apply to some extent, as shown in **Figure 4** below.

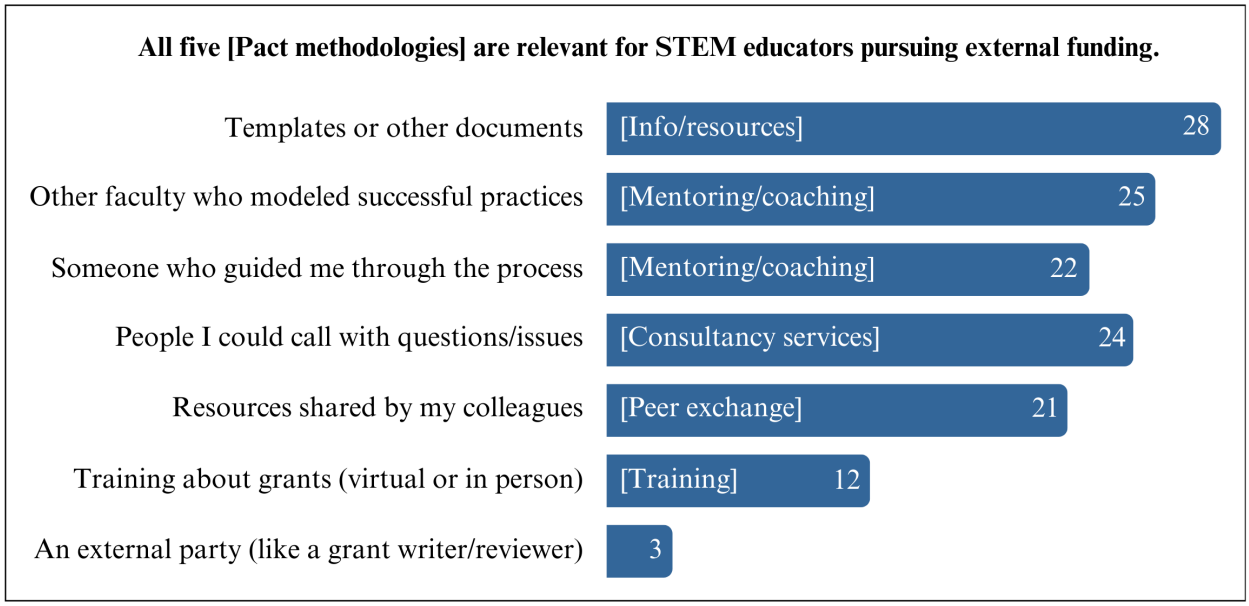

Figure 4: Graph of Survey Responses Involving Resources that Helped Participants

The last item shown on the graph, "an external party (like a grant writer/reviewer)," is not a Pact methodology. However, it is the authors' experience that large R1 universities, and small universities without a grants office, provide this type of support to educators. Institutions "in the middle" of the spectrum may not provide these resources; this is a topic for further exploration. In any case, "an external party" was included on the survey as a separate answer, acknowledging that several of the Pact methodologies may be provided by an external party as well.

Outcome dimensions: The World Bank framework's learning outcomes of raised awareness and enhanced skills are fully relevant. Specifically, awareness of relevant grant programs and/or fundable research ideas was identified as a crucial "first step" by 8 of 9 interview participants. Later in interviews, the most mentioned benefit from mentors/collaborators was helping the newer educators identify a grant or idea (mentioned by 7 of 9 participants). Several participants shared how a more seasoned researcher saw potential in their work and encouraged them to pursue external funding. Examples of enhanced skills mentioned by survey and interview participants were strategic time management, writing, graphics, budgeting, and people-related skills which are described more in the next research answer.

Answering Research Question 3

Several **aspects of capacity development are new or different** considering the situation of STEM educators pursuing external funding.

Process dimensions: Training was not as relevant to the study's participants as the other Pact methodologies. Though some participants cited training in quantitative survey responses (see graph above), it was the least answered Pact methodology to have helped their pursuit of external funding. In open-ended survey answers, only 2 of 40 participants mentioned a desire for more training or workshops, and in interviews fewer than half shared that workshops supported their first steps. Therefore, the authors have not included training as a **core process** dimension of the new framework presented in **Figure 2** above (though training may be one of the resources accessed by the STEM educator within a new **outcome** dimension called "leveraged relationships").

Survey participants often mentioned the remaining Pact methodologies in the context of collaboration (as opposed to only having mentors/consultants external to their grant proposal processes). This aligns with Bandura's social learning theory [19]. When asked what helped the most when pursuing external funding, participants' example answers included:

- "Collaboration to help write different sections of the grant and to brainstorm ideas,"
- "Working with a team of experienced researchers," and
- "Collaborating with colleagues who had successfully pursued and [been] awarded grants in the past."

Survey participants advised early-career educators to:

- "Find and join an existing, successful team;"
- "Collaborate with colleagues from other institutes that have [a] strong track record of getting grants and have a bigger grant writers support office;" and
- "Try to collaborate with more senior educators who have experience pursuing external funding. Why try to reinvent the wheel if they have walked this road before?"

Interview results agreed with the value of this type of relationship, with over half of participants mentioning a benefit from mentors/collaborators was bringing the newer educator into the mentor/collaborator's own grant.

Based on this overwhelming data, the authors' new framework introduces **"collabo-gleaning" relationships** as those in which the individual STEM educator intentionally collaborates with a more experienced researcher in order to build their own capacity for pursuing external funding.

Though collabo-gleaning pulls characteristics from traditional mentoring and collaboration, it stands apart from both. Compared to mentoring, collabo-gleaning shifts power, action, and

knowledge generation to the STEM educator themselves. They are not being acted upon as the "mentee" but are taking purposeful action both to collaborate and to glean. This approach also provides more real context for mentoring conversations and a more tangible benefit to the experienced researcher - someone new to work on their project! And compared to general peer collaboration, collabo-gleaning emphasizes collaborating with a more experienced researcher to achieve results more quickly. This is especially valuable when the early-career STEM educator has minimal dedicated time for pursuing funding amidst many responsibilities.

A tenured STEM educator shared advice that directly follows the collabo-gleaning approach:

> "Find three research groups on your campus that you would be interested in learning more about and ask the lead educator/investigator to participate in their… research meetings... You will give up only 1-2 hours per week, but you will learn a lot and you will be able to see where you could contribute. Everyone who has ever followed this advice has found at least one collaborative relationship that has spawned years of funded research and projects beyond what they imagined they would ever have done."

Interview participants discussed how relationships began with such colleagues, including through formal reporting channels, informal "hallway" communications, workshops, professional organization networks, and graduate school.

Outcome dimensions: Compared to the last four outcomes in the World Bank framework, the authors' new framework defines relational and action-oriented outcomes in terms more simplified and specific to STEM educators pursuing external funding. **Leveraged relationships** includes two strategies recommended by interview participants to overcome the barriers listed above: gaining administrator support and taking advantage of resources both internal and external to the university. Finally, the **action and persistence** outcome involves submitting and resubmitting proposals. Among the study's 14 survey participants who have received tenure (a treasured goal among many STEM educators), a majority have submitted 20 or more proposals! The funding range pursued by most survey participants is $40,000-$199,000; nearly two-thirds of participants have pursued grants in this range. One survey participant shared that "persistence and submitting multiple times" helped most; while another recommended that early-career educators "apply for as many opportunities as possible."

Discussion

Surprising Results

The results of this study spark several counterintuitive ideas regarding early-career STEM educators and their pursuit of external funding.

First, **STEM educators do have power to take steps toward external funding, with or without an initial course release.** Collabo-gleaning is a brilliant response of STEM educators at non-R1 universities to the challenges inherent at their universities. Collabo-gleaning makes the most of the educator's time investment, which can start at only 1-3 hours per week. Then over time, gaining administrator support, strategically managing time, and being included as Co-PIs on funded grants can lead to course release and other forms of workload reduction to pursue external funding.

Second, **grants and research ideas are the "chicken and egg" situation** of external funding. Identifying relevant grant programs and identifying a strong research idea are both plausible "first steps" for a STEM educator pursuing external funding. Several interview participants cited each, and there was not a correlation between levels of experience and participants' views on which comes first (it was a very small sample size, so this is a potential future research topic). In any case, grants and research ideas work in parallel, and collabo-gleaning can help with both.

Next, **workshops and training are not the answer**, especially at non-R1 universities. Though these universities may offer broad "Intro to Grants" workshops, they likely do not have the resources to provide a large quantity of consistent workshops targeted for various funding agencies, nor ongoing training that continues to build educator capacity over time. However, STEM educators can leverage training along with collabo-gleaning. First, they can use workshops as a way to explore potential collabo-gleaning relationships. Then, once they have participated in a collabo-gleaning relationship for some time, they can identify any remaining learning gaps. Perhaps with input and recommendation from the more experienced researcher, the early-career researcher can pursue training (or an additional collabo-gleaning relationship!) targeted to their specific learning need and/or the grant being pursued.

The next surprising concept shown by the data is **success is happening before a grant award.** Though most of the study's interview participants had taken a first step toward grant funding, sometimes participants called their efforts "unsuccessful" because they had not won a grant. The collabo-gleaning framework allows early-career STEM educators to reframe their own narrative, providing steps and milestones that confirm progress and redefine success along the journey of submitting and re-submitting grant proposals.

Finally, **STEM educators are not stifled by feelings of competitiveness**; instead they are open to sharing their experiences. Two-thirds of interview participants have helped students or other STEM educators in similar ways to the help they have received from mentors and collaborators. This cycle of learning and teaching is a critical component of the collabo-gleaning framework.

Recommendations for Administrators

Though this paper's focus is on individual educator empowerment and action, the results also suggest evidence-based actions for administrators. First, **open communication channels** such as

having junior educators write one-pagers on their project interests, inviting senior educators to present about grants funded, and sharing funding opportunities with potential collabo-gleaning teams. Administrators can also **establish connections** through introducing educators who may be open to a collabo-gleaning relationship and through encouraging the inclusion of graduate students as well. Finally, administrators can **advocate** for their early-career STEM educators by minimizing their service requirements in the first year or two, helping them with time management, prioritizing equipment/lab needs with university advancement offices, incentivizing senior faculty to add junior faculty to grants, and recognizing effort in evaluations.

Recommendations for STEM Educators

If you resonate with the challenges identified by this study's participants, use the self-assessment in Appendix A to uncover your individualized needs, potential collabo-gleaning relationships, and next steps. You can also use this tool to communicate expectations as you are developing collabo-gleaning relationships. The collabo-gleaning framework is made of real solutions put forth by real STEM educators. This is **your opportunity, your career, your chance** to contribute to the world with your research ideas.

Conclusion

Higher education institutions face unprecedented funding challenges, increasing their reliance on early-career educators to secure external funding. This situation leaves new STEM educators, who often lack experience navigating the external funding landscape, to pursue grants with insufficient support and limited ability to influence institutional systems that could enhance their success.

This study investigates how STEM educators at non-R1 universities pursue external funding by examining three key aspects: the barriers new educators encounter, how their experiences align with existing capacity development frameworks, and what unique aspects of capacity development emerge specifically for new STEM educators seeking external funding. Together, these questions explore both the challenges and developmental pathways for STEM educators at non-R1 institutions in their pursuit of external funding.

Building off two existing frameworks and direct feedback from educators, the authors created the "collabo-gleaning" framework in which new STEM educators build their own capacity by intentionally collaborating with knowledgeable educators, gleaning from their experiences. This model emphasizes the critical role of people-to-people knowledge transfer, where educators with expertise guide newcomers through the funding process. This results in an increase of educators with the knowledge to not only pursue external funding but to also "collabo-glean" with the next group of new educators. This systematic approach helps to unveil the mystery of external funding, representing a step toward the authors' vision of an environment where educators feel

empowered to confidently navigate funding processes, increase their success in securing external support, and continuously build their research capacity through collaborative learning.

Acknowledgements

The authors would like to acknowledge the brilliance of our study's participants, whose persistence and innovative ideas have built the collabo-gleaning framework. We would also like to thank our own collaborators and mentors over the past 20 years, who have allowed us to collabo-glean before it had a definition. And finally, we are honored to continue the cycle, welcoming early-career STEM educators into our work and into the work of our field.

References

[1] S. Carlson, “Sustaining the college business model,” The Chronicle of Higher Education, Inc., Washington, D.C., rep., 2018

[2] “Annual Nacubo tuition discounting study finds financial aid awards and undergraduate enrollment on the rise at private colleges and Universities,” NACUBO, https://www.nacubo.org/Press-Releases/2024/Annual-NACUBO-Tuition-Discounting-Study-Finds-Financial-Aid-Awards-on-the-Rise (accessed Jan. 5, 2025).

[3] J. Marcus, “Colleges are now closing at a pace of one a week. What happens to the students?,” The Hechinger Report, https://hechingerreport.org/colleges-are-now-closing-at-a-pace-of-one-a-week-what-happens-to-the-students/ (accessed Jan. 5, 2025).

[4] M. T. Nietzel, “Rate of college closures likely to increase, according to New Study,” Forbes, https://www.forbes.com/sites/michaeltnietzel/2024/12/07/rate-of-college-closures-likely-to-increase-according-to-new-study/ (accessed Dec. 27, 2024).

[5] M. Villeneuve and O. Sanchez, “Tracking College closures,” Tracking college closures, https://hechingerreport.org/tracking-college-closures/#:~:text=In%20recent%20years%2C%20the%20annual,closing%20between%202020%20and%202023 (accessed Jan. 5, 2025).

[6] A. W. June, “Which Colleges Spent the Most Money on Research?,” *The Chronicle of Higher Education*, vol. 70, no. 10, Jan. 2024.

[7] “Carnegie Classification of Institutions of Higher Education,” Carnegie Classification of Institutions of Higher Education, https://carnegieclassifications.acenet.edu/ (accessed Jan. 5, 2025).

[8] “Basic classification,” Carnegie Classification of Institutions of Higher Education, https://carnegieclassifications.acenet.edu/carnegie-classification/classification-methodology/basic-classification/ (accessed Jan. 5, 2025).

[9] K. Mangan, “A Race to the Top in Research,” *The Chronicle of Higher Education*, vol. 68, no. 13, Mar. 2022.

[10] H. C. Greene *et al.*, “Building a support system toward tenure: Challenges and needs of tenure-track faculty in Colleges of Education,” *Mentoring & Tutoring: Partnership in Learning*, vol. 16, no. 4, pp. 429–447, Nov. 2008. doi:10.1080/13611260802433791

[11] L. R. Larson *et al.*, "Getting started on the tenure track: Challenges and strategies for Success," *SCHOLE: A Journal of Leisure Studies and Recreation Education*, vol. 34, no. 1, pp. 36–51, Jan. 2019. doi:10.1080/1937156x.2019.1589804

[12] E. Schmiedehaus *et al.*, "The great resignation in higher education: An occupational health approach to understanding intentions-to-quit for faculty in higher education," *Teaching and Teacher Education*, vol. 123, Mar. 2023. doi:https://doi.org/10.1016/j.tate.2022.103992

[13] A. Bandura, "Self-efficacy: Toward a unifying theory of behavioral change," *Psychological Review*, vol. 84, no. 2, pp. 191-215, Mar. 1977. doi: 10.1037/0033-295X.84.2.191.

[14] J. B. Rotter, *Social Learning and Clinical Psychology*. Englewood Cliffs, NJ, USA: Prentice-Hall, Inc., 1954. doi: 10.1037/10788-000.

[15] A. Kiremire, B. Williamson, E. Wilson, and C. Dean, "(Re) shaping STEM evaluation through organizational capacity development," presented at *Amer. Eval. Assoc. Annual Conf. (Evaluation 2022)*, New Orleans, LA, USA, Nov. 10, 2022.

[16] Pact, "Pact's approach to capacity development," Washington, DC, USA, n.d.

[17] "Evaluating capacity development," Better Evaluation, https://www.betterevaluation.org/en/themes/capacitydevelopment (accessed Jan. 5, 2025).

[18] S. Otoo, N. Agapitova, and J. Behrens, "The Capacity Development Results Framework: A strategic and results-oriented approach to learning for capacity development," World Bank Institute, Washington, DC, USA, June 2009. Accessed: Jan. 8, 2025. [Online]. Available: https://openknowledge.worldbank.org/server/api/core/bitstreams/2cf30660-d718-5309-be6c-1df03572d170/content

[19] A. Bandura, *Social Learning Theory*. Englewood Cliffs, NJ, USA: Prentice-Hall, Inc., 1977.

A paid version of Canva was used to make graphics. A paid version of Canva includes non-exclusive, perpetual rights to use included images.

Appendix A: Self Assessment

SELF ASSESSMENT

for STEM educators pursuing external funding

		Not satisfied	Somewhat satisfied	Extremely satisfied
AWARENESS	My awareness of relevant grants in my field			
	A good, fundable research idea			
SKILLS	My strategic time management skills			
	My writing skills			
	My graphics skills			
	My budgeting skills			
RELATIONSHIPS	My ability to gain administrator support			
	My use of internal and external resources			
ACTION & PERSISTENCE	Submission of my first proposal			
	My persistence in continuing to submit			

From which researchers are you already gleaning the items listed above?
Don't forget to thank them!

With whom can you collaborate to address the items needing growth?
Consider experienced researchers you know through formal reporting channels, informal "hallway" communications, workshops, professional organization networks, and/or grad school.

How many hours per week can you commit to a collabo-gleaning relationship?
This is an important expectation to communicate between the two of you. The authors recommend starting with 1-3 hours per week.

Which other STEM educators or students could benefit from your experience?
Be open to a collabo-gleaning relationship by adding them to your grant!

For more details on collabo-gleaning, see:

A.DeLeo-Allen, A. B. Kiremire, K. Evans, A. Case Hanks, & K. C. Cruse, "Unveiling the mystery: A capacity development framework for early-career STEM educators pursuing external funding," in *Proceedings of the 2025 ASEE Annual Conference & Exposition, Montreal, QC, Canada, June 22-25, 2025.*

Appendix B: Survey of STEM Faculty and Graduate Students Pursuing External Funding

Page 1: INFORMED CONSENT

Thank you for your interest in participating in this project.

Information about the study is presented in **this informed consent document (click to open)**. This document was also emailed to you.

It is important that you read the informed consent document so you will know what to expect in the study.

By pressing "Next" you agree that you have read the document and consent to participate.

Page 2: SURVEY QUESTIONS

- Which best describes you:
  - STEM graduate student
  - STEM early-career faculty (within first 5 years)
  - STEM experienced faculty but not tenured
  - STEM tenured faculty
  - Other (fill in)
- Alone or in collaboration with others, how many grant proposals have you…
  - Worked on _____
  - Submitted _____
  - Been awarded _____
- What funding sources have you pursued? (check all that apply)
  - Private
  - Federal
  - State
  - Other (fill in)
  - N/A
- What level of funding have you pursued? (check all that apply)
  - $4,999 and under
  - $5,000 - $39,999
  - $40,000 - $199,999
  - $200,000 - $499,999
  - $500,000 - $999,999
  - $1M+
  - N/A
  - Other - Write in
- Which **resources helped you** as you pursued external funding? (check all that apply)
  - Training about grants (virtual or in person)

    - People I could call with questions/issues
    - Other faculty who modeled successful practices
    - Someone who guided me through the process
    - Templates or other documents to which I had access
    - Resources shared by my colleagues
    - Outsourcing work to an external party (like a grant writer)
    - Other - Write in
- **How important** have each of the following been **as you have built your own capacity** for pursuing external funding? (scale from not important to very important)
    - Increasing my awareness about grants
    - Building my skills in grant-related work
    - Being persistent in the face of challenges
    - Growing collaborative relationships
    - Identifying relevant funding agencies/programs for my work
    - Establishing a detailed plan/timeline
    - Implementing that plan/timeline
- What do you think **helped you the most** when pursuing external funding?
- What **barriers/challenges** have you faced when pursuing external funding?
- What **support do you wish you had** when pursuing external funding?
- What is your **advice for early-career faculty or graduate students** when pursuing external funding?
- What are your **experiences post-award** (if any)?

Page 3: THANK YOU

Thank you for your time completing this survey. We look forward to learning from you and sharing results.

Appendix C: Interview Guiding Questions for STEM Faculty Pursuing External Funding

- Level of experience
    - How would you describe your level of experience?
    - *Can probe for… level of promotion? Less than or more than 5 years of experience after graduate school?*
- First steps
    - In your opinion, what are the "first steps" for pursuing external funding?
    - Have you taken any of these steps? Why or why not?
        - If not, what would help you to take these steps?
            - *Can probe for: challenges removed, support added*
- Hacks/solutions
    - I am interested to know if you have found any "hacks" or solutions to common barriers faced by faculty. I will read out the top 3 barriers we found in our survey, then you can share any solutions you've found.
        - Lack of time because of many other responsibilities
        - Lack of support, help, or facilities at your university
        - Lack of experience or knowledge
- Help through collaboration or mentoring
    - Can you describe any other people who have helped, or are helping, to build your capacity in pursuing external funding?
        - *Can probe for… How did the relationship begin? What have you learned from them? What tangible support have they provided (such as lab space, administrative resources, etc)?*
    - Have you <u>provided</u> similar help to other faculty?
        - If so, what was your motivation? What are the benefits to you?

We have come to the end of our questions. Before we close, do you have any questions for me?