

# Facilitating the Transition of Underrepresented Minority STEM Dissertators into Academic Careers: Evolution of TxARM AGEP Alliance Model

**Mehrube Mehrubeoglu,** **Kimberle Kelly,** **Karen Butler-Purry,** **Ra'sheedah Richardson,** **Shannon Walton,**  
Texas A&M University-Corpus Christi Independent Texas A&M University Texas A&M University Texas A&M University

**Linda Challoo,** **Gloria Regisford,** **Scott King,** **Theresa Murphrey,** **Erin Burr,**  
Texas A&M University-Kingsville Prairie View A&M University Texas A&M University-Corpus Christi Texas A&M University Oak Ridge Associated Universities

**Laura Carson,** **Richard Coffin,** **Rosana Moreira,** **Carmen Carter,**  
Prairie View A&M University Texas A&M University-Corpus Christi Texas A&M University Prairie View A&M University

**Rajab Challoo,** **Audra Richburg,** **Adrienne R. Carter-Sowell**  
Texas A&M University-Kingsville Texas A&M University The University of Oklahoma

## Abstract

A national focus on Diversity, Equity, and Inclusion (DEI) has increased public awareness and acknowledgement of challenges faced by members of Underrepresented minority (URM) groups pursuing academic careers. This case study of a multi-institutional partnership explores the development, implementation, and evolution of a replicable model to transition a cohort of STEM URM dissertators into the professoriate. The model structured cohort engagement around an Individual Development Plan (IDP), cohort participant engagement with multiple mentors, monthly scholarly learning community meetings, research and teaching immersion experiences at Historically Black Colleges and Universities (HBCUs) and international institutions, and support and training around transferable skills necessary for job preparation and success, such as grant development, job search, portfolio preparation, interview skills, and online course development. Program evaluation results emphasized the evolution of collaborative practice among stakeholders in promoting the success of the model and among cohort participants as these participants transitioned into academic careers. Discussion of best practices to design and fine-tune the model included engagement of cohort participants in refining the implementation of the model activities, offering personalized services to the cohort members, and engaging research and practitioner communities using multiple dissemination strategies. The results of this work include publicly available virtual resources curated as part of the dissemination plan that can be explored for implementation at other institutions and use by individuals.

**Keywords:** STEM Partnership Programs, Collaborative Practice, Continuous Improvement, Higher Education, Diversity, Equity, Inclusion of Underrepresented Minorities

ties, Early Career Faculty, Alliances for Graduate Education and the Professoriate (AGEP)

## Introduction

Multiple researchers describe the challenges faced by underrepresented minority (URM) groups in pursuing academic careers (Bates et al., 2017; Boyd-Williams et al., 2019; Santillan-Jimenez & Henderson, 2017; Sinex et al., 2020). Consequently, a pervasive lack of diversity in the STEM professoriate exists across higher education in the United States. Adequately supporting diversity, equity, and inclusion (DEI) efforts requires that programs have sufficient depth and breadth to meet the needs of scholars from URM groups. One approach is to form an academic partnership in which multiple institutions and stakeholder groups work together to meet the needs of URM scholars through a collective and collaborative process.

Four institutions in a southern state (Texas) operating within a common university system (Texas A&M University System), varying in Carnegie and Minority-serving institution classifications (Indiana University Center for Postsecondary Research, 2021; U.S. Department of Education, 2020), established an academic alliance in September 2017, funded by the National Science Foundation's (NSF) Alliances for Graduate Education and the Professoriate (AGEP) program. AGEP is a national initiative committed to increasing the number of STEM faculty who come from URM groups (NSF, 2016). This case study explores the evolution of TxARM, Texas A&M System Research Model – AGEP Alliance, over a five-year period as it developed, implemented, studied, evaluated, researched, and disseminated a unique model for transitioning dissertators from URM groups to STEM careers in the professoriate (TxARM, Texas A&M System Research Model – AGEP Alliance, 2022).

Formative and summative evaluation focused on col-

laborative practice within and among stakeholder groups as crucial to the success of the TxARM AGEP Alliance Model. Distinct benefits of collaborative practices for scholars from URM groups were also documented. Evolution of the Alliance depended on the agility of the leadership team to both identify and respond to changing needs and circumstances as cohort participants moved forward in their career paths. As part of the Alliance dissemination plan, activity teams curated resources that are available to the academic community to learn about the TxARM AGEP Alliance Model and how it can be applied in other settings.

## Rationale for the TxARM AGEP Alliance Model

Individuals who are members of Underrepresented Minority (URM) groups face many challenges in their pursuit of academic careers (Bates et al., 2017; Boyd-Williams et al., 2019; Santillan-Jimenez & Henderson, 2017; Sinex et al., 2020). These challenges include isolation, ostracism, the hidden curriculum, and a lack of role models (Charleson et al., 2014; Cortina et al., 2013; Elliot et al., 2016; Figueroa & Hurtado, 2013; Kuchynka et al., 2018; O'Meara et al., 2019). Even more fundamental issues of teaching and learning exist; for example, analyses of STEM syllabi indicate that even these cornerstones of the academic experience can require major changes to facilitate active learning and avoid creating barriers for students from minority groups (Savaria & Monteiro, 2017).

Efforts to tackle these institutional and cultural challenges and create solutions that are adoptable by institutions of higher education to support URM groups in academia are not new (McClain et al., 2008; Young & Tilletson, 2008). Development of the TxARM AGEP Alliance Model encouraged multiple institutions to collaboratively curate a collection of activities that directly met the needs of cohort participants. Support for STEM scholars from

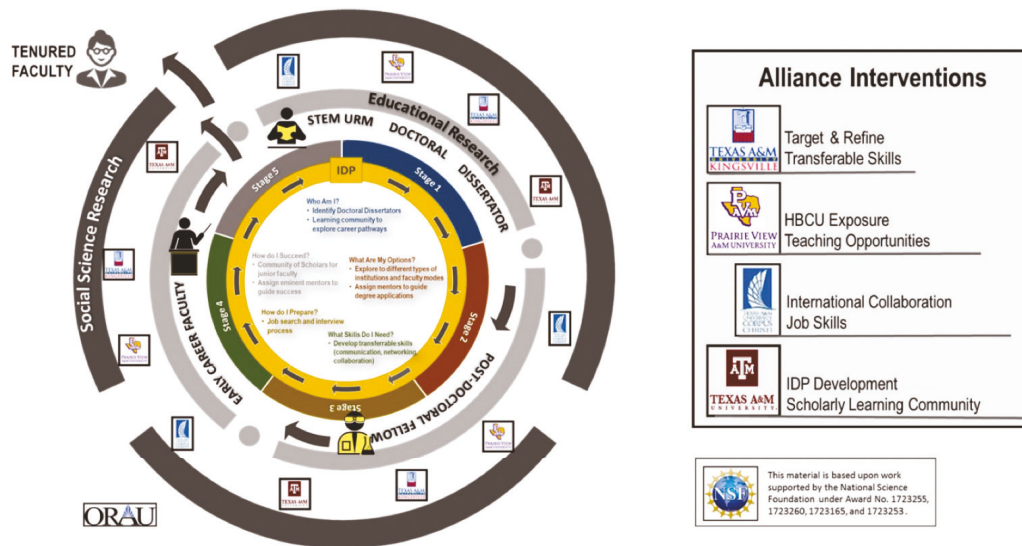


Figure 1. TxARM AGEP Alliance Model

underrepresented groups can exist at both the micro and macro levels, and university faculty and staff play key roles in student retention and success (Rice & Alfred, 2014). Thus, an approach involving nested stakeholder communities representing the academic ecology in which cohort participants are embedded can be beneficial.

Elements of the model are supported by prior research. For example, workshops focused on specific skills (i.e., mentorship, portfolio preparation, job applications, grant writing) have been found to improve URM scholars' confidence in those skill areas (Yadav & Seals, 2019), supporting our inclusion of the workshop method in several activity types. Furthermore, exposure to both domestic and international institutions has been shown to add value to the academic experience (Denney et al., 2015).

### Structure of the TxARM AGEP Alliance Model

The Alliance represented in this work is composed of four institutions of a common uni-

versity system in a southern state varying in size and other institutional characteristics. The stated goal of the AGEP Alliance Model (depicted in Figure 1) is to develop, implement, study, evaluate, and disseminate a model for transitioning dissertators from URM groups to STEM careers in the professoriate. The model is a strategic collection of activities and approaches that involve multiple individuals across the institutions working together to serve the cohort of URM dissertators from the four alliance institutions pursuing careers in the professoriate. Findings from TxARM social science research studies were shared with the members of the TxARM Alliance leadership, with the cohort scholars, and disseminated in report summaries, conference presentations, and peer reviewed publications (Ganesan & Carter-Sowell, 2021; Zimmerman, Ganesan & Carter-Sowell, 2021; Burr et al., 2022; Murphrey et al., 2022).

The TxARM AGEP Alliance Model consists of seven cohort-level and six Alliance-level activities to create pathways towards the professoriate for URM individuals in STEM. Each cohort-level activity was designed to offer unique services across the partnership institutions to serve URM scholars from each of the four participating campuses. Table 1 summarizes the products and services being delivered as part of each activity to stakeholders.

### Function of the TxARM AGEP Alliance Model

This case study explores the evolution of the TxARM AGEP Alliance Model for transitioning dissertators from URM groups to STEM careers in the professoriate (TxARM, Texas A&M System Research Model – AGEP Alliance,

| Activity                             | Description   |
|--------------------------------------|---|
| <b>Cohort-Focused Activities</b>     |   |
| Individual Development Plan          | Online form completed regularly to facilitate cohort's reflection on career and educational path progress   |
| Scholarly Learning Communities       | Monthly one-hour meetings conducted throughout the funding period, focusing on teaching and research activities with guest speakers (members of the advisory board)                                 |
| Ongoing and multiple mentors         | Facilitated individual mentoring relationships for each scholar, including with a faculty advisor, AGEP mentor, and eminent scholar   |
| Immersion HBCU                       | In-person and virtual campus visits; immersive teaching and research experiences  |
| Immersion International Institutions | In-person visits (Note: this activity was negatively impacted by the pandemic.)   |
| Transferable skills training         | Two to three half-day sessions per semester for three years   |
| Career planning and pursuit          | Weekly one hour writing group sessions; mock interview; portfolio preparation (cover letters, diversity statements, research and teaching statements, targeted CV development, etc.), grant writing |
| <b>Alliance-Wide Activities</b>      |   |
| Partnership collaboration            | Monthly meetings; information sharing   |
| Advisory boards                      | Cohort level, social science research level, Alliance level; meet annually for two-to-four hours  |
| Cohort recruitment                   | Completed in year 1 by interviewing prospective students across Alliance  |
| Formative and summative evaluation   | Formal annual evaluation process with internal and external evaluators using interviews and questionnaires, resulting in annual progress reports and a final report                                 |
| Social science research              | Studies focused on ostracism as related to pain sensitivity   |
| Dissemination                        | Sharing of products and results via refereed publications, conferences, and other venues for implementation by other institutions and individuals   |

Table 1. Cohort-Focused and Alliance-Wide Activities of the TxARM AGEP Alliance Model



2022) over a five-year funding period. Some Alliance-level activities (see Table 1) were focused on building collaborative practice within and among stakeholder groups, which is considered crucial to the success of the TxARM AGEF Alliance Model.

The emphasis on collaborative practice was motivated by multiple lines of research. The idea that expertise and resources across institutions can be centrally leveraged to achieve partnership goals is a major argument in favor of collaboration (Mattessich & Monsey, 1992). The literature supports the importance of collaborative practice while recognizing that there is a cost in increased time for coordination and the development of shared understanding across partners (Taylor-Powell et al., 1998; Gajda, 2004; Carey et al., 2009; Woodland and Hutton, 2012; Marek et al., 2015). Research also supports additional benefits of collaboration (Aitchison, 2009) especially as collaboration can build connections and provide a rich network to support URM students in succeeding in the professoriate (Carter-Veale et al., 2016).

Some Alliance-wide activities (see Table 1) also reflect an emphasis on data sources and feedback from diverse stakeholders to inform a continuous improvement cycle and engage research and practitioner communities. Even dissemination of the TxARM Alliance model can benefit from collaborative practice. Research on facilitating writing consistently highlights the use of collaborative practices to improve the quality and quantity of writing produced (Aitchison, 2009; Jones et al., 2012). Collaborative practice around writing was therefore employed to assist both cohort participants and leadership team members in the production of academic products.

## Methods

The formative and summative evaluations emphasized collaborative practices across the partnership ecology. Collaboration theory is a useful framework for evaluating the success of a strategic partnership, so the evaluation team adopted an ecological approach to evaluating collaborative practice in the context of an academic partnership, dubbed the SPARC model (Burr et al., 2022). As shown in Figure 2, the SPARC model considers collaborative practice as it relates to each group of stakeholders in the TxARM AGEF Alliance Model, emphasizing their roles and positions within the academic ecology as well as

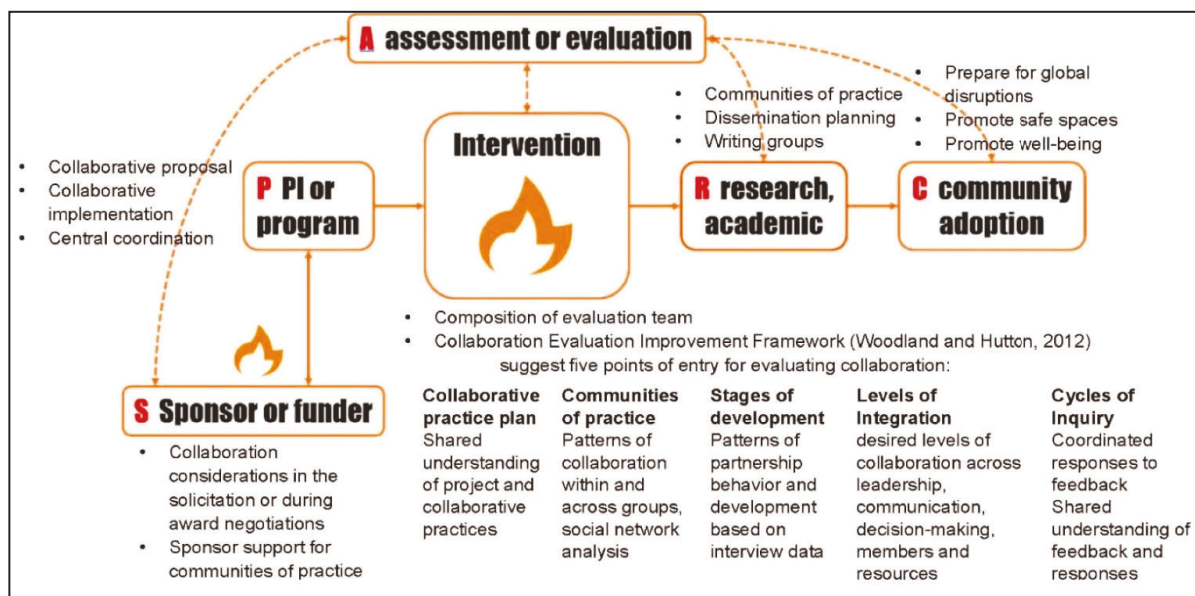


Figure 2. SPARC model of collaborative practice (author-provided)

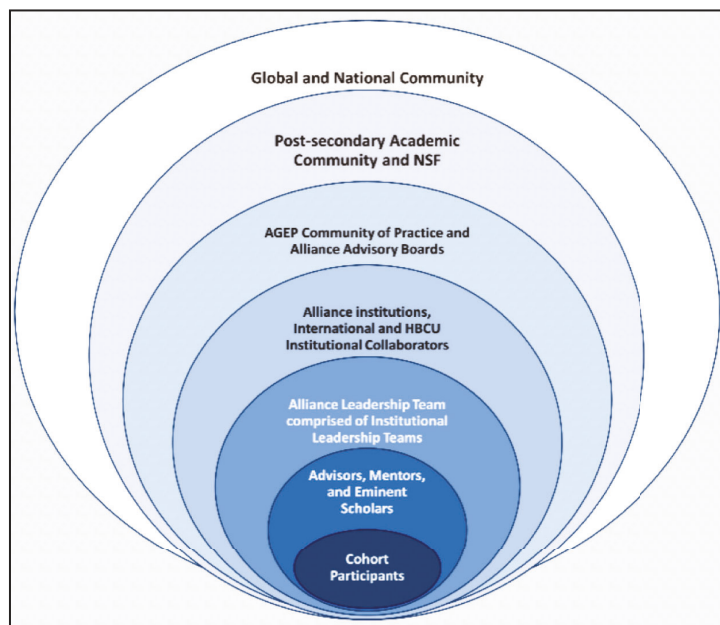


Figure 3. Stakeholders in the AGEF Alliance Model Academic Ecology (used with author permission: Burr, Kelly, Murphrey, & Koswatta, 2022)

how they contribute to and engage in the overall Alliance model.

With the SPARC model serving as an evaluation framework for collaborative practice, the evaluation of the TxARM AGEF Alliance Model employed case-study methodology (Yin, 2018). The case study method is particularly appropriate for evaluating the TxARM alliance, as the evaluation questions seek to understand how and why the alliance works. These questions require an in-depth description of the structure and function of the alliance in context. Further, the size of the participant cohort was limited to 12. This creates a situation where there are more explanatory variables than participants, precluding traditional statistical analysis.

From the beginning, the leadership team was focused on gathering feedback from stakeholder groups, particularly from cohort participants as part of a continuous improvement cycle. Post-activity reflections, annual evaluation interviews, needs assessment interviews, advisory boards comprised of cohort participant representatives, monthly scholarly learning community meetings, and annual meetings and site visits provided opportunities to receive feedback from stakeholders both in formal and informal settings. The following sections provide details about the continuous improvement cycle including information about the Alliance stakeholders, the assessment of collaborative practice for documenting outcomes for model

| Entry Point                                   | Description   | Measure   | Data Source  |
|---|---|---|--|
| Operationalize the construct of collaboration | Collaboration structures and strategies, shared understanding of model  | Itemized structures and strategies, shift in shared understanding over time | Annual Self-Report, Leadership Team, Program Documentation, Observation of Alliance Events |
| Identify and map communities of practice      | Interactions among stakeholders using a social network questionnaire and network mapping and visualization tool, the emergence of communities of practice (COPs) among stakeholders | Number and density of interactions among stakeholders                       | Annual Self-Report, Leadership Team, Cohort Participants                                   |
| Monitor stages of development                 | Characterizing the developmental stage of Alliance partnership using a semi-structured interview that is framed around current developmental status                                 | Developmental trajectory of Alliance over time, from assemble to adjourn    | Annual Self-Report, Leadership Team, Observation of Alliance Events                        |
| Assess levels of integration                  | Integration among partners around model execution in terms of leadership, communication, members, decision-making, resources  | Rubric scores A (low) cooperation to E (high) collaboration                 | Annual Self-Report, Leadership Team  |
| Assess cycles of inquiry                      | Assess cycles of inquiry--feedback and data-driven dialogue, decision-making, and action  | Feedback cycle completion across sources of feedback                        | Cohort Participants, Site Visits, Advisory Board Meetings, Annual Evaluation and Reporting |

**Table 2. Collaboration Components for Model Validation and Partnership Improvement**

validation and partnership improvement, and the collection of data from cohort participants.

### Academic Ecology of Alliance Stakeholders

The SPARC model considers the roles and positions of stakeholders within the academic ecology as well as how they contribute to and engage in the overall Alliance. The stakeholders in the AGEF Alliance included URM dissertators, faculty, researchers, staff, and administrators at the participating institutions of higher education, as well as evaluators of the project. Figure 3 represents the relationships among stakeholder groups of the AGEF Alliance in a nested model that proceeds from the cohort participants in the center of the model to society's support for DEI in higher education in the outermost ring. These stakeholder groups, therefore, include cohort participants; advisors, mentors, and eminent scholars; Alliance leadership teams comprised of institutional leadership teams; Alliance institutions, international and HBCU institutional collaborators; AGEF Community of Practice (COP) and Alliance advisory boards; as well as the post-secondary academic community and NSF.

Twelve STEM Ph.D. candidates were selected across four institutions as the first participant cohort. Out of the twelve, three chose positions outside of academia in industry and government after completion of their Ph.D. The nine remaining cohort members have progressed toward academic careers at different rates and through different

pathways depending on their STEM field of study. Their status in the professoriate is addressed in the results section.

The AGEF institutional portfolio consisted of 27 AGEF Alliances (since 2013; 18 are currently active) as of the end of the 2021 academic year, representing 112 unique institutions which have partnered in one or more Alliances (NSF, 2022). Alliance members from all funded projects participate in a community of practice through annual conferences and webinars, providing opportunities for capacity building around common Alliance needs.

### Evaluation of Collaborative Practice Among Stakeholders

As shown in Figure 2, the program evaluation of collaborative practice in TxARM Alliance was informed by the Collaboration Evaluation and Improvement Framework (CEIF; Woodland & Hutton, 2012). The CEIF outlines qualitative and quantitative data collection strategies and measurement tools for each of the five entry points to collaborative practice in a partnership. Table 2 lists the five entry points, each with a description of the construct, measured data points, and data sources.

While a comprehensive discussion of evaluation measures and analysis is beyond the scope of this article, the details of program evaluation development, collection, and analysis are part of the virtual resources available to

readers and were the focus of a recent publication (Burr et al., 2022), which is publicly available.

### Self-Study and Dissemination Practices Within and Among Activity Teams

The Alliance leadership team was not just open to receiving feedback, but actively sought feedback. From early on, the leadership team focused on gathering feedback from stakeholder groups, particularly from cohort participants, as part of a continuous improvement cycle. An important development was establishing advisory boards to represent the cohort participants. Additionally, post-activity reflections, needs assessment interviews, and monthly scholarly learning community meetings served as ongoing sources of feedback from cohort participants. Annual evaluation interviews, Alliance-wide meetings, and NSF site visits provided formal opportunities to receive additional feedback.

Cohort feedback was instrumental in fine-tuning the model of personalized services and training offered through the TxARM AGEF Alliance Model. Seeking feedback on behalf of the cohort participants regarding the content and direction of Alliance activities became increasingly important over the project lifecycle. This was in part due to increasing needs for customized and just-in-time support as cohort participants' trajectories to the professoriate diverged over time (Mehruheoglu, Kelly, Butler-Purry et al., 2022).

Other sources of feedback included annual evaluation and reporting requirements, Alliance-wide meetings, advisory board meetings, and site visits and negotiations with NSF. Advisory boards composed of faculty experts were formed, one to advise the overall Alliance model, and another focused on advising the social science research component. Composition of the advisory boards was part of initial grant negotiations with the program officer to ensure a range of expertise among members. Annual reporting of project activities and ongoing discussion during monthly virtual leadership team meetings were also key contributors to the evolution of the model.

### Results

An obvious question to consider about the TxARM AGEF Alliance Model was whether the Alliance achieved the proposed goal to develop, implement, study, evaluate and disseminate a model for transitioning dissertators



from URM groups to STEM careers in the professoriate. In other words, did the implementation of the model result in expected outcomes for cohort participants? Academic status variables are objective indicators of cohort participants' progress in their academic career pathways. A review of the nine cohort participants' status in higher education (at the time of submission) reveals that five are currently serving as Assistant Professors, one as Instructor, two as Post-Doctoral Researchers, and one with an institutional commitment to be placed in a faculty position upon completion of the dissertation. With this evidence of successful outcomes for cohort participants, evaluation focused on identifying the critical components of the model's success. Data from the program evaluation revealed four main drivers of Alliance success:

- Evolution of collaborative practice among leadership team members promoted the success of the alliance model.
- Evolution of collaborative practice among cohort participants supported their pathway to the professoriate.
- Identified best practices and design principles with cohort feedback supported URM cohort participants as part of a continuous improvement cycle.
- Engaged research and practitioner communities resulted in multiple dissemination strategies.

Each of these areas are discussed in the following sections.

## Evolution of Collaborative Practice among Partnership Members

Partnership evolution of collaborative practice us-

ing the CEIF framework was evident among leadership team members and URM scholars participating in the cohort. Network data also indicated that collaboration across activities and institutions increased over time. A practical example illustrates the findings as observable changes in Alliance function. Each cohort-focused activity in Table 1 started as an independent subprogram with its own objectives and outcomes, assigned across institutions and team members, all independently contributing to the development of the model. As the leadership team spent more time together, they developed interpersonal relationships and a shared understanding of the TxARM AGEF Alliance Model. This promoted working together to streamline the model, consolidate data collection, integrate elements of different activities into common sessions, and achieve overlapping objectives, thereby optimizing cohort members' time investment in model-based activities. The alliance logic model pictured in Figure 4 summarizes the activities within the model, which can be adopted and adapted as needed.

It is important to recognize that development of collaborative practice over time is an expected outcome for a multi-institutional partnership like the TxARM AGEF Alliance Model. Thus, partnerships should be prepared to experience the challenges inherent in establishing, implementing, and maintaining a partnership model. Opportunities for in-person Alliance-wide and cohort annual development meetings provided the space and opportunity for initial development of connections and collaborative practice, forming a basis of trust to continue collabora-

tive practice remotely once a strong foundation had been established. During the peak of the COVID-19 pandemic, these already-established connections and practices enabled successful continuity for the Alliance model activities. Ongoing connections maintained the network over space and time, such as monthly Scholarly Learning Community meetings and weekly Writing Sessions with the cohort participants, and monthly institutional and Alliance-wide meetings for the leadership team. The collaborations and activities have led to significant camaraderies, friendships, and support groups, integral to the implementation of the model.

## Evolution of Collaborative Practice among Cohort Participants

Collaboration with and among cohort participants took several forms: with members of the Alliance team, within the cohort, and new collaborations because of participation in Alliance activities or in their pathways to the professoriate.

Alliance model activities promoted new collaborations with other students, faculty, and institutions. Exposure of cohort participants to Alliance stakeholders, including leadership team members, multiple mentors, advisory board members, NSF program staff, faculty, and students at HBCU and international institutions as part of immersion experiences provided opportunities for URM cohort scholars to build their professional network in tangible ways aligned to their research interests.

The TxARM AGEF Alliance Model cohort activities pro-

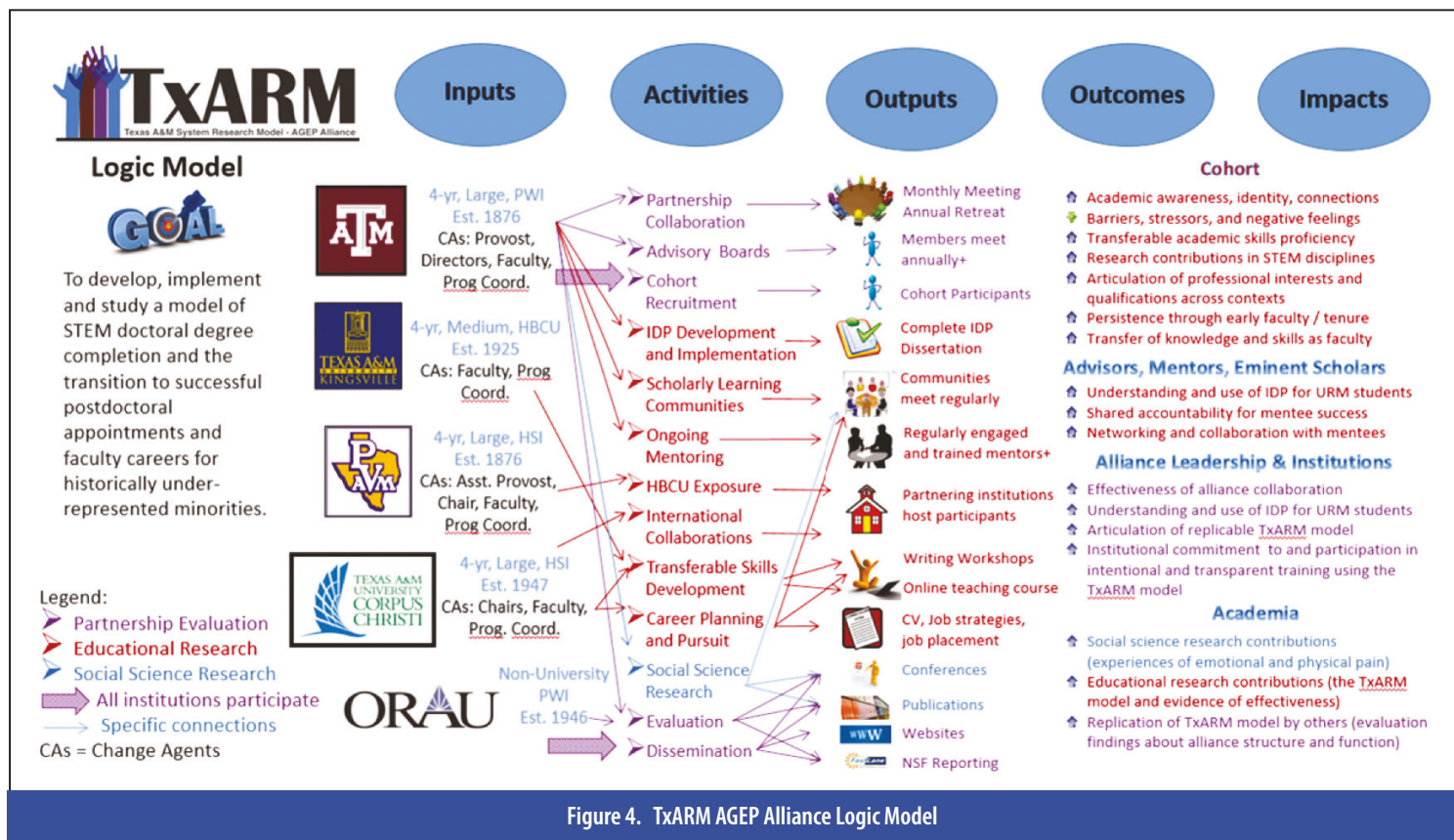


Figure 4. TxARM AGEF Alliance Logic Model

vided the space and structures to bring cohort members together, facilitate their collaborative structure, and support their experiences. As with the leadership team, initial in-person experiences were crucial in establishing a firm foundation for authentic collaboration. A supportive network among the cohort participants was initially cultivated through cohort-focused activities but was maintained outside AGEF activities as a highly valued activity by the cohort participants in supporting their academic progress and persistence.

Writing groups and collaborative technologies (i.e., Slack™) reflect cohort participants' desire to collaborate in real time and engage in peer support directly through the group experience. Collaborative synchronous and asynchronous writing groups (Aitchison, 2009; Kozar & Lum, 2015; Tyndall et al., 2019) facilitated by leadership team members promoted scholarly productivity among the cohort participants for the development of portfolio products needed to secure, perform, and excel in academic positions. Similarly, synchronous and asynchronous writing among the leadership team facilitated the fulfillment of the proposed dissemination plan. In addition to promoting collaborative practice among the cohort participants, the next section discusses other best practices for supporting stakeholder success across the TxARM AGEF Alliance.

### Best Practices to Support Cohort and Model Success

The developed TxARM AGEF Alliance Model has been refined over five years to serve as a flexible model to assist URM dissertators through their path to STEM academic careers. The adaptability of the TxARM model is one of its strengths, to best serve a diverse group of dissertators as they transition to postdoctoral researchers and early-career faculty.

Ongoing feedback from cohort participants as part of a continuous improvement cycle facilitated the evolution of a more meaningful and implementable model over time. Their participation and reflections revealed what had to be adjusted in the model to accommodate individual needs along the various pathways. For example, the impact of personal situations, like familial responsibilities in moving or willingness to relocate, as well as the COVID-19 pandemic, contributed to the need for customization of activities to maximize their value to the URM aspirants to the professoriate.

Key design features to benefit cohort participants emerged from this continuous improvement process. Cohort participants benefit most from personalized services that are received just-in-time, rather than generalized services available at most institutions, such as general workshops on resume writing and job search databases. Cohort members' time is valuable; most have additional commitments as they are trying to move forward with their dissertation. Overburdening them with required activities does not serve them

well, and activities must provide experiences that support the work they are already doing.

### Dissemination for Sustainability and Adoption by Practitioners

A primary motivation in sharing this case study is to provide the academic community with the opportunity to access virtual resources curated as part of the TxARM AGEF Alliance Model's dissemination plan, a required element for NSF-funded AGEF alliances. The Alliance website features a bibliography of dissemination products of the TxARM model to date (TxARM, Texas A&M System Research Model – AGEF Alliance, 2022). While the dissemination plan of the alliance model initially targeted plans for journal articles, it evolved to include Alliance websites at each participating institution, participation in conference events, as well as press releases, newsletters, a toolkit, and other relevant information sources to increase access to the findings and resources that will allow sustainability and future implementations of the model.

As demonstrated throughout this case study, collaborative practice provides capacity and opportunities to benefit from the collective knowledge generated as part of alliance development and implementation. Collaborative practices also improve the quality and quantity of dissemination products. The Alliance leadership sought dissemination guidance from among the leadership team and advisory board members, offering sessions framing Alliance research in the "science of teaching and learning" literature with a list of potential journals to target for Alliance contributions. Finally, the Alliance leadership team enlisted the services of a STEM education consultant to promote collaborative dissemination practices and assist Alliance-wide dissemination teams in preparing conference papers and journal articles identified in the Alliance dissemination plan. Some leadership faculty members also targeted engineering conferences and journals to ensure the results are disseminated to the very faculty who will be interacting with the URM dissertators and early career faculty along their path (Mehrubeglu, Kelly, Walton et al., 2022, June 26–29).

One of the conclusions drawn from the NSF AGEF TxARM Social Science research studies was that roles as a ghost writer, silent partner, and anonymous donor imply that no negative consequences accompany being present but not accounted for in the workplace. However, studies (Carter-Sowell et al., 2021) show that being an "invisible" worker matters. Furthermore, being visible is differentially beneficial for career advancement and on positive experiences at the job. Importantly, factors related to intersectional identities influence differences in stepping out of a perpetual, professional blind spot and confronting workplace ostracism practices offer mixed outcomes for minoritized workers (Carter-Sowell et al., 2021).

An important product of this model implementation is an Alliance toolkit with instructional materials and implementation resources for the academic community

to learn more about the TxARM AGEF Alliance Model and how it could be applied in other settings (TxARM Toolkit, 2022; Texas A&M System AGEF Alliance (TxARM) Toolkit, 2022). The TxARM Alliance leadership team developed the tools and resources with other practitioners in mind so that they can be useable as a sustainable model that can be adopted and adapted by a variety of institutions in their own institutional partnerships.

### Conclusions

The TxARM AGEF Alliance Model reported here has been refined over five years to serve as a flexible model to assist URM dissertators on their pathway to the STEM professoriate. Best practices and design principles to support URM cohort participants emerged as part of a continuous improvement cycle. The cohort members played a significant role in fine-tuning the model during the implementation phase, and their participation and reflections were critical in adjusting the model to accommodate individual needs along the various pathways. The adaptability of this TxARM AGEF Alliance Model is a tremendous strength, especially due to the turbulence created by COVID-19 during the project time period.

Success hinged on network development and engagement, expanding and deepening connections amongst stakeholders, particularly in person, and reflecting on feedback and data to improve partnership implementation and thus cohort participant success. Partnership evolution of collaborative practice using the CEIF Framework (Woodland & Hutton, 2012) was evident among leadership team members and URM scholars participating in the cohort. Over time, products and services were improved and streamlined by working across activities and institutions, demonstrating evolution of the TxARM AGEF Alliance Model to better serve URM dissertators to early career faculty.

The model can be adopted by institutions to serve URM STEM scholars in their quest to enter academic careers by overcoming the systemic challenges that exist in higher education today as institutions strive to achieve DEI. As demonstrated throughout this case study, collaborative practice provides capacity and opportunities to benefit from the collective knowledge generated as part of Alliance model development, implementation, study, evaluation, and dissemination. The fine-tuned model is available in an online toolkit with instructional materials and implementation resources (TxARM Toolkit, 2022; Texas A&M System AGEF Alliance (TxARM) Toolkit, 2022).

### Limitations of the Case Study

Given this is a case study of one group's work, causality cannot be implied. However, there is the potential for others to benefit from the lessons learned through the Alliance's analysis and journey mapping which are invaluable in deepening the understanding as to what matters

the most in promoting DEI as part of a partnership model. Teams of varying size can benefit from the TxARM AGEP Alliance experiences, and these experiences are expected to be of interest to and benefit the AGEP COP and related partnership programs.

The TxARM AGEP Alliance Model was cultivated for a specific cohort and is not generalizable to all URM dissertators. The data from this case study suggest that cohort participants' needs must be continually assessed, as career paths and career goals and objectives will differ from one another, career paths will progress at different speeds, and options will vary. The model must accommodate such changes and variations in individual members over time.

## Implications of the Case Study

Despite the limitations inherent in a case study design of one Alliance, many alliances share similar characteristics and developmental trajectories. Both leadership team and cohort participants reported the value of in-person meetings and events, particularly at the beginning and before the COVID-19 pandemic, to cultivate the development of trust needed for successful collaboration. It is, therefore, reasonable to suggest that any partnership interested in success would benefit from the cultivation of collaborative practice across stakeholders. Collaborative practice provided continuity across activities and connections among stakeholders. An admirable element of the NSF AGEP program is the encouragement to share these models in the AGEP COP so that others can also benefit from them. Providing practitioners access to this partnership model through dissemination is a primary motivation for this case study.

The final model has yielded tools and resources that will be available to cohort participants as they move through their individualized paths in their academic careers. The participants will be able to use and apply what they have learned in their local context. Participant adoption of strategies into their own practice is an area that warrants further documentation.

## Acknowledgments

This material is based upon work supported by the National Science Foundation under awards 1723255, 1723260, 1723165, and 1723253. The authors thank all the faculty, staff, administrators, and participants who contributed to the project.

## References

Aitchison, C. (2009). Writing groups for doctoral education. *Studies in Higher Education*, 34(8), 905–916. <https://doi.org/10.1080/03075070902785580>

- Bates, R. A., Jones, E. C., & Arnold, A. A. (2017, June 24–28). *Career arcs that blend industry, government and military service with faculty experiences to increase diversity in the engineering professoriate* [Paper presentation]. 2017 ASEE Annual Conference & Exposition, Columbus, OH, United States. <https://doi.org/10.18260/1-2--28011>
- Boyd-Williams, A. A., Bigsby, S., Gloster, C., Sowell-Boone, E., & Melton, M. A. (2019, June 15). *Preparing future minority faculty for the professoriate (Experience)* [Paper presentation]. 2019 ASEE Annual Conference & Exposition, Tampa, FL, United States. <https://doi.org/10.18260/1-2--33191>
- Burr, E. B., Kelly, K. A., Murphrey, T. P., & Koswatta, T. J. (2022). An ecological approach to evaluating collaborative practice in NSF sponsored partnership projects: The SPARC model. *Frontiers in Psychology*, 12, 751660. <https://doi.org/10.3389/fpsyg.2021.751660>
- Carey, C., Smith, K., & Martin, L. M. (2009). Cross-university enterprise education collaboration as a community of practice. *Educ. Train.* 51, 696–706. doi:10.1108/00400910911005244
- Carter-Sowell, A. R., Ganesan, A., Williams, M., & Zimmerman, C. A. (2021). Ostracism in the diverse workplace: Experiences of different racial/ethnic groups and immigrant employees. In C. Liu and J. Ma (Eds.), *Workplace ostracism: Its nature, antecedents, and consequences*. Palgrave Macmillan. [https://doi.org/10.1007/978-3-030-54379-2\\_7](https://doi.org/10.1007/978-3-030-54379-2_7)
- Carter-Veale, W. Y., Tull, R. G., Rutledge, J. C., & Joseph, L. (2016). The Dissertation House Model: Doctoral student experiences coping and writing in a shared knowledge community. *CBE—Life Sciences Education*, 15, 1–12. <https://doi.org/10.1187/cbe.16-01-0081>
- Charleston, L. J., George, P. L., Jackson, J. F. L., Berhanu, J., & Amechi, M. H. (2014). Navigating underrepresented STEM spaces: Experiences of black women in U.S. computing science higher education programs who actualize success. *Journal of Diversity in Higher Education*, 7(3), 166–176. <http://dx.doi.org/10.1037/a0036632>
- Cortina, L. M., Kabat-Farr, D., Leskinen, E. A., Huerta, M., & Magley, V. J. (2013). Selective incivility as modern discrimination in organizations: evidence and impact. *Journal of Management*, 39(6), 1579–1605. <https://doi.org/10.1177/0149206311418835>
- Denney, L. B., Sanchez-Pena, M., & Main, J. B. (2015). *Examining how international experiences promote global competency among engineering graduate students* [Symposium presentation]. The Summer Undergraduate Research Fellowship (SURF) Symposium, West Lafayette, IN, United States.
- Elliot, D. L., Baumfield, V., Reid, K., & Makara, K. A. (2016). Hidden treasure: successful international doctoral students who found and harnessed the hidden curriculum. *Oxford Review of Education*, 42(6), 733–748. <https://doi.org/10.1080/03054985.2016.1229664>
- Figuerola, T., & Hurtado, S. (2013). *Underrepresented racial and/or ethnic minority (URM) graduate students in STEM disciplines: A critical approach to understanding graduate school experiences and obstacles to degree progression*. Los Angeles, CA: University of California.
- Gajda, R. (2004). Utilizing collaboration theory to evaluate strategic alliances. *Am. J. Eval.*, 25, 65–77. doi:10.1177/109821400402500105
- Ganesan, Asha, & Carter-Sowell, A. R. (2021). Buffering anti-fat attitudes using contact: The roles of contact quantity, duration, favorability, and inter-group anxiety *Body Image*, v.38, 2021 <https://doi.org/10.1016/j.bodyim.2021.03.019>
- Indiana University Center for Postsecondary Research (2021). *The Carnegie classifications of institutions of higher education* [2018 Update public file]. <https://carnegieclassifications.iu.edu/downloads.php>
- Jones, D., Jones, J. W., & Murk, P. J. (2012). Writing collaboratively: Priority, practice, and process. *Adult Learning*, 23(2), 90–93. <https://doi.org/10.1177%2F1045159512443526>
- Kozar, O., & Lum, J. F. (2015). Online doctoral writing groups: Do facilitators or communication modes make a difference? *Quality in Higher Education*, 21(1), 38–51. <http://dx.doi.org/10.1080/1353832.2015.1032003>
- Kuchynka, S. L., Salomon, K., Bosson, J. K., El-Hout, M., Kiebel, E., Cooperman, C., & Toomey, R. (2018). Hostile and benevolent sexism and college women's STEM outcomes. *Psychology of Women Quarterly*, 42(1), 72–87. <https://doi.org/10.1177/0361684317741889>
- Marek, L. I., Brock, D.-J. P., & Savla, J. (2015). Evaluating collaboration for effectiveness: conceptualization and measurement. *Am. J. Eval.* 36, 67–85. doi:10.1177/1098214014531068
- Mattessich, P. W., & Monsey, B. R. (1992). *Collaboration: What makes it work. A review of research literature on factors influencing successful collaboration*. Amherst H. Wilder Foundation.
- McClain, L., Schrader, C., & Callahan, J. (2008, June 22–25). *Improving campus climate for faculty from underrepresented groups* [Paper presentation]. 2008 ASEE Annual Conference & Exposition, Pittsburgh, PA, USA. <https://doi.org/10.18260/1-2--4185>



- Mehrubeoglu, M., Kelly, K., Walton, S., Richardson, R., Butler-Purry, K., & King, S. (2022, June 26–29). *Academic Job Preparation for Underrepresented STEM Dissertators, Postdoctoral Researchers, and Early Career Faculty: Contributions to an Institutional Partnership Model for Promoting Diversification of the Professoriate*. Proc. 129th Annual ASEE 2022 Conference & Exposition, Minneapolis, MN, USA <https://peer.asee.org/academic-job-preparation-for-underrepresented-stem-dissertators-postdoctoral-researchers-and-early-career-faculty-contributions-to-an-institutional-partnership-model-for-promoting-diversification-of-the-professoriate.pdf>
- Mehrubeoglu, M., Kely, K., Butler-Purry, K., Green, M. B., Walton, S., Richardson, R., Carson, L., Challoo, L., Moreira, R., Carter, C., Regisford, G., Fowler, D., King, S., Coffin, R., Murphrey, T., & Burr, E. (2022, Nov. 2–4). *Evolution of TxARM Model of STEM: Assisting Underrepresented Minority STEM Ph.D. Dissertators to Transition to Academic Careers Through Personalized Pathways*. 2022 AGEP National research Conf. (AGEP 2022), Corpus Christi, TX, USA.
- Murphrey, T. P., Carter, C. R., Regisford, E. G. C., Carson, L. E., Butler-Purry, K., Carter-Sowell, A. R., Ganesan, A., & Richburg, A. (2022). An Examination of the Paths of Successful Diverse STEM Faculty: Insight for Programming. *Frontiers in Education*, 7: 767476. <https://doi.org/10.3389/feduc.2022.767476>
- National Science Foundation [NSF]. (2016). *NSF division of HRD Alliances for Graduate Education and the Professoriate (AGEP) program guidelines*. <https://www.nsf.gov/pubs/2016/nsf16552/nsf16552.htm>
- National Science Foundation [NSF]. (2022). *NSF awards search*. Retrieved August 1, 2022, from <https://www.nsf.gov/awardsearch/advancedSearchResult?ProgEleCode=1515&BooleanElement=Any&BooleanRef=Any&ActiveAwards=true#results>
- O'Meara, K., Griffin, K. A., Nyunt, G., & Louder, A. (2019). Disrupting ruling relations: the role of the PROMISE program as a third space. *Journal of Diversity in Higher Education*, 12(3), 205–218. <https://doi.org/10.1037/dhe0000095>
- Rice, D., & Alfred, M. (2014, July–September). Personal and structural elements of support for African American female engineers. *Journal of STEM Education*, 15(2), 40–49. <https://www.jstem.org/jstem/index.php/JSTEM/article/view/1843>
- Santillan-Jimenez, E., & Henderson, W. (2017, June 24–28). *Using a research center-based mentoring program to increase the participation of African Americans, Hispanics and Native Americans in engineering* [Poster presentation]. 2017 ASEE Annual Conference & Exposition, Columbus, OH, United States. <https://peer.asee.org/27731>
- Savaria, M. C., & Monteiro, K. A. (2017). A critical discourse analysis of engineering course syllabi and recommendations for increasing engagement among women in STEM. *Journal of STEM Education*, 18(1), 92–97. <https://www.jstem.org/jstem/index.php/JSTEM/article/view/2217/1840>
- Sinex, D. C. E., Besterfield-Sacre, M. E., Carter-Veale, W., Yohe, D. G., Abramowitch, S., & Wosu, S. N. (2020, June 22–26). *The Pitt STRIVE Program: Adopting evidence-based principles “The Meyerhoff and PROMISE Way”* [Paper presentation]. 2020 ASEE Virtual Annual Conference Content Access, virtual conference. <https://doi.org/10.18260/1-2--35355>
- Taylor-Powell, E., Rossing, B., & Geran, J. (1998). Evaluating collaboratives: reaching the potential. *University of Wisconsin—Extension*, 8. Available at: [https://books.google.com/books/about/Evaluating\\_Collaboratives.html?id=QsMJHQAAAJ](https://books.google.com/books/about/Evaluating_Collaboratives.html?id=QsMJHQAAAJ) (Accessed June 27, 2022).
- TxARM, Texas A&M Research Model – AGEP Alliance. (2022). *WELCOME TO TxARM*. Available at: <https://agep-txarm.tamu.edu/> (Accessed July 29, 2022)
- TxARM Toolkit. (2022). *About TxARM Toolkit and Model*. TxARM AGEP Alliance. Available at: <https://agep-txarm.tamu.edu/About/Activities/TxARM-Toolkit>
- Texas A&M System AGEP Alliance (TxARM) Toolkit. (2022). *TxARM AGEP Alliance*. Available at: <https://rise.articulate.com/share/b0ihnmt3-PvMt9PU7R7x-ICbul6Gw8Frp#/> (Accessed July 10, 2022).
- Tyndall, D. E., Forbes, T. H. III., Avery, J. J., & Powell, S. B. (2019). Fostering scholarship in doctoral education: Using a social capital framework to support PhD student writing groups. *Journal of Professional Nursing*, 35(4), 300–304. <https://doi.org/10.1016/j.profnurs.2019.02.002>
- Yadav, A., & Seals, C. (2019, May). Taking the next step: Supporting postdocs to develop an independent path in academia. *Journal of STEM Education*, 6(15). <https://doi.org/10.1186/s40594-019-0168-1>
- Young, M., & Tillotson, J. (2008, June 22–25). *Negotiating the path to the professoriate: A study of faculty perspectives in mechanical engineering* [Paper presentation]. 2008 ASEE Annual Conference & Exposition, Pittsburgh, PA. <https://doi.org/10.18260/1-2--4085>
- Woodland, R. H., & Hutton, M. S. (2012). Evaluating organizational collaborations: Suggested entry points and strategies. *American Journal of Evaluation*, 33(3), 366–383. <https://doi.org/10.1177%2F1098214012440028>
- U.S. Department of Education (2020). United States Department of education lists of postsecondary institutions enrolling populations with significant percentages of undergraduate minority students. *Office for Civil Rights*. Retrieved July 29, 2022, from <https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html>
- Yin, R. (2018). *Case Study Research and Applications, Design and Methods*, 6th Ed. Los Angeles: SAGE Publications, Inc. [https://www.sagepub.com/sites/default/files/yin\\_6e\\_chapter\\_1\\_getting\\_started.pdf](https://www.sagepub.com/sites/default/files/yin_6e_chapter_1_getting_started.pdf)
- Zimmerman, C. A., Ganesan, A., & Carter-Sowell, A. R. (2021). Confrontation as an interpersonal response to ostracism. *European Journal of Social Psychology*, 51, 436–449. <https://doi.org/10.1002/ejsp.2749>



**Dr. Mehrube Mehrubeoglu** is a Professor and Program Coordinator of Electrical Engineering and M.S. in Engineering. She received her B.S. degree in Electrical Engineering from UT Austin, and her M.S. in Bioengineering and Ph.D. in Electrical Engineering from Texas A&M University. She is interested in applications of imaging, image processing, classification and AI methods. She is committed to effective teaching and learning in STEM. She can be reached at [ruby.mehrubeoglu@tamucc.edu](mailto:ruby.mehrubeoglu@tamucc.edu).



**Dr. Kimberle Kelly** has managed and directed research and evaluation outcome studies in education and mental health for major research universities, offices of education, school districts, and nonprofit organizations. Her specialties include mixed-methods research and evaluation designs for Science, Technology, Engineering, and Mathematics (STEM) education initiatives in early childhood, K-12, and higher education settings.



**Dr. Karen Butler-Purry** received the Ph.D. degree in electrical engineering from Howard University. Currently she is a professor in the electrical and computer engineering. Her research interests are in the areas of protection and control of electric power systems for ships, mobile grids, and microgrids, cybersecurity protection, and graduate and engineering education.



**Dr. Ra'sheedah Richardson** is the Associate Director of the Texas A&M University Center for Teaching Excellence. Dr. Richardson supports and oversees the operation of programs such as Academy for Future Faculty and Graduate Teaching Consultant. She also leads the Teaching Assistant Institute and serves as a campus representative for the Center for the Integration of Research, Teaching, and Learning (CIRTL).



**Dr. Shannon D. Walton** is Assistant Dean in the Graduate and Professional School at Texas A&M University. Shannon oversees the recruitment and retention of high quality, diverse graduate students, professional development, graduate student success and management of federal grants focused on developing a diverse pool of scientists and engineers earning PhDs.



**Dr. Linda Challoo** is a Professor in the Educational Leadership and Counseling Department and former Associate Dean for University Research and Graduate Studies at A&M University-Kingsville. She is the doctoral level STEM Certificate Program Coordinator and A&M-Kingsville PI for multi-institutional NSF grant. She holds a doctorate in Educational Leadership and M.S./B.S. degrees in Engineering.



**Dr. E. Gloria C. Regisford** is a professor of Biology who also serves as the Associate Dean for Research – Sciences and Math in the College of Arts and Sciences at Prairie View A&M University (PVAMU). Recently awarded the Texas A&M University System (TAMUS) Regents Professor, Dr. Regisford has dedicated her academic career to the mission of helping to diversify the STEM workforce.



**Dr. Scott A. King** received his Ph.D. from The Ohio State University in 2001 in Computer and Information Science. He joined Texas A&M University-Corpus Christi in 2004 and is currently a Professor of Computer Science and the director of Innovation in Computing REsearch (iCORE) lab.



**Dr. Theresa Murphrey** is a Professor in the Department of Agricultural Leadership, Education, and Communications at Texas A&M University. Her research focuses on teaching and learning, evaluation, and change dynamics to address educational and learning issues, develop best practices, and maximize individual learning opportunities. She can be contacted at [t-murphrey@tamu.edu](mailto:t-murphrey@tamu.edu).



**Dr. Erin M. Burr** serves as a lead evaluator for STEM Workforce Development working on evaluations of local, national, and international STEM education and workforce development programs that include K-12 students and teachers; university students and faculty; post-graduates, and PhD-level researchers. She is a graduate of the Evaluation and Assessment Ph.D. program at the University of Tennessee.



**Dr. Laura Carson** completed her BS Chemistry (Alcorn State University) and PhD Polymer Science (University of Akron). She currently serves as the Director for Undergraduate Research in the Cooperative Agricultural Research Center at PVAMU. As a research scientist, she has engaged approximately 100 undergraduate students in STEM-based research areas and 50% of them are engaged in STEM field careers.



**Dr. Richard Coffin's** geochemical background focuses on natural and anthropogenic carbon cycles for understanding pertinent Earth ecosystem cycles. Work is global off eight continents. Platforms include ships, autonomous and manned sea and air craft. Contributions have been through working as leader or co-leader of planning, execution, data collection and interpretation.



**Dr. Rosana G. Moreira** is a Professor and Director of Distance Education Program in Food Engineering in the Biological & Agricultural Engineering Department (BAEN) at Texas A&M University. Moreira's research involves applying the engineering approach to understand biological systems and processes. She has worked with URM graduate students in STEAM fields helped dissertators develop a confident academic identity as they progress to the professoriate.



**Dr. Carmen R. Carter** serves as the Assistant Provost for Academic Affairs at Prairie View A&M University.



**Dr. Rajab Chaloo** is a professor in the EE/CS department and former department chair, faculty senate president, and founding director at A&M Univ-Kingsville. He received multiple Univ/College/Dept awards and has been involved in over \$7M research grants funded by the NSF/ONR/DoD/etc. and over 100 publications. He is a licensed Professional Engineer and has B.S./M.S./Ph.D. degrees in Electrical Engineering.



**Audra Richburg** (M.Ag., Texas A&M University) is a program coordinator in the Department of Agricultural Leadership, Education, and Communications at Texas A&M University. She provides instructional design support, evaluation support, and administrative assistance to several federally-funded projects within the department.



**Dr. Adrienne R. Carter-Sowell** leads the Social Sciences research team for the TxARM AGEP Alliance. She serves on the planning committee that hosted the NSF AGEP Conference held in Corpus Christi, TX. She's a tenured, Professor of Psychology and inaugural, First Year Experience Program Director at the University of Oklahoma.

