

An Institutional Transformation Model to Increase Minority STEM Doctoral Student Success

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Introduction

Of doctorates granted in STEM disciplines in the U.S. in the past ten years, African American and Hispanic American students make up only 2.7% and 3.3%, respectively [1]. The Doctoral Initiative on Minority Attrition and Completion found that after a STEM student has been in a program for two years or more—i.e., in the dissertation stage—the underrepresented minority (URM) doctoral student attrition rate is nearly 50% [2]. Completion rates vary by ethnicity and discipline. In one major PhD completion study, the 10-year completion rate in all fields was 51% for Hispanic American students and 47% for African American students; in contrast, White students had a 55% completion rate. In the same study, the 10-year completion rate for African American students in engineering, science, and mathematics was 43% compared to 56% for White students [3]. If a goal is to have a more diverse workforce and faculty in STEM, these gaps must be addressed.

The National Science Foundation-funded Alliance for Graduate Education and the Professoriate North Carolina Alliance (AGEP-NC) includes representatives of three institutions with a shared goal of diversifying the doctoral student body and the faculty: The University of North Carolina at Charlotte, a large urban research university; North Carolina A&T State University, a medium-size historically black land grant institution; and North Carolina State University, a large research-intensive predominantly white land grant institution. The goal of AGEP-NC is to develop and implement a model for creating institutional and department-level changes that facilitate the movement of URM STEM doctoral candidates into faculty positions. The AGEP program focuses specifically on African American, Hispanic American, American Indian, Alaska Native, Native Hawaiian and Native Pacific Islander doctoral students, postdoctoral scholars, and faculty. The basic idea of the AGEP-NC project is first to make STEM faculty knowledgeable about the issues that keep URM doctoral candidates from completing their degree programs and from seeking academic positions when they graduate, and then to equip the faculty to address those issues within their departments.

The AGEP-NC approach is based on the academic institutional change model of Kezar and Eckel [4], which proposes five core elements for achieving cultural change in colleges and universities:

- Supportive senior administrators (such as provosts and deans)

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- Collaborative leadership throughout the project shared by administrators (e.g., department heads and graduate program directors) and other faculty members involved in the change initiative
- Robust project design that presents a clear picture of the future, includes goals and objectives related to the realization of that picture, and has the flexibility to allow adjustments to new opportunities
- Staff and faculty development opportunities for individuals to acquire new knowledge and skills related to issues associated with the change effort
- Visible actions taken during the project demonstrating that change is still important and is continuing.

The five change elements are synergistic and allow for flexibility in project design to address challenges present on each campus and to be responsive to feedback throughout the life of the project. Kezar and Eckel indicate that another overarching element of their change model—sensemaking—plays a major role in institutional change. The project leaders design and implement activities through which “members of the institution change the way they perceive their roles, skills, and approaches/philosophies.” [4, p.303]

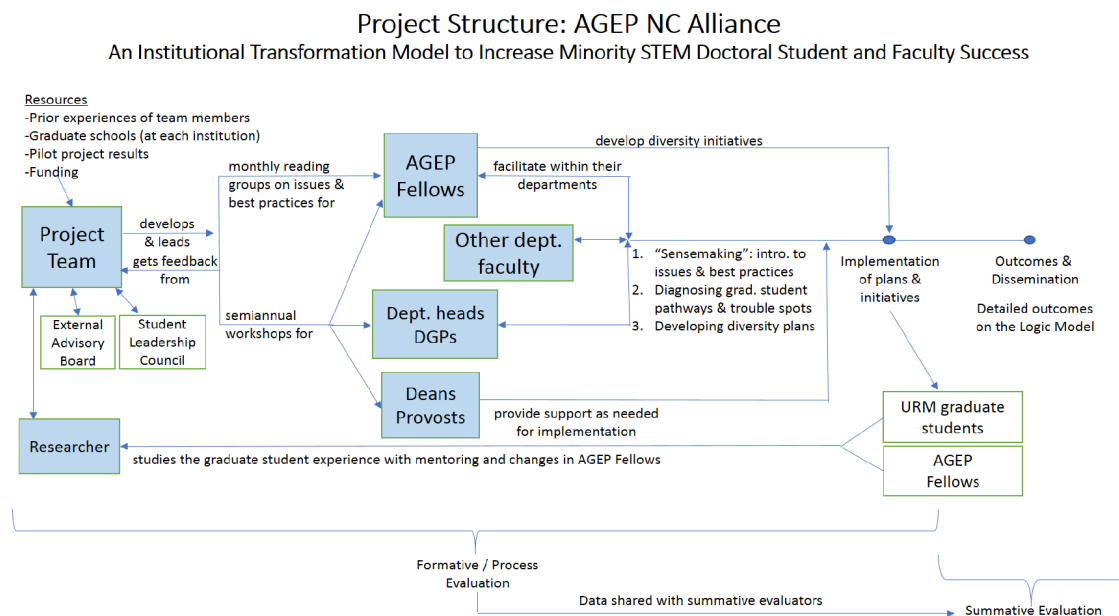
In addition to Kezar and Eckel’s model, experience with NSF ADVANCE projects to promote the careers of women faculty in STEM disciplines has shown that collaborative synergistic participation by faculty and administrators at various levels with support and promotion by campus leadership are key elements to successfully shifting faculty culture [5–6].

Project Design: Faculty-Led Department Change

The AGEP-NC project focuses heavily on doctoral dissertation advisors, who have a strong direct impact on their students’ progress and career decisions [7–8]. The project aims first to raise faculty awareness about the experiences of URM students and proven strategies to improve doctoral program completion rates and the graduates’ progression to faculty careers. This step is sensemaking [4], and it involves educating faculty through reading groups, workshops and presentations on diversity in higher education and doctoral mentoring, as well as collecting and sharing data on department culture and doctoral completion rates. The next step is to engage the faculty in designing and adapting strategies aimed at increasing URM completion rates and progression into academic careers to fit their department culture and needs, and to create departmental policies and structures that incorporate the strategies.

Figure 1 outlines the overall project structure, including the inputs leading up to development of department-led strategies. The project logic model with detailed outputs, outcomes, and objectives can be found in Appendix A. In addition, the leadership team has developed a map showing how project activities relate to the change model elements. (See Appendix B.) The mapping process has helped the team to better understand the change model and to highlight areas in need of strengthening.

Figure 1: Project Structure



Faculty members designated “AGEP Fellows” are at the core of the project. Each participating department nominates a faculty member to serve as a Fellow for a two-year term. The Fellows meet monthly on their home campuses and attend semi-annual Alliance-sponsored workshops on such topics as the URM doctoral student experience and culturally responsive mentoring. Over the life of the project, at least 25 departments will designate faculty Fellows and participate in the change process.

Fellows serve as connectors between the AGEP-NC project and their department faculties. They are responsible for disseminating information to and collecting information from their departments. For example, Fellows might share information they learned in project workshops and their own individual studies, and they might gather departmental data on rates of doctoral program completion and attrition and career paths of recent doctoral graduates. They also coordinate faculty efforts to develop plans to increase URM doctoral candidate recruitment and retention. Figure 1 depicts arrows between the AGEP Fellows and the Project Team to show the two-way information exchange between the two groups that helps guide work efficiently towards project goals.

Department heads and graduate directors play a critical role in encouraging faculty and students to participate in project programs and providing time for the Fellows to share project information in department faculty meetings and seminars. The provosts and college deans at the three Alliance institutions are expected to promote the project across the university, provide web space and news outlets to share the project’s progress, and attend semi-annual Alliance meetings to share ideas with project leaders and one another.

The AGEP-NC Leadership Team consists of 11 administrators and other faculty members, a process evaluator to provide formative feedback on progress of the project throughout its duration, and a summative evaluator to evaluate the success of the project at achieving its goals.

Both of the evaluators are from consulting firms external to the Alliance institutions. One of the co-PIs on the project is carrying out a research study of the conditions that lead to effective preparation of dissertation advisors to engage in culturally responsive mentoring.

Two advisory boards have proved invaluable to the project: an external advisory board (EAB) and a student leadership council (SLC). The ten members of the EAB bring extensive experience with designing and evaluating change initiatives in higher education and promoting the success of URM graduate students using such methods as culturally responsive mentoring. The EAB meets with the AGEF-NC leadership team formally once per year at the summer and is also available for consultation and electronic meetings as needs arise.

The SLC consists of two doctoral students from each of the Alliance institutions. They meet regularly to share ideas among themselves and share student perspectives with the AGEF-NC leadership team and the faculty Fellows. These perspectives have already shown the Fellows aspects of their department culture of which they were previously unaware, which led them to change some of their own perspectives.

Faculty Fellow Training and Responsibilities

The first cohort of faculty Fellows was assembled in September 2018 and consists of six faculty members representing NC State's doctoral programs in Applied Ecology, Biochemistry, Chemistry, Comparative Biomedical Sciences, Poultry Science, and Statistics. The group includes one department head, one director of graduate programs, one associate professor and three assistant professors. They were selected based on the following criteria.

- Experience and interest in promoting diversity in doctoral programs;
- Commitment to serve two years and fulfill the obligations of an AGEF-NC Fellow, with an average time commitment of four to five hours per month;
- Interest in serving as an advocate for diversity and inclusiveness beyond the two-year term as a Fellow.

The first cohort meets monthly to discuss readings and findings from their department studies. The first meeting (September 2018) was devoted to discussing the aims and approach of the project and the Fellows' central role in it. The facilitators provided a timeline for the Fellows to study the pathways and experiences of URM students in their departments as the students move through their doctoral programs. The Fellows were given four tasks to complete before the next meeting:

- Identify URM doctoral students in their departments. Reach out to them and tell them about the AGEF-NC project.
- Announce the AGEF-NC project to the department faculty and graduate students. The project leadership team provided a PowerPoint file to use for this purpose.
- Write a short description of department policies and practices that affect URM graduate students.
- Brainstorm items for a questionnaire to be used in a department study of URM experiences.

The second meeting (October) focused on effective mentoring. Prior to this meeting, the Fellows read *Mentoring Guide: A Guide for Mentors* [5] and watched a video called “Mentoring: Creating Mutually Empowering Relationships” [6] At the meeting, the Fellows were charged with collecting the following information about their departments’ doctoral programs:

- Data on backgrounds of both URM and non-URM students entering the program
- Data on URM students who left the program without completing the PhD
- Information on program requirements that may cause particular difficulty for URM students
- Identification of advisors who attract URM students and have good success with them

The November Fellows meeting focused on the experiences of URM doctoral students. Two readings were assigned prior to this meeting: (1) “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” [9], and (2) *Rooted in the Soil: The Social Experiences of Black Graduate Students at a Southern Research University* [10]. This topic generated rich discussion that brought into sharp focus areas where the Fellows’ preconceptions about URM students’ experiences differed greatly from the students’ reports of their experiences. The discussion generated ideas that Fellows could use for preparing faculty members to be mentors and giving incoming doctoral students ideas to promote their success in the program.

In November, the process evaluator administered surveys to faculty and graduate students in the six departments represented by the Fellows. The surveys were designed to measure perceptions of the department climate for diversity from the perspective of both faculty and students, opportunities afforded to students by dissertation advisors, and experiences of doctoral students. The Fellows also participated in a two-hour workshop on mentoring PhD students at the Alliance Winter Meeting. The workshop surveyed skill-building activities that doctoral advisors and mentors can conduct to help their advisees and mentees build both core academic skills and other skills such as making lucid scientific presentations, writing effective technical documents, and preparing grant proposals and papers for submission to funding agencies and journals. The Fellows responded positively to the workshop, with all six reporting in anonymous feedback forms that they “learned things in the workshop that will help me be a better mentor to my graduate students” and that “the workshop will help me in my role as an AGEF Fellow.”

For December, the Fellows were charged with writing a summary report of their findings for the first semester, along with a plan for reporting the findings to the faculty in their departments.

In January 2019, the process evaluator shared results from the November surveys of the Fellows’ departments’ faculty and doctoral students, and the Fellows discussed ideas for sharing the results in their departments.

In February, the Fellows turned their attention to models of institutional change, reading “Creating Deep Change,” Chapter 4 of *How Colleges Change: Understanding, Leading and Enacting Change* by Adrianna Kezar [11]. This reading gave Fellows a foundation on which to base initiatives for bringing their faculty colleagues into the dialog about diversity in their doctoral programs.

What We Have Learned: Making Sense of Early Efforts Going Forward

There is a learning curve for project managers engaged in new ventures, and the AGEP-NC project leaders have been learning how to tweak and improve program activities in response to feedback. These changes lay the groundwork for enhanced organizational performance in the future. At the first NSF site visit and semi-annual Alliance-wide meeting, we identified two important priorities for the remainder of the first year: (1) meeting face-to-face more often to forge a stronger common Alliance identity, and (2) developing a stronger program for engaging provosts, deans and department heads in the AGEP-NC project.

The first semi-annual AGEP-NC Alliance Meeting showed the benefit of the leadership team meeting in person. Discussions were much more robust than in conference calls. The team consequently plans to meet in person more frequently than originally proposed. All Alliance institutions are within 90 miles of NCA&T by Interstate, so more frequent in-person meetings should not be difficult to arrange.

The External Advisory Board (EAB) has recommended that we involve the provosts and deans more deeply in the project, communicating the goals of the project very clearly and formulating explicit pictures of what success will look like in five and ten years. The Board also recommended that we consult with a communications expert to develop a strategy for this undertaking. Based on these recommendations, the leadership team engaged in a full-day retreat facilitated by a professional leadership development consultant. The retreat provided a dedicated environment for the leadership team to develop a deeper understanding of the project members' motivations and hopes for the project as well as intense discussions of priorities for the upcoming semester. Out of these discussions has come a planning process for more meaningfully engaging provosts, deans and department heads and for adding programming during the year specifically targeted to these campus leaders. The proposed additions include individual meetings with each dean, a webinar on the Kezar and Eckel model of institutional change that could be applied to changes beyond diversity in doctoral programs, and a seminar on diversity and leadership for department heads and graduate directors by a graduate of one of our doctoral programs.

Another formidable challenge is the unavailability of much critical baseline data. In particular, some departments do not have records of where their graduates went and/or what jobs they took after completing the PhD. This information is crucial for helping departments understand the current situation for URM students and developing their diversity plans. The leadership team will be working with the Fellows to strategize how to address this problem.

The AGEP-NC Fellows' studies of the pathways and experiences of URM students through the doctoral programs have begun to provide the Fellows with some valuable insights and suggest potential targets for change. One Fellow reported the following statement from his department head:

“Leadership within the department—that is, the department head and director of the graduate program—has created and maintained an informal support network of faculty and staff for [URM] students. A recent anecdotal example was of a female student from an underrepresented group wanting to leave the department because she felt isolated and unable to find study partners. The faculty found study partners for the student and she is

now reportedly doing much better in her coursework and plans to stay. I am personally aware of other positive stories like this one and the department seems dedicated to monitoring all of its graduate students but places special emphasis on underrepresented groups.”

A listening session with URM doctoral students in that department gave the head a different impression. To paraphrase his verbal report on the session:

“I did not feel good at the end of this meeting. The students felt that some of their needs are not being met. If they are having difficulty, they do not want to let anyone know for fear of being seen as a weak student.”

A second Fellow identified four areas of concern in his program’s policies and practices: (1) student isolation; (2) lack of structure within the program that can prevent the communication of clear expectations to all students and mentors; (3) difficulty of bringing all students’ knowledge bases and skill sets to the same level before the qualifying exam since the required program coursework is minimal; (4) inconsistent expectations for mentoring within the program.

These studies of department practices and student experiences have led to rich discussions within the Fellows’ cohort about best mentoring practices, developing materials for mentor and doctoral student orientation, and ways to address students’ isolation, low confidence, and avoidance of risks like taking a class in an unfamiliar subject and asking faculty members or classmates for help. These studies coupled with the departmental climate surveys and data on doctoral student completion rates will inform the next stage of the AGEP-NC Fellows’ term, which is to work with their department head and graduate director to initiate a process in which the department faculty develop a plan for fostering the success of URM doctoral students.

As a result of what we have learned so far, we have made some additions and changes to the AGEP-NC project. The timeline for the first year of the project is shown below. The components that have been added as a result of feedback and experiences during the first several months are shown in blue font to highlight the adaptive nature of the AGEP-NC model, an important feature of “robust project design” in the Kezar and Eckel model of change.

- Summer year 1:
 - Collect baseline data, refine evaluation plan and logic model
 - Recruit and select Fellows, develop Fellow curriculum, select readings and speakers
 - Announce project to participating departments and administrators and develop website
 - Meet with External Advisory Board for input and feedback on plans, baseline data, and evaluation plan
 - Select Student Leadership Council members
- Fall year 1:
 - Fellows’ reading group meets monthly, with discussion topics including culturally responsive mentoring, experiences of minority doctoral students
 - Information sessions for department heads and graduate directors, deans, and provosts to orient them to the AGEP-NC project

- Fellows collect information on pathways of doctoral students through their programs
- Winter year 1:
 - Winter alliance-wide meeting for provosts, deans, Student Leadership Council, leadership team, evaluators and Fellows. Fellow workshop on culturally responsive mentoring
 - [Retreat for leadership team and evaluators](#)
 - Project evaluator surveys doctoral students and faculty on department climate and mentoring practices, shares results with Fellows for their own department
 - Fellows share climate survey data with their graduate director, department head, and faculty
 - [Attention to branding: develop logo and tag line, fully develop website and newsletter](#)
- Spring year 1:
 - Fellows' reading group meets monthly, with topics including faculty impact on student career trajectory, examples of initiatives to foster sense-making among departmental colleagues, Kezar and Eckel model of change and Fellows' role in it, examples of diversity plan elements for doctoral programs
 - Fellows develop and implement a diversity initiative for their department
 - [Individual meetings with deans and vice provosts to solicit their ideas for enhancing accountability and buy-in among faculty](#)
 - [Webinar for provosts and deans on institutional change model](#)
 - [Seminar on leadership for department heads, graduate directors, and faculty](#)
 - Fellows, department heads, and graduate directors begin process of developing a diversity plan for their doctoral programs
 - Share AGEP-NC model and process at conferences
- Summer year 1:
 - Summer alliance-wide meeting for provosts, deans, department heads, graduate directors, leadership team, evaluators, Fellows, and External Advisory Board. Workshops on goals, promoting institutional change, and inclusive mentoring

The AGEP-NC project is a work in progress. The changes above have been implemented to better integrate the deans and department heads into the AGEP-NC project, so that they are involved throughout the year and are well-informed about the project goals, activities and progress. In this way we hope to engage the deans in developing goals for their own colleges that extend beyond the funding period of this project, and incentives for faculty to participate seriously in their department's diversity planning for doctoral programs.

Future papers and presentations in the remaining four years of the project will report on (1) the formal research component examining mentoring of URM doctoral students, (2) the launching of Fellow cohorts at NC A&T and UNC-Charlotte and the adaptations necessary to make the model work in the different institutional environments, (3) progress made and challenges uncovered in engaging provosts and deans, and (4) efforts to share the model with other institutions.

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Appendix A: AGEP NC Logic Model

Activity	Participants in the activity	Short-Term Outcomes	Medium-Term Outcomes	Long-Term Outcomes
Campus-level monthly reading groups on diversity issues, best practices in mentoring, facilitating change initiatives, and other related topics	Project team leaders and AGEP Fellows (faculty) at each institution	<ul style="list-style-type: none"> - Increased AGEP Fellow awareness of diversity issues and experiences of URM graduate students - Implementation of “diversity initiatives” by each AGEP Fellow - Enhanced knowledge of AGEP Fellows about best practices for culturally responsive mentoring - Actions taken related to changes in the program 	<ul style="list-style-type: none"> - Increased faculty awareness of diversity issues for URM graduate students - Additional outcomes added from development of diversity initiatives by AGEP Fellows 	<p>By the end of the project, the following outcomes will be completed:</p> <ul style="list-style-type: none"> - Development, implementation and study of the NC Alliance institutional transformation model to increase minority STEM doctoral student and faculty success - Changes in policies and procedures at the department and graduate school level to enhance diversity support - Improved URM graduate student progress toward completion of Ph.D.
Faculty discussions in each participating department including: <ul style="list-style-type: none"> • Introduction to issues and sharing of best practices in mentoring • Study of pathways through the doctoral program • Development of a department diversity plan for doctoral program 	Department faculty with leadership by AGEP Fellow and participation and support by department head, Director of Graduate Programs (DGP), and the AGEP Leadership Team	<ul style="list-style-type: none"> - Identification of the pathways of URM doctoral students and where students may leave the program - Department Diversity Plans developed using the steps identified on the project model structure: <ol style="list-style-type: none"> 1. “Sensemaking”: introduction to issues and best practices for culturally responsive mentoring 2. Diagnosing graduate student pathways and trouble spots 3. Developing diversity plans 	<ul style="list-style-type: none"> - Implementation of Department Diversity Plans - Improved department climate for graduate students and faculty - Increased use of best practices for culturally responsive mentoring of URM graduate students - Positive changes in perspectives of faculty about diversity in their graduate programs - Diversity in doctoral program becomes a recognized departmental priority 	<p>The following outcomes will be on track for completion in the years immediately following the project:</p> <ul style="list-style-type: none"> - Improved URM graduate students’ completion of the Ph.D. and entry into faculty positions and postdocs
Semi-annual workshops	AGEP Fellows, DGPs, and heads from each participating department, deans from each participating college/ school, provosts from each university in the Alliance	<ul style="list-style-type: none"> - Sharing of ideas across departments, colleges/schools, and universities - Incorporation of ideas into department-level diversity plans 	<ul style="list-style-type: none"> - Diversity in doctoral programs becomes a recognized institutional priority 	<ul style="list-style-type: none"> - Adaptation and adoption of model by STEM departments at each university in the Alliance - Adaptation and adoption of model by departments at other universities
Leadership team meetings	PIs, Co-PIs, Senior Personnel The researcher and evaluators will participate as appropriate	<ul style="list-style-type: none"> - Working definition of culturally responsive mentoring - Plans for campus-level discussion group readings and activities and semi-annual workshops - Understanding of progress being made toward achieving program objectives and developing, implementing, and studying the NC Alliance model 	<ul style="list-style-type: none"> - Submission of conference presentations and papers about the project 	<ul style="list-style-type: none"> - Presentations of AGEP NC Alliance model and research and evaluation data - Publications of AGEP NC Alliance model and research and evaluation data

Appendix B
AGEP NC Alliance
Institutional Change and
Selected Project Activities

Supportive Leaders	Shared Leadership	Robust (flexible) Design	Staff & Faculty Development	Visible Actions
Department heads collect data and promote project in the department	Fellows, department heads, AGEP-PI lead discussions in the departments	Templates of diversity plans are shared with Fellows, department heads.	Faculty from three campuses come together at least each semester for development activities	Modified department and college policies and procedures
Deans and provosts participate in semi-annual workshops and promote the project at the college and institution levels.	Project helps Fellows develop a model for change.	Project makes use of metrics, strategic planning documents, and accreditation processes when designing and implementing changes	Presentations and publications at professional meetings and in journals share what is being learned beyond the project institutions	Diversity plans
The Graduate School leaders support and jointly sponsor activities.	Faculty senate meetings once/semester to update on project	Pathways for students in each department are studied to provide relevant data for department changes	Presentation on graduate student diversity data, model of change, student experiences for department faculty	Sponsored workshops, seminars, etc. for larger community