A Change Model That Helps Faculty Mentor Underrepresented Minorities (URM) Doctoral Students for the STEM Professoriate

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Abstract

In response to the well-documented themes of unique challenges URM doctoral student experience (tokenism, stereotyping, micro-aggressions, etc.), faculty mentoring remains an especially critical resource to change the trajectory for URM students in graduate education. The purpose of this study is to examine the first two years of change in institutional culture which will increase the number of URM doctoral students who pursue the STEM professoriate. The primary research question asked is "Can a focus on developing and mentoring faculty catalyze change in the culture and practices of their doctoral programs to increase faculty diversity?" Based on the idea that faculty are drivers of lasting institutional change, three diverse public universities collaborate to adapt and implement an institutional change project, called "AGEP-NC Alliance: A Change Model for Doctoral to Faculty Diversity in STEM," that prioritizes cultural frameworks for deep change in postsecondary education (Gumpertz et al., 2019). Key model components include faculty learning communities; use of national faculty mentoring networks; and use of institutional diversity data. Culturally relevant mentoring is among several approaches of interest to STEM reformers to shift the focus to institutional-level change and not student deficiencies. Operationalized as "cultural integrity," the approach calls upon students' racial and ethnic backgrounds as assets for reform in pedagogies and learning activities, while valuing those backgrounds as critical ingredients for acquiring academic capital and career success (Tierney, 1999). Kezar's (2018) cultural framework for institutional change emphasizes knowledge formation in context as well as analysis of espoused meaning and values organizational members maintain. The researchers present the AGEP-NC Alliance as a narrative, rich case study and collaborative mentoring model, an approach allowing participant researchers to detail sustained data use in collaborative social interaction (Patton, 1990). Results will be shared that highlight faculty as cultural change agents, and organizational learning as a cultural process. Preliminary results show evidence of institutional change at several levels from classroom and laboratory practices to key departmental policies.

Introduction

Recent calls for social justice and racial equality across the nation are echoed in a policy maker statement on the import of postsecondary education: "The greatest benefit to U.S. society will only come when students from all segments of U.S. society and backgrounds succeed in graduate school through a supportive atmosphere that begins to reverse a long history of underrepresentation and exclusion across many STEM and non-STEM fields alike" (National Academy of Sciences, 2018, p. 37). Despite two decades of progress, a wide gap in educational attainment remains between underrepresented minorities (URM) and whites. In 2018, African American and Hispanic/Latinx students each made up only 7% of all doctorates granted in STEM disciplines in the U.S while white students made up 70% (NSF-NCSES, 2017).

Sowell et al. (2015) in their final report found that after a URM student enrolled in the doctoral program for two years or more (dissertation stage) that their attrition rate was nearly 50%. While completion rates vary by ethnicity and disciplines, Sowell et al. (2008) earlier work showed that the 10-year completion rate in all fields was 51% for Hispanic American students, 47% for African American students, and 55% for white students. When examining completion rates for African American students in engineering, science, and mathematics, their completion rates were 43% when compared to white students at 56%.

Faculty mentoring plays an especially critical role for students from historically underrepresented groups (Hill et al. 1999; Whittaker & Montgomery, 2014). This project, AGEP-NC Alliance: A Change Model of Doctoral to Faculty Diversity in STEM, focuses on developing faculty fellows to catalyze change in the culture and practices of their departments' doctoral programs because dissertation advisors, and the academic opportunities they make available to doctoral students exert a strong influence on doctoral completion (Lovitts, 2002; Sowell et al. 2015; Vaquera, 2007) and choice of faculty careers (Gibbs et al., 2014, Gibbs & Griffin, 2013; Lindholm, 2004). The aim is to create deep change at the department level in faculty mentoring, departmental processes, and institutional outcomes while promoting PhD completion and progression to faculty careers among historically underrepresented dissertation students in STEM disciplines.

Theoretical Framework and Methodology

The project design draws on the institutional change elements of shared leadership; supportive leaders; visible actions; robust design; and development learning (Kezar & Eckel, 2002) (see Figure 1). Cultural frameworks for institutional change operate on a micro-level and seek deep change in the way individuals think and behave. For STEM faculty, the cultural context of the institution and professional expectations of disciplinary societies exert significant forces on the way faculty engage in teaching, research, and service. For example, the tenure and reward system of higher education provides faculty with high levels of autonomy that work at cross purposes to advance change through bottom-up consensus building.   Cultural views of understanding and practicing change in higher education emphasize knowledge formation in context and de-emphasize traditional scientific management approaches that prioritize logic, roles, and goals. Accordingly, the change process from a cultural view incorporates institutional culture, institutional context, and other external forces, including disciplinary societies. Cultural theories of change draw on the analysis of meaning and values organizational members espouse. Assessments of institutional history, symbols, and mission are important for change agents to consider in the reform process (Kezar, 2018; Tierney, 1988).

The idea of the professional learning community (PLC) has gained interest with STEM education reform researchers as a way to engage faculty participation in institutional change (Schimmel et al., 2020). PLCs are formally structured as a localized group of faculty members in a single institution who are sanctioned by administrative leadership. They operate largely through peer-to-peer learning around a specific agenda to advance an innovative idea, including graduate student mentoring. PLCs offer the potential for transformation and function through joint activities, mostly at a distance mediated through digital communication. The PLCs often consist of faculty leaders who promulgate a new philosophy for a new reality; and span multiple institutions, agencies, and organizations in the context of changing academic department culture.

For many STEM faculty members, their socialization to faculty work de-emphasizes mentoring graduate students as a priority. Unlike the cultural process of tenure and promotion, mentoring graduate students is informal and not a direct result of professional training faculty undertakes. The values of collegiality in faculty culture, including consultation, consensus, and deliberation, allow researchers of STEM reform in higher education to better capture individual-level change dynamics, notably how departmental faculty together work through extra-mural engagement with other faculty in professional societies, associations, and peer-review work through funding agencies (Schimmel et al., 2020).

The purpose of this paper is to examine the first two years of change in institutional culture which will increase the number of URM doctoral students who pursue the STEM professoriate. The primary research question asked is "Can a focus on developing and mentoring faculty catalyze change in the culture and practices of their doctoral programs to increase faculty diversity?"

Method
This project uses interpretive case study analysis, which allows holistic analysis of discrete pieces of information "woven into ideographic framework" (Patton, 1987, p. 148) as an investigative report on a unique phenomenon, i.e., diversifying STEM doctoral education. In this regard, interpretive case study is more than a descriptive accounting of the phenomenon. It is an informed interpretation of existing theory founded in cultural interpretations relevant to the investigation. To that end, the focus is on institutional theory with the application of faculty in professional learning communities. In this regard, case study researchers collect the maximum amount of information available to them with the intent of theorizing or hypothesizing about the phenomenon. Merriam (1998) maintained that case studies are interpretive in that they draw upon descriptive data the investigator uses to develop conceptual categories that in turn illustrate, support, or challenge existing theoretical assumptions held prior to the data collection. The primary data-gathering strategies employed in this study were participant observation of project activities over a two-year period.

Participant observation optimizes the research team's access to data, often through direct participation and observation of AGEP project events, analysis of related institutional documents, and reflection and introspection (Patton, 1987, 1990). Information for the analysis includes review of on-and off-campus participation in a variety of meetings, including online project team meetings, technical assistance meetings with the sponsoring agency, professional association meetings to share project research findings, and analysis of project evaluator and social scientist internal documents.

The Alliance and Institutional Context of the Case Study
As seen in Figure 2, each of the three diverse Alliance institutions, under the guidance of the Project Team, develops cohorts of faculty fellows. The Project Team assists the fellows in developing and cultivating a depth of knowledge about the issues facing underrepresented minority doctoral students. These fellows, together with their department chair and the director of their graduate programs then lead the department in studying the pathways, obstacles and successes of URM students moving through their doctoral programs, developing strategies for change in their department, and adopting a plan to promote the success of URM doctoral students.
The project targets URM dissertation advisors because for the URM population, attaining the PhD and moving from the PhD to faculty roles present major hurdles as mentioned earlier. Degree completion is just the basic requirement; desire for a faculty career is also necessary for students to pursue this path. The model has the flexibility to be applied at various types of institutions and in different disciplines.

Faculty Fellows
The core of the project consists of STEM faculty change agents in the academic departments selected by the leadership team through an application process. Each fellow serves a two-year term. During that time, the fellows meet monthly with Project Team leaders on their home campuses and attend semi-annual Alliance-sponsored workshops on topics related to URM doctoral student experience and culturally responsive mentoring. The Fellows serve as the connectors between the project and their departmental faculty. They are responsible for collecting from as well as sharing information with their departments. Information shared includes sensemaking from the literature read, conversations held during monthly meetings, as well as key data collected from the department as to degree completion and key policies that serve as barriers to success for URM doctoral students. They also may coordinate faculty efforts to develop plans to increase URM Doctoral candidate recruitment and retention. Faculty fellows work closely with their department heads and directors of graduate studies to form an informal team to encourage faculty to address the needed programmatic changes to enhance success of URM doctoral students.

Project Team Leadership
The NC Alliance consists of a leadership team including tenured STEM faculty members who are the principal investigators, several co-investigators including senior diversity and academic affairs administrators, a social science researcher, professional evaluators, and

other departmental STEM faculty from all three institutions. Project management consists of bi-weekly videoconference meetings with leadership team members, annual site visits with NSF officials, and meetings with external advisory board members. Recommendations from the NSF, advisory board and evaluators on project developments are incorporated into action plans. Collectively, the leadership team and its partners, including higher education researchers on the advisory board, work as change agents as they participate in strategic activities to enhance and further the goals of the project.

Results

Taken together, outcomes from two components of the Alliance project provide the basis for advancing institutional change: 1) preliminary results from Faculty Fellows' authored plans for increasing departmental diversity, and 2) formative discussions for change action by the project leadership team informed by systematic data collection through evaluation, social science, and practitioner research.

Fellow Initiatives

The AGEP-NC first cohort of faculty fellows designed and implemented initiatives to engage their faculty colleagues in discussions about diversity and inclusion in their doctoral programs. Examples of these initiatives include sharing data comparing faculty perceptions about department climate with the perceptions of URM students, skills workshops on inclusive mentoring, and hosting diverse speakers on issues of importance to the department or discipline regarding the goals of the AGEP project.

Faculty Fellows began the project/study by participating in guided monthly reading groups on diversity and inclusion, unconscious bias, mentoring, findings from the AGEP-NC mentoring research, and facilitating change initiatives. These discussions resulted in increased awareness of diversity issues and experiences of URM doctoral students and improved skills for culturally responsive mentoring. Next, each faculty fellow, department chair and director of their department's graduate programs lead department faculty in discussions and initiatives regarding diversity and mentoring. They examined the pathways of URM students through their doctoral programs, and participated in the development of a departmental diversity plan. By the end of the two-year term, the faculty in each participating department increased their awareness of diversity issues in their discipline, identified pathways of URM doctoral students, and diagnosed trouble spots where students may be at risk of leaving the program. Each department developed and adopted a plan for promoting the success of URM doctoral students. After participating in the AGEP-NC project, the researchers expect diversity in doctoral programs to become a recognized departmental priority, and that improvements in the climate and use of best practices for mentoring URM doctoral students and positive changes in the perspectives of faculty about diversity in their graduate programs will continue.

Preliminary Outcomes

The preliminary outcomes will be shared from the first cohort of faculty fellows. The outcomes will include two parts: 1) sensemaking initiatives, and 2) departmental diversity plans.

Sensemaking for Culturally Relevant Mentoring (CRM). The project evaluator and social science researchers conducted institutional and department climate surveys which revealed URM students felt more discomfort voicing concerns with faculty advisors than non-URM students, and URM students reported they were less likely to pursue an academic career than majority doctoral students. The surveys similarly confirmed themes from the literature in that Alliance institution's faculty held URM student mentoring as "deficit" and "vacuous" (Merriweather et al., 2019). That is, STEM faculty have disciplinary content, but lack knowledge about accounting for racial/ethnic identity as an asset in mentoring.

The project leadership team reviewed the survey results and the faculty fellows' meeting developments over several months through web-based and in-person, bi-weekly meetings at the three institutions. These reviews served as "cycles of inquiry" that other STEM reformers have pursued to effect institutional change through practitioner inquiry that links faculty leadership at the department level to institutional leadership across the three institutions (Dowd & Liera, 2017). Project team leadership agreed two results from this cycle of inquiry are important: 1) development of an organic definition Culturally Relevant Mentoring (CRM); and 2) use of a nationally recognized URM graduate student mentoring training for STEM faculty led by faculty peers from the project.

Culturally relevant mentoring (CRM) is among several approaches of interest to STEM reformers to shift the focus to institutional-level change and not student deficiencies. Operationalized as "cultural integrity," the approach calls upon students' racial and ethnic backgrounds as assets for reform in pedagogies and learning activities, while valuing those backgrounds as critical ingredients for acquiring academic capital and career success (Tierney, 1999). Cultural integrity takes account of cultural capital linguistic and cultural competencies individuals inherit and learn, and habitus, a set of perceptions individuals have of their environment (Bordieu, 1986). Going forward, cultural integrity may serve as a framework for faculty mentors and other individuals to serve as "social agents" who "produce the conditions for change and improvements in opportunity" (Tierney, 1999, p. 85). From a programmatic standpoint, cultural integrity points to the importance of the localized context, the academic department, the local definitions of racial and ethnic identity for creation of institutionalized capital with the PLC.

Departmental diversity plans

This year, the lead institution's Cohort I faculty fellows developed sensemaking activities that then enabled the Fellows to lead their departments in developing a diversity plan for promoting the success of URM doctoral students. One item from each of the sensemaking initiatives is highlighted:

- Invited a facilitator to lead the faculty in discussion of culturally responsive mentoring.
- Created a module for all incoming graduate students and their faculty mentors to develop better communication skills and

overcome communication barriers between graduate students and their faculty mentors.
- Recruited intentionally a diverse candidate pool for open faculty positions and hosted several URM seminar speakers.
- Facilitated a workshop for department faculty members on creating an inclusive department climate.
- Hosted a National Research Mentoring Network (NMRN) workshop for faculty.

The goal of the departmental diversity plans is to institute change strategies that will improve the climate, practices and policies so they positively impact URM graduate students and faculty in the program. Each plan has the following components: 1) the faculty's assessment of any obstacles for URM doctoral students in the program and any elements of the program that enhance the success of URM students; 2) three concrete actions to promote success of URM doctoral students in completing the PhD and preparing for faculty careers, based on the assessment in part 1; and 3) a discussion of how the actions developed in part 2 will be sustained past the end of the Fellow's 2-year commitment. One item from each plan is listed below that addresses a component listed above:
- Required mandatory annual survey of doctoral students on climate, expectations and progress.
- Revamped the existing Introduction to Graduate Studies class and the weekly seminar program to create a structured professional development program for graduate students.
- Advised faculty mentors to be flexible in advising first year graduate students' course selection, tailoring the advice to the student's level of preparation.
- Created a formal recognition of faculty commitment to URM training and success.
- Changed departmental policy; as of 2020, Reappointment, Promotion and Tenure rules include language that explicitly assesses the culture of inclusion in the laboratory and classroom environments of all faculty.

It is the expectation of the Project Team Leadership that lasting change will come from the fellow initiatives and doctoral diversity plans.

Discussion and Conclusion
Results above reflect organizational learning and sensemaking important for institutional change. Organizational learning involves detection of errors in the environment and making structural adjustments in response to those errors (Kezar, 2018). Sensemaking involves individual-level learning in which underlying assumptions and values are challenged creating deep, lasting, and cultural change (Kezar, 2018).

The development of department diversity plans does not guarantee change, however these represent opportunities to build on transformation activities, notably through tenured faculty who have permanent residency in their departments. Documenting diversity plans and gaining consensus from faculty peers in the department reflects ideas that are codified and accepted. The organizational learning approach has been embedded in campus diversity evaluation models where internal and external peer-reviewers assess project change efforts against stated goals and objectives. Given the informal and unsupervised nature of mentoring in graduate education, project leaders should consult related research on change efforts in faculty reward systems, faculty workload, and faculty diversity for more as a body of knowledge to inform future directions (O'Meara & Braskamp, 2005; O'Meara et al., 2017).

Sensemaking involves faculty moving from the "vacuous" mentoring mindset to one that embraces CRM. Across the three institutions, the low numbers of URM graduate student enrollment present researchers and evaluators challenges in maintaining participant confidentiality in the reporting of survey results. A single Latino/X doctoral student in an institution's computer science department may be reluctant to critique poor mentoring in an online survey, for example. Qualitative researchers examining academic success among high-achieving students of color have recognized that individual and group interviews of students of color foster safe spaces with appropriate research design protections. URM students reveal they may pursue high prestige careers to dispel stereotypes, for example (Gandara, 1995; Taylor & Antony, 2000), and better facilitate exchange of break-through ideas needed to effect change. When project leaders incorporate student interview data taken these voices of color increase chances for appropriate interventions that are locally appropriate.

Finally, the Project Team Leaders see that the development of departmental diversity plans are emerging as an important vehicle for discussion, sense making, and are serving as a roadmap for institutional change. At the individual level, the sensemaking process for faculty involves use of leaders to maintain momentum and keep the emphasis on race as a critical factor in mentoring. As project leaders systematically integrate research-based findings from external evaluators and others engaged in systematic inquiry around organization learning the project goals promises to meet its goals.

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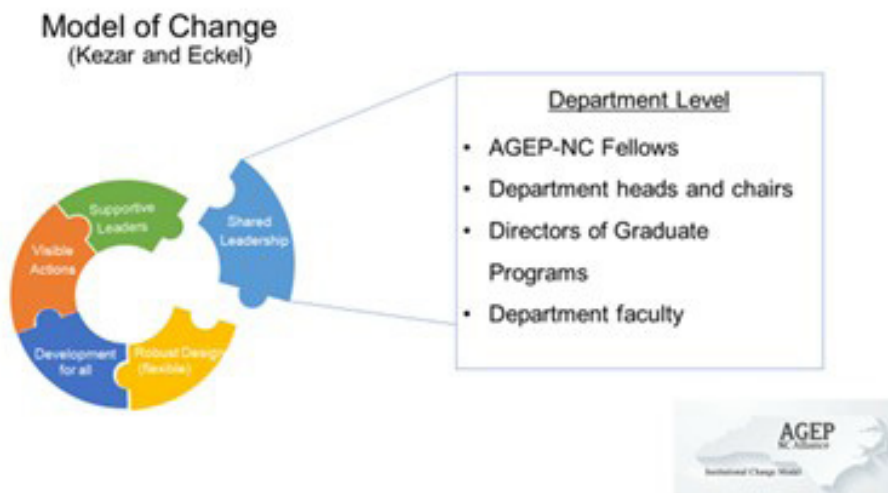
Figure 1: Institutional Model of Change

Figure 2: AGEP North Carolina Alliance