

# Diversity, Equity, and Inclusion (DEI) by Design to Build Connections with Campus Communities: The Role of Collaborations in the Changing Academy

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## Abstract

For 25 years, the National Science Foundation's Alliances for Graduate Education and the Professoriate (AGEP) program has been supporting efforts to broaden participation and meaningfully diversify the Science, Technology, Engineering, and Mathematics (STEM) postdoctoral and faculty ranks. To examine the structures and strategies carried out by NSF AGEP programs, a thematic taxonomy was developed based on awardees operating from 2013–2021. The classification of 27 NSF AGEP programs, spanning across the U. S. and representing Institutions of Higher Education from coast to coast, identified the interventions and activities undertaken at the individual, cohort, and institutional levels. Findings from the thematic taxonomy are accompanied by a discussion of both the strengths of AGEP alliance models in higher education, and critical gaps that persist for minoritized STEM scholars. Clear commonalities across all alliances were found. For example, the impact of the COVID-19 pandemic affected all daily operations at colleges and universities. The shared aims of these separate alliances also revealed novel advances. Accordingly, a case study was conducted and the TxARM AGEP cohort members provided useful insights regarding their social learning dynamics and crises of belonging from the cohort members' level.

**Keywords:** NSF AGEP programs, DEI interventions, minoritized STEM scholars, social learning at institutions of higher education, building belonging, and well-being for graduate students.

## Diversity, Equity, and Inclusion by Design: The Role of Collaborations and Communities in Promoting the Well-Being of Students Representing Minoritized Groups in the Academy

Science, technology, engineering, and mathematics (STEM) disciplines are diverse by design. The equity and inclusion experiences of scholars in these physical, natural, social, and cyber worlds coexist by design as well. The

National Science Foundation (NSF, 2008) has sponsored efforts to build campus communities, sustain the well-being of scholars, and expand diversity in the professoriate by means of the Alliances for Graduate Education and the Professoriate (AGEP) program. The AGEP program “provides grants to increase knowledge about, and to improve the academic pathways of doctoral candidates, postdoctoral scholars and faculty who are members of the AGEP populations, and who advance to tenure and/or promotion in the STEM professoriate (NSF, 2020). The Council for Graduate Schools (CGS, 2021) reported that “the COVID-19 pandemic presented new obstacles to the matriculation, persistence and completion of U.S. graduate students, with those who are first-generation, low-income, racially and ethnically underrepresented (URM) at greatest risk for educational disruptions.”

By design, the strategic collaborations and interconnected campus communities created by individual, intergroup, and interdisciplinary networks provide plausible models for other academic institutions. With oversight from the Directorate of STEM Education, and resources provided by the NSF national office in Washington D.C., the 2013–2021 AGEP alliances have set specific objectives for reaching across disciplines and systems to increase institutional partnerships, raise retention rates, and develop a self-sustaining model of community building across the academy. These large, multiple-year projects offer practical guidance for administrators, faculty, and students seeking to increase diversity, equity, and inclusion in their local contexts.

The presentation of this mixed methods study aligns with the purpose of the *Journal of STEM Education's* (JSTEM) Special Issue on *Making Waves to Advance Diversity, Equity, and Inclusion in the STEM Professoriate*. The cross-sectional research findings offer several novel contributions to the literature on broadening participation in STEM fields, including a Thematic Taxonomy of national programs, taken from public data about AGEP Alliances during 2013–2021. Additional analyses were conducted on the Texas A&M System Research Model (TxARM) AGEP Alliance to illuminate the cohort level outcomes. This AGEP alliance consisted of institutional leadership, staff, and a cohort of scholars from four Texas A&M System

institutions, including Texas A&M University, Texas A&M University Corpus Christi, Texas A&M University Kingsville, and Prairie View A&M University. From 2017–present, the members of the TxARM AGEP Alliance have implemented planned interventions and community building activities for 12 cohort members recruited from various STEM disciplines at the alliance institutions.

## Persistence Problems On The Pathway To The Professoriate

College campuses represent communities, cultures, and a recognizable brand for those who belong and those who want to belong. Simple routines of academic life establish and maintain enduring relationships in environments that can be stressful, competitive, and hostile. An ongoing global pandemic have laid bare preexisting inequities and brought into the forefront instances of overlapping physical and social pains, especially for minoritized STEM scholars, including African American/Black, Hispanic/Latinx, and Indigenous Peoples, plus foreign-born, immigrant, and international graduate students, postdoctoral researchers, and early career faculty members. Past and present dynamics produce intentional and unintentional circumstances for the reoccurring exclusion of members from prototypically disenfranchised groups. The changing conditions of the labs, classrooms, and campuses also changes the emerging paths of inclusion for a growing and diverse professoriate. Staying vigilant to the programs and influences that sustain community well-being in higher education is a necessity, with costly consequences, if neglected, for the entire academy.

Mental health issues are especially prevalent at the end of the Ph.D. program. Bernstein (2015) reported “... Thirty years of academic research has gone into showing that happiness, apart from being valuable in its own right, is critical for performance on so many levels. . . . This couldn't be more true for graduate students. Graduate school requires a long-term goal pursuit that people who are well and happy are best positioned to do. . . . Graduate students have unique needs, and we need to expand the mental health conversation beyond mental illness and talk about everyone's performance and everyone's well-

being.” Moreover, in the United States, racial and ethnic minorities are more likely to underutilize mental health services and prematurely terminate treatment despite their continued need for it (Leong & Kalibatseva, 2011). These findings compel members of labs, departments, and institutions to cultivate supportive communities and encourage activities that promote mental health.

In 2021, graduate education leaders (CGS, 2021) convened to identify the key, adverse impacts of the COVID-19 pandemic on the pathways to professoriate for URM graduate scholars in STEM fields. This convening panel found that the pandemic era produced:

- Caregiving burdens that disproportionately impacted the ability of students from traditionally underserved backgrounds to pursue and continue their graduate studies.
- Career uncertainty was linked to increased stress among current graduate students and decreased interest in pursuing graduate education for prospective students.

Altogether, a systemic, evidence based, transferable, and adaptive solution needs to amend a distinct yet growing, national trend in the rate of doctoral degrees conferred, postdoctoral fellowships awarded, industry jobs filled, and faculty positions accepted.

## Synopsis of the Alliances for Graduate Education and the Professoriate (AGEP) Program

The National Science Foundation (NSF) is an independent, U. S. federal agency that supports researchers’ pursuits of scientific endeavors to advance daily living on a global scale (NSF, 2018, February). The U. S. Congress, the National Science Board, and the NSF have forecasted and disseminated a vision for sustainable science infrastructure to occur by 2030 (NSF, 2020, May). These strategic plans rely on innovative leadership along with “improving equity and inclusion to advancing STEM faculty, educating America’s future STEM workforce, fostering individual opportunity and contributing to a thriving U.S. economy” (NSF, 2021, April).

The NSF’s Alliances for Graduate Education and the Professoriate (AGEP) Program works to increase the number of historically underrepresented minority faculty and promote systemic change. At the graduate student level, only doctoral candidates are included because they have greater potential to enter a faculty position within the project duration time frame. According to the published guidelines (NSF, 2008), the use of the term “historically underrepresented minority” reflects language from Congress, and in the context of the AGEP program, the AGEP populations are defined as STEM doctoral candidates, postdoctoral scholars and faculty, who are African Americans, Hispanic Americans, American Indians,

Alaska Natives, Native Hawaiians, and Native Pacific Islanders. The terms for these racial and ethnic populations are derived from the U. S. government’s guidance for federal statistics and administrative reporting. These annual funding opportunities are designed to draw interest in the development, implementation, study, and dissemination of evidence-informed models for higher education audiences.

Alliances for Graduate Education and the Professoriate (AGEP) programs build their communities according to NSF rules of eligibility. In specific, individuals recruited for this federal program must be citizens, nationals, or permanent residents of the United States. The creation of a Thematic Taxonomy of IHE campuses, united by the AGEP program, was developed using archival and qualitative data. For example, all AGEP grant awardees are listed at the website, <https://www.nsf.gov/awardsearch/>,

Solicitations for proposals to the NSF AGEP program have been continuously available to the public. When examining the solicitations in 2012 (National Science Foundation, 2012), 2014 (National Science Foundation 2014), and 2016 (National Science Foundation 2016), the NSF AGEP program goals have remained consistent. However, each cycle of proposals indicated a small shift in expectations and requirements. For example, the inclusion of embedded social science and education researchers were newly added to join alliances specifically to build the knowledge base about the underlying issues, policies and practices that have an impact on the participation, transition, and advancement of historically underrepresented minorities in the STEM fields. Over the years, these calls for proposals produced a total of 112 institutions of higher education (IHE) partnered in one or more NSF AGEP alliances. The number of partners in each alliance ranges from 2 or 3 (20% of alliances) to more than 10 (10% of alliances). Five lead institutions, SUNY at Stony Brook, Texas A&M University, Tuskegee University, University of California-Berkeley, and University of Maryland Baltimore County, have consecutive or multiple NSF AGEP alliance projects. Each NSF AGEP alliance identified a lead institution for administrative purposes and 22 different IHEs have led NSF AGEP alliances from 2013–2021, see Table 1.

## NSF AGEP Models Designed to Foster Well-Being for Minoritized STEM Scholar Cohorts

Characteristics noted for each institution include the Basic Carnegie Classification of Institutions of Higher Education (Carnegie, 2021) as well as designations for minority serving institutions (MSIs), based on 2020 data from the U.S. Department of Education (U.S. Department of Education, 2020). All 112 institutions are located within the continental United States. Two-thirds of the partnering institutions have doctoral programs with high

or very high research activity according to the Carnegie Basic Classification. The other third is comprised of schools focused on associate’s (n=8), baccalaureate (n=5), and master’s (n=18) degree programs, tribal colleges (n=3), and a few professional doctoral programs (n=4). These collaborating IHEs work collaboratively and use intersectional approaches in their change strategies.

Abstracts that describe each alliance’s partnership, program plans, and funded activities are available through the NSF.gov website. Utilizing these award abstracts, AGEP interventions initiated at both the individual and institutional levels were added as a classification in the thematic taxonomy. Findings indicate that NSF AGEP alliance models mostly study factors based on individual differences, such as measures of persistence. NSF AGEP alliances with funding in 2020 amended their project plans and project timelines to account for the substantial changes in training protocols, research practices and campus access due to the pandemic.

A total of 27 NSF AGEP alliances are included in the taxonomy and the completeness of the tally was cross checked and verified from a listing provided at the 2022 NSF AGEP National Research Conference, see Appendix. The 27 alliances were classified according to 1) the number of member institutions in each alliance, 2) the target population of each alliance, 3) the disciplinary focus of each alliance, 4) the intervention level(s) of each alliance, and 5) whether each alliance included a mentorship program and/or specialized training and professional development. This collection of information allowed for a broad examination of NSF AGEP alliances across multiple program dates, locations, and institutions.

## Commonalities across the NSF AGEP Thematic Taxonomy for Awardees 2013–2021

Clear commonalities across the 27 alliances were found. For example, NSF AGEP alliance models mostly study factors based on individual differences, such as measures of persistence. Generally, these NSF AGEP alliances examined individual variables, such as self-efficacy, academic identity, as well as experiences of being ignored and excluded, that were hypothesized to influence differences in persistence. The shared aims of these separate alliances also manifested two alliances specifically measuring self-reported, feelings of well-being and one alliance examining issues of intersectionality for a cohort of Hispanic/Latina and African American women. Due to the impact of the COVID-19 pandemic on daily operations at colleges and universities, the AGEP alliances with funding in 2020 amended their project plans and project timelines to account for the substantial changes in training protocols, research practices and campus access due to the pandemic.

In the NSF AGEP Thematic Taxonomy, levels of inter-

Tally	Abbreviated Names of the NSF Alliance Programs Awarded Grants	Solicitation No.
1	The CIC Professorial Advancement Initiative (PAI)	Solicitation N/A
2	Michigan AGEP Alliance for Transformation (MAA)	Solicitation N/A
3	Stony Brook-Brookhaven AGEP Frontiers of Research and Academic Models of Excellence (FRAME Alliance)	Solicitation N/A
4	TAMUS-E&S AGEP: Energy & Sustainability – Texas Alliance	Solicitation N/A
5	Tuskegee Alliance to Forge Pathways to STEM Academic Careers (T-PAC)	(NSF 14-505)
6	NOA-AGEP: The Northern Ohio AGEP Alliance	(NSF 14-505)
7	The Pacific Northwest AGEP Alliance to Develop, Implement, and Study a STEM Graduate Education Model for American Indians and Native Alaskans	(NSF 14-505)
8	Bridging the PhD to Postdoc Faculty Transitions for Women of Color in STEM	(NSF 16-552)
9	CIRTL AGEP Alliance – Improved Academic Climate for STEM Dissertators and Postdocs to Increase Interest in Faculty Careers	(NSF 16-552)
10	The Hispanic AGEP Alliance for the Environmental Science and Engineering Professoriate in Community Colleges and Associate Degree Programs	(NSF 16-552)
11	The Texas A&M University (TAMU) System AGEP Alliance	(NSF 16-552)
12	The Willow AGEP Alliance: A Model to Advance Native American STEM Faculty	(NSF 16-552)
13	The AGEP California Hispanic Serving Institutions Alliance to Increase Underrepresented Minority Faculty in STEM	(NSF 16-552)
14	AGEP North Carolina Alliance	(NSF 16-552)
15	The Historically Black Universities Alliance	(NSF 16-552)
16	The AGEP Engineering Alliance	(NSF 16-552)
17	The AGEP Alliance State System Model to Transform the Hiring Practices and Career Success of Tenure Track Historically Underrepresented Minority Faculty in Biomedical Sciences	(NSF 16-552)
18	An AGEP Alliance Model to Advance Underrepresented Minority STEM Faculty at Predominantly Undergraduate Institutions	(NSF 16-552)
19	The AGEP California State University Underrepresented Minority STEM Faculty Alliance Model	(NSF 16-552)
20	The AGEP Florida Alliance Model	(NSF 16-552)
21	The AGEP Data Engineering and Science Alliance Model	(NSF 16-552)
22	AGEP Research Universities Alliance Model	(NSF 16-552)
23	The AGEP Alliance Model for Advancing the Faculty Careers of Underrepresented Minority STEM Doctoral Candidates who are Instructors at Historically Black Universities	(NSF 16-552)
24	An AGEP Historically Black Universities Model with Community College Teaching as a Platform for Advancing Underrepresented Minority STEM Doctoral Candidates in Faculty Careers	(NSF 16-552)
25	The AGEP University of California Alliance	(NSF 16-552)
26	AGEP FC-PAM: Project ELEVATE (Equity-focused Launch to Empower and Value AGEP Faculty to Thrive in Engineering)	(NSF 21-576)
27	The AGEP Massachusetts State University System Equity-Minded Model for Recruiting and Advancing Early Career Faculty in the STEM Professoriate	(NSF 21-576)

Table 1. Alliances for Graduate Education and the Professoriate Programs during 2013-2021



Taxonomy Specifications	Mean %
Number of Member NSF AGEP Alliance Institutions (N=27)	4.56 <i>Min: 2; Max: 12</i>
<b>Target Population</b>	
Underrepresented Racial/Ethnic Minorities (URM)	62.96%
Hispanic	11.11%
URMs at Historically Black Colleges and Universities (HBCU)	11.11%
American Indian and Alaska Natives <sup>1</sup>	7.41%
Women of Color	7.41%
<b>Disciplinary Focus</b>	
STEM (broadly)	66.70%
Biomedical Sciences	3.70%
Data and Engineering Science (DES)	3.70%
Energy & Sustainability in STEM	3.70%
Engineering	3.70%
Environmental Sciences and Engineering (ESE)	3.70%
Mathematical, Physical Science, Environmental Science, Engineering	3.70%
Mathematical, Physical and Life Sciences, and Engineering	3.70%
Science and Engineering	3.70%
STEM Education <sup>2</sup>	3.70%
<b>Intervention Level<sup>3</sup></b>	
Individual	100.00%
Culturally Contextual	22.22%
Structural	25.93%
Mentorship Program	96.30%
Specialized Training and/or Professional Development	100.00%

<sup>1</sup> Includes Alliances with broad target of American Indian or Alaska Natives and Alliances with specific target of enrolled in and/or descendants of Native American tribes.

<sup>2</sup> One alliance includes STEM and STEM Education as its disciplinary focus.

<sup>3</sup> Alliances can include multiple levels of intervention.

Table 2. Descriptive Overview of Thematic Taxonomy of the NSF AGEP Alliances - 2013-2021

vention were coded as individual, culturally contextual, and structural. These coding categories were determined a priori. Additional analyses related to program activities and participant expectations came from information gathered from AGEP alliance websites. Also, in the NSF AGEP Thematic Taxonomy, individual alliances were coded as having multiple levels of interventions in threaded through their programs. Culturally contextual interventions included alliance activities that were developed and/or implemented in a culturally contextual and/or responsible manner, for example developing an indigenous field school with input from local tribal community members or providing training to mentors about the unique experiences of cohort members based on specific identities. Finally, structural level interventions include those meant to structurally change or transform the institutions participating in the alliance, see Table 2.

## Consistent Limitations Found with the NSF AGEP Programs during 2013-2021

While the summarized practices are an important part of a program focused on serving scholars representing minoritized groups, there are some notable gaps that limit their impact. In terms of mentoring, not enough alliances attended to the match between cohorts and mentors in terms of mindset or who “looks like me”. This extends to other cultural supports, as most alliances tended to use “generic” models of support for students representing minoritized groups; only 25% of alliances had models customized for affinity or cultural groups. It is the common fallacy of assuming that all students representing minoritized groups are the same. Further, the alliance websites identify the same students participating in multiple programs focused on the success of students representing minoritized groups in STEM fields.

Moreover, there is a cost to participating in such extensive, extra-curricular, skills training. For many scholars of color, balancing independent skill building with seeking diverse, collaborative interactions can derail timely advancements in their emerging career (Ong, Wright, Espinosa, & Orfield, 2011). The need for more customized content might be met by collaborations beyond the funded project level (such as cross-alliance collaboration). The use of structures to account for prior experience, like an Individual Development Plan to itemize skills and needs more explicitly, could be used when a student is considered for a program.

If there is a high likelihood that alliances might attract students who already have related prior training and experiences, it suggests a need for cross-level coordination and customization of program offerings to account for prior experiences participants might have had. The portfolio funding structure makes it difficult to coordinate the continuity of programming over the levels

of the higher education system.

## Conceptual Framework for a Case Study of the NSF TxARM AGEP Cohort

The Social Science Researchers have been members of the Texas A&M System Research Model (TxARM) AGEP Alliance from the initial award (Carter-Sowell, 2023, March 31; Carter-Sowell, Miller, & Thompson-Clayborn, 2022, November 2). This alliance implemented planned interventions and community building activities for 12 cohort members recruited from various STEM disciplines at the TxARM alliance institutions from 2017–present. The social sciences researchers drew on published literature about campus climates conditions and intergroup behaviors to design a mixed method case study of the TxARM AGEP cohort of scholars. The conceptual framework for these analyses is guided by established constructs from the social sciences disciplines.

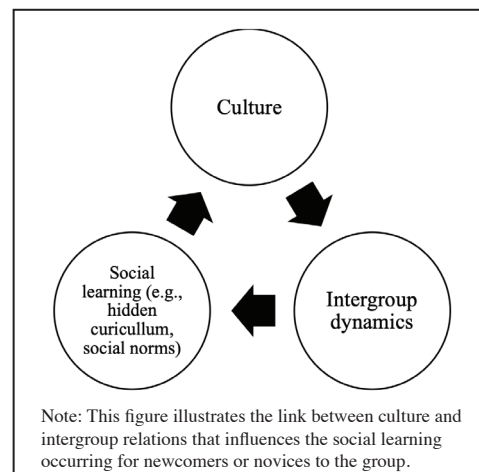
### The Cyclic Relationship of Culture, Intergroup Dynamics, and Social Learning

Mentoring practices have the potential to significantly impact the experience of students representing minoritized groups, as they may lack individuals around them to recognize and encourage their potential, assets, and strengths (Yeneabat & Butterfield, 2012; Ponjuan, 2013). Students representing minoritized groups are more likely to lack connections, networks, and mentoring compared to the students who are considered prototypical (e.g., ethnic majority or second-generation graduate students). Expectations for developing academic independence can further isolate those whose identities and backgrounds make them feel like they are not a “good fit” for the academy (Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012). Essentially, social learning plays a crucial role in how novices learn from experts (Kendal et al., 2018), implying mentorship will result in students representing minoritized groups becoming more versed in the hidden curriculum that is necessary for moving on to the professoriate (Settles, 2020).

Based on the intersection of social learning and ingroup-outgroup dynamics, see Figure 1, the National Science Foundation's Alliances for Graduate Education and the Professoriate directorate has fostered alliances with the aim of making the outgroup into the ingroup, transforming the broader culture and bolstering learning of socially beneficial information among scholars of color.

### Social-Belonging Interventions to Benefit Minoritized Groups at U. S. Colleges

Pete Buttigieg, the U.S. Secretary of Transportation said that “The more you know about exclusion, the more you think about belonging... We have a crisis of be-



Note: This figure illustrates the link between culture and intergroup relations that influences the social learning occurring for newcomers or novices to the group.

Fig. 1. The Cyclic Relationship of Culture, Intergroup Dynamics, and Social Learning

longing in this country” (Buttigieg, 2019, May 11). This intergenerational crisis has been associated with wide-ranging, negative effects (Cohen, 2022). Researchers (Walton et al, 2023) developed a simple and successful intervention for undergraduate students to confront potential worries about belonging that can undermine academic progress at the group level. This social-belonging intervention relates to a different intervention, resulting from a NSF ADVANCE program grant, to retain minoritized faculty scholars. Researchers (Carter-Sowell, Vaid, Stanley, Pettit, & Battle, 2019; Carter-Sowell, Vaid, Stanley, Pettit, & Yennello, 2019). developed a six-phase model of mentoring and engagement, see Figure 2, to retain women faculty of color in STEM positions at the professoriate rank. This intervention, derived from an NSF ADVANCE IT Program at Texas A&M University, focuses on institutional transformation and is designed to tackle the lack of role models and experiences of social isolation that occurs for women faculty of color by building professional visibility and belonging throughout campus communities.

These efforts focused on undergraduate students and early career STEM faculty illustrate the omission of an important, but regularly underserved community

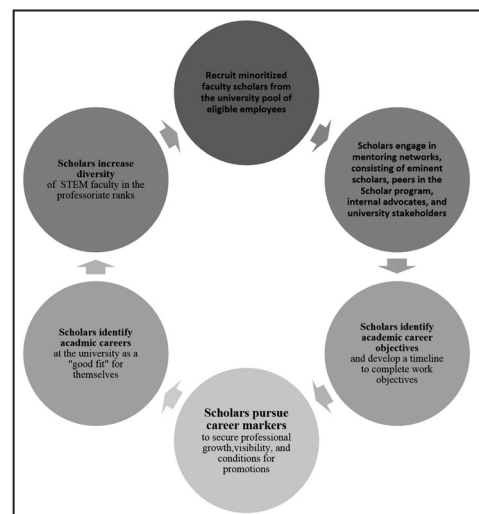


Fig. 2. Model to Retain Minoritized Faculty Scholars

in higher education – the graduate and professional students. Bolotny, Basilio, and Barreira (2021) found that mental health issues are especially prevalent at the end of the Ph.D. program: 36.7% of students in years 6+ of their program experience moderate or severe symptoms of depression or anxiety, versus 21.2% of first-year students. What should matter most to all educators is keeping their students safe, healthy, and connected to increase their persistence. Ongoing opportunities to collaborate and connect across diverse communities can increase feelings of trust and belonging, and the more connected someone feels, the more persistent they can be. In fact, without such safe spaces where students feel they belong and are respected as a member of the academy, persistence becomes much more difficult if not impossible.

## Constructing Professional Pathways: A Study of the NSF TxARM AGEP Cohort

In 2017, the NSF TxARM AGEP Alliance Program was formed with 12 STEM scholar members and in 2023, the group has retained 11 of the 12 original cohort members. In 2021, the TxARM Social Science Researchers recruited the existing TxARM cohort members to complete a two-part study. The first part of the case study requested that each TxARM cohort member complete an online questionnaire of various measures during a window of availability. The second part of the case study requested that each TxARM cohort member participate in a scheduled, recorded, synchronous, and transcribed remote interview with two members of the TxARM Social Science Research team. All data was collected from 11 of the 12 original cohort members over a 30-day period and the cohort members received \$100 for their participation in the 4-hour, two-part study. The 12<sup>th</sup> original cohort member did not respond to any outreach efforts to participate in the case study. The results from data that was collected from the original cohort members provided new findings about professional visibility, mentoring experiences, and managing communities of belonging along one's professional pathway. Grawitch & Ballard (2015) developed criteria for the Psychologically Healthy Workplace and similar needs were expressed by the TxARM cohort members, who also wanted a win-win workplace at every career stage. The value of positions that provided and promoted five key elements related to recruiting and retaining minoritized STEM scholars are as follows:

1. *Growth and development in work functions.* Upon completing their doctoral programs, a majority of TxARM cohort members felt confident in their scientific knowledge and technical skills. However, they also sought specific training, information, and guidance that would facilitate successful transitions into academic careers.

2. *Health and safety in physical, social, and personal settings.* As dissertators, TxARM cohort members had established the expectation that they had a right to enter institutions post-graduation that would afford them protections. Furthermore, they also desired work environments that went beyond mandated rights but also allowed them to live as their authentic selves and celebrate their identities.
3. *Input and involvement in decision making processes and implementation.* Through their PhD programs, TxARM cohort members gained the experience needed to confidently offer feedback and make decisions relevant to their research areas. Accordingly, cohort members desire careers at academic institutions that are interested in their ideas and will implement their vision.
4. *Recognition of meaningful contributions and rewards for notable achievements.* As NSF AGEP Scholars, TxARM cohort members had achieved a level of professional visibility that was an important catalyst for their early careers. Thus, they expect to continue to make remarkable contributions to their fields.
5. *Sincere endorsement of work and life integration (balance).* TxARM cohort members were introduced to the challenge of being present and navigating balance in their professional and personal lives. Moving forward, they prioritize institutions that broadly support the communities who will contribute to their holistic success.

Clearly, this check list would satisfy the needs of many groups, however, an important difference exists in the rates of attainability and longevity of these conditions for minoritized STEM scholars compared to their comparable peer groups. Gordon W. Allport (1954) observed that the differing nature of intergroup contact predicts the consequences of it. For many minoritized STEM scholars, this list seems impossible to reach and limited representative role models are present to these STEM scholars to offer the needed guidance in ways to pursue it.

## Discussion

Commonplace strategies to build campus community, increase retention, and improve well-being at the undergraduate, graduate, and early career faculty levels exist. From 2013–2021, the momentum was steadily building the infrastructure to support the coping and resilience of targeted and vulnerable scholars. The approaches that the NSF AGEP alliances have undertaken to turn perceived outgroup impostors into ingroup area experts has involved reciprocal learning of socially

beneficial information, strategic access to the upper administration, and respected input in decision-making processes for all STEM disciplines.

From the beginning, the two primary goals of the NSF AGEP program have been 1) to increase the proportion of STEM doctoral degree recipients among eligible Indigenous, African Americans, Hispanic and Latinx STEM scholars living in the United States and 2) to prepare these graduate students for faculty positions, rather than industry jobs. The outcomes of NSF AGEP alliances, established before 2013, signaled that intellectual merit, broader impacts, and generalizability of findings could be improved with the mandated integration of social science, education, and evaluation research. Guided by publications (Henrich, Heine, & Norenzayan, 2010; Mendoza-Denton, 2010; Mendoza-Denton, Patt, & Carter-Sowell, 2023) endorsing diversity to make better science, the NSF AGEP directorate revised the solicitation for proposals reviewed beginning December 2012. In line with evolving research practices in the social sciences favoring diverse participant representation and strong, replicable methodological foundations (Freese & Peterson, 2017; Moeriera et al., 2019; Plaut, 2010), the AGEP program continues to encourage new and innovate models alongside replications of existing ones in addressing minority underrepresentation in STEM. Thus, the federal, national, and local AGEP network provides a model not just for the next generation of diversity and inclusion sciences, but also for research in the social sciences, education, and evaluations areas.

Our thematic taxonomy of NSF AGEP Alliances coalesces with the five key elements as reported by TxARM cohort members related to recruiting and retaining minoritized STEM scholars. Our taxonomy identifies that across alliances, two of the five key elements are consistently incorporated into interventions and program activities. All 27 alliances (100.00%) analyzed included specialized training or professional development meant to facilitate successful transitions into academic careers. Additionally, all 27 alliances (100.00%) recognized their cohort members as NSF AGEP Scholars, providing professional visibility that could be utilized for launching early careers.

Notably, three of the five elements were utilized less frequently. Importantly, 6 of the 27 alliances (22.22%) included a culturally contextual level intervention. This level of intervention more directly involved endorsing a work life balance that supported both personal and academic communities. TxARM cohort members pursued academic positions that would prioritize the balance of their professional and personal lives – something that these culturally contextual interventions considered when developing and implementing their programming. Further, 7 of the 27 alliances (25.93%) included a structural level intervention. These alliances included activities meant to transform or change their respective institutions, often in ways that would go beyond protecting mandated rights



that would allow minoritized STEM scholars to live authentically and celebrate their identities.

Finally, 26 of the 27 alliances (96.30%) directly included a mentorship program in their activities. TxARM cohort members noted that mentorship is often implemented in a “one-size-fits-all” manner that may give the appearance of providing active input and involvement in decision making processes but regularly falls short. TxARM cohort members desired careers at academic institutions that are interested in their ideas and desire to implement their visions, yet this homogeneous manner of implementation results in maintaining and reproducing marginalization of minoritized STEM scholars.

## Conclusion

Measurable good is occurring with the consortium of students, staff, scholars, and investigators working in alliance with the NSF AGEP program. With guidance from the NSF AGEP leadership and resources provided by the NSF head office in Alexandria, VA the 27 AGEP alliances have met the objectives for reaching across disciplines and institutions, by design, to increase alliances, raise retention rates, and collaborations in the academy. In addition to the targeted populations, these NSF AGEP projects also have increased individual, intuitional, and programmatic visibility from local and regional audiences to national forums and international platforms. Although the successes are satisfying, dedication to these multi-year programs come with personal and professional costs, including increased workloads, backlash from lab mates not “benefitting from” the AGEP programs, and frustration from members inside and outside the NSF AGEP alliances on the pace of change within system alliances, across STEM professions, and in the academy. More trained and certified allies should be available with open-door policies that encourage open discussions among everyone and provide advice on how to solve interpersonal and institutional issues as they arise.

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The contributions of the TxARM AGEP Social Science Studies (SSS) Research Team Advisory Board and Project Brain Trust, 2017 – 2023.

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## Appendix

### National Science Foundation AGEP Programs Funded during 2013-2021

Tally	Complete Names of the NSF Alliance Programs Awarded Grants	Solicitation No.
1	The CIC Professorial Advancement Initiative (PAI)	Solicitation N/A Pre-2014
2	Michigan AGEP Alliance for Transformation (MAA): Mentoring and Community Building to Accelerate Successful Progression into the Professoriate	Solicitation N/A Pre-2014
3	Stony Brook-Brookhaven AGEP Frontiers of Research and Academic Models of Excellence (FRAME Alliance)	Solicitation N/A Pre-2014
4	Texas A&M University System (TAMUS) Energy & Sustainability AGEP Alliance	Solicitation N/A Pre-2014
5	Tuskegee Alliance to Forge Pathways to STEM Academic Careers (T-PAC)	2014-2015 (NSF 14-505)
6	NOA-AGEP: The Northern Ohio AGEP Alliance	2014-2015 (NSF 14-505)
7	The Pacific Northwest AGEP Alliance to Develop, Implement, and Study a STEM Graduate Education Model for American Indians and Native Alaskans	2014-2015 (NSF 14-505)
8	Bridging the PhD to Postdoc Faculty Transitions for Women of Color in STEM	2016-2021 (NSF 16-552)
9	CIRTL AGEP Alliance – Improved Academic Climate for STEM Dissertators and Postdocs to Increase Interest in Faculty Careers	2016-2021 (NSF 16-552)
10	The Hispanic AGEP Alliance for the Environmental Science and Engineering Professoriate in Community Colleges and Associate Degree Programs	2016-2021 (NSF 16-552)
11	The Texas A&M University System AGEP Research Model ( <u>TAMU</u> ) Alliance: A Model to Advance Historically Underrepresented Minorities in the STEM Professoriate	2016-2021 (NSF 16-552)
12	The Willow AGEP Alliance: A Model to Advance Native American STEM Faculty	2016-2021 (NSF 16-552)
13	The AGEP California Hispanic Serving Institutions Alliance to Increase Underrepresented Minority Faculty in STEM	2016-2021 (NSF 16-552)
14	AGEP North Carolina Alliance: An Institutional Transformation Model to Increase Minority STEM Doctoral Student and Faculty Success	2016-2021 (NSF 16-552)
15	The Historically Black Universities Alliance: A Model to Advance Early Career Minority Faculty in the STEM Professoriate	2016-2021 (NSF 16-552)
16	The AGEP Engineering Alliance: A Model to Advance Historically Underrepresented Minority Postdoctoral Scholars and Early Career Faculty in Engineering	2016-2021 (NSF 16-552)
17	The AGEP Alliance State System Model to Transform the Hiring Practices and Career Success of Tenure Track Historically Underrepresented Minority Faculty in Biomedical Sciences	2016-2021 (NSF 16-552)
18	An AGEP Alliance Model to Advance Underrepresented Minority STEM Faculty at Predominantly Undergraduate Institutions	2016-2021 (NSF 16-552)
19	The AGEP California State University Underrepresented Minority STEM Faculty Alliance Model: A Culturally-Informed Strengths-Based Approach to Advance Early-Career Faculty Success	2016-2021 (NSF 16-552)

**Appendix (continued)**  
**National Science Foundation AGEP Programs Funded during 2013-2021**

Tally	Complete Names of the NSF Alliance Programs Awarded Grants	Solicitation No.
20	The AGEP Florida Alliance Model: Improving Minority Women Success in STEM Faculty Careers	2016-2021 (NSF 16-552)
21	The AGEP Data Engineering and Science Alliance Model: Training and Resources to Advance Minority Graduate Students and Postdoctoral Researchers into Faculty Careers	2016-2021 (NSF 16-552)
22	AGEP Research Universities Alliance Model: Advancing Minority Math, Physical Science, Environmental Science, and Engineering PhD Candidates and Postdoctoral Scholars to Faculty	2016-2021 (NSF 16-552)
23	The AGEP Alliance Model for Advancing the Faculty Careers of Underrepresented Minority STEM Doctoral Candidates who are Instructors at Historically Black Universities	2016-2021 (NSF 16-552)
24	An AGEP Historically Black Universities Model with Community College Teaching as a Platform for Advancing Underrepresented Minority STEM Doctoral Candidates in Faculty Careers	2016-2021 (NSF 16-552)
25	The AGEP University of California Alliance: A Model to Advance Equitable Hiring of Teaching-Focused Faculty in STEM	2016-2021 (NSF 16-552)
26	AGEP FC-PAM: Project ELEVATE (Equity-focused Launch to Empower and Value AGEP Faculty to Thrive in Engineering)	2022 (NSF 21-576)
27	The AGEP Massachusetts State University System Equity-Minded Model for Recruiting and Advancing Early Career Faculty in the STEM Professoriate	2022 (NSF 21-576)



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