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**A PROGRAM EVALUATION OF A POLICY
INTERVENTION TO INCREASE RACIAL DIVERSITY
IN THE SCIENCES AND ENGINEERING**

A Dissertation Presented

by

RICARDO LEÓN GÓMEZ YEPES

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF EDUCATION

September 2013

Educational Policy and Leadership

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Educational Policy and Leadership

*In loving memory of Edilberto Gómez
(3/7/1936–10/28/2007)*

It is the policy of the United States to encourage men and women, equally, of all ethnic, racial, and economic backgrounds to acquire skills in science, engineering and mathematics, to have equal opportunity in education, training, and employment in scientific and engineering fields, and thereby to promote scientific and engineering literacy and the full use of the human resources of the Nation in science and engineering.

*Science and Engineering Equal
Opportunities Act, 1980*

ACKNOWLEDGMENTS

This project could have not been accomplished without the support and assistance of many people. My deepest thanks to all of those who gave of themselves so generously, enabling me to achieve this goal.

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And finally, I owe my deepest gratitude to my family—Zulma, Sofía, and Isabela—for their love, their understanding, their patience, and their sacrifices over the years without which I could not have achieved this lifelong goal. There are no words that can express the extent of my appreciation, my gratitude, and most of all, my love, for everything my family has given me.

ACRONYMS

AGEP	Alliances for Graduate Education and the Professoriate
AISES	American Indian Science and Engineering Society
ATT	Average Treatment Effect on the Treated
ATU	Average Treatment Effect on the Untreated
ATE	Average Treatment Effect
CSS	College Senior Survey
CSS	College Seniors Survey
CRE	Culturally Responsive Evaluation
FOIA	Freedom of Information Act
GPI	Gender Parity Index
GEI	Graduate Education Initiative
HBCU-UP	Historically Black Colleges and Universities–Undergraduate Program
I-E-O	Input-Environment-Outcome model
IRB	Institutional Review Board
IPEDS	Integrated Postsecondary Education Data System
LSAMP	Louis Stokes Alliances for Minority Participation

MGE	Minority Graduate Education Program
MURAP	Moore Undergraduate Research Apprentice Program
NCES	National Center for Education Statistics
NORC	National Opinion Research Center
NSF	National Science Foundation
NSBE	National Society of Black Engineers
NS&E	Natural Sciences and Engineering
NC A&T	North Carolina Agricultural and Technical State University
NC AGEF	North Carolina Alliance for Graduate Education and the Professoriate
NC OPT-ED	North Carolina Alliance to Create Opportunity through Education
NC-MSEN	North Carolina Mathematics and Science Education Network
NCSU	North Carolina State University
OPE	Office of Postsecondary Education
PARI	Pisgah Astronomical Research Institute
PFF	Preparing Future Faculty Program
PI	Principal Investigator
PPA	Program Participation Agreement
PSS	Psychosocial Support Services
RISE	Research Internships in Science and Engineering

RTG	Research Training Grant
SAT	Scholastic Achievement Test
STEM	Science, Technology, Engineering, and Mathematics
SBE	Social, Behavioral and Economic Sciences
SHPE	Society of Hispanic Professional Engineers
SPGRE	Summer Pre-Graduate Research Experience
SED	Survey of Earned Doctorates
TOC	Theory of Change
URM	underrepresented minority
UNC-CH	University of North Carolina at Chapel Hill

ABSTRACT

A PROGRAM EVALUATION OF A POLICY INTERVENTION TO INCREASE RACIAL DIVERSITY IN THE SCIENCES AND ENGINEERING

SEPTEMBER 2013

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This dissertation is an evaluation of an intervention designed to (a) increase the number of minority students who pursue graduate degrees in Science, Technology, Engineering, and Mathematics (STEM) disciplines, and (b) to develop a cadre of qualified individuals from minority backgrounds who, upon finishing their training, are ready to take positions as faculty members and mentors.

The Alliances for Graduate Education and the Professoriate (AGEP) is a program funded by National Science Foundation (NSF) to support a pathway from undergraduate to graduate school and to a career in the professoriate. AGEP is part of an effort by the U.S. Government to keep the nations' competitive edge; redress historical gender and racial inequalities still prevalent at the higher levels of science and academia; and to use those who have reached the top of their professions as effective role models for the thousands of talented youth who are excluded from STEM fields due to

real or perceived social, economic, or cultural barriers. As of September 2012, there were 178 colleges and universities grouped in 37 alliances nationwide and serving approximately 22,000 minority doctoral students.

Specifically, this evaluation focuses on one alliance situated in the North Region of the United States, and presents the approaches, rationale, and findings of evaluation activities conducted during 2011 through 2012. The overarching goals of this evaluation were to assist program managers and staff in their efforts to improve the quality and effectiveness of the program, and to provide them with information related to the program's contribution to increasing the recruitment and retention of students underrepresented minority (URM) in STEM graduate programs, their transition into the professoriate, and the strength of the program's theory of change. To achieve these goals the evaluation design included a) the reconstruction of the program's theory, b) a systematic review and meta-analysis of existing research; and c) analysis of primary data collected from a sample of current AGEP students, alumni, faculty, staff, and program officers. Primary data were collected through focus groups, interviews, and electronic surveys for current and former participants.

The evaluation found evidence that the North Region program has been largely successful in contributing to the number of URM receiving STEM graduate degrees at both the master's and doctoral levels since its inception in 1999. Those who have received their graduate degrees are employed in academic and non-academic settings as practitioners, researchers, and as university faculty. This study also reviews the program's current monitoring and evaluation system and provides suggestions for improvement.

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INTRODUCTION

The purpose of this evaluation was to examine the implementation and outcomes of the North Carolina Alliance for Graduate Education and the Professoriate (NC AGEP). The NC AGEP was established in 1999 as a partnership between three higher education and research institutions. Overtime, this alliance was joined by other institutions, including historically black colleges, women’s colleges, and community colleges. This Alliance is sponsored by the National Science Foundation (NSF) and is part of a larger plan by the the U.S. Government to increase the number individuals from minority backgrounds—Black, Indian, Hawaiian, Pacific Islander, and Hispanic—with graduate degrees in Science, Technology, Engineering, and Mathematics (STEM) fields. Aside from increasing the representation of minorities at the graduate and professorial levels, another expected goal of the program is that those minority individuals who reach the top of the academic or corporate ladder take an active role in encouraging low-income, first-generation, and minority youth to pursue careers in STEM. One of the premises that underlie the AGEP program is that exposing students to faculty who share a similar racial or ethnic background can increase their motivation and interest in pursuing a STEM-related career (National Science Foundation, 2010). After all, they are the trailblazers who have overcome the hurdles faced by many low-income, first generation, or minority students and reached top positions in science and academia, proving that it can be done.

Based on in-depth consultations with program staff, it was surmised that there were three areas of primary interest to this group of stakeholders: (a) value added of the program, (b) program’s impact on clients and their perceptions of program impact, and (c) the factors or variables impacting the implementation and outcomes

of the program. Hence the evaluation sought to answer the following questions related to the above mentioned areas:

1. What is the value added of the program?
2. Which of the Alliance's program activities made the most significant difference in students' persistence into the PhD and through the doctoral degree?
3. What is the value/effectiveness of each institutional program in regards to the student's completion of the doctoral degree and interest in an academic career?

The evaluation questions will be investigated through a mixed-methods evaluation design that includes a) the reconstruction of program theory (Donaldson, 2007; Pawson, 2006; Weiss, 1998), b) a systematic review and meta-analysis of existing research (Card, 2012; Cooper, 2009); and c) analysis of primary data collected from a sample of current AGEF students, alumni, and faculty. This research has implications for policy makers, program administrators, and organizations who seek to increase the participation of low-income, first generation, or minority individuals in the STEM educational pipeline. An schematics of the research logic for this study is shown in Figure 1.

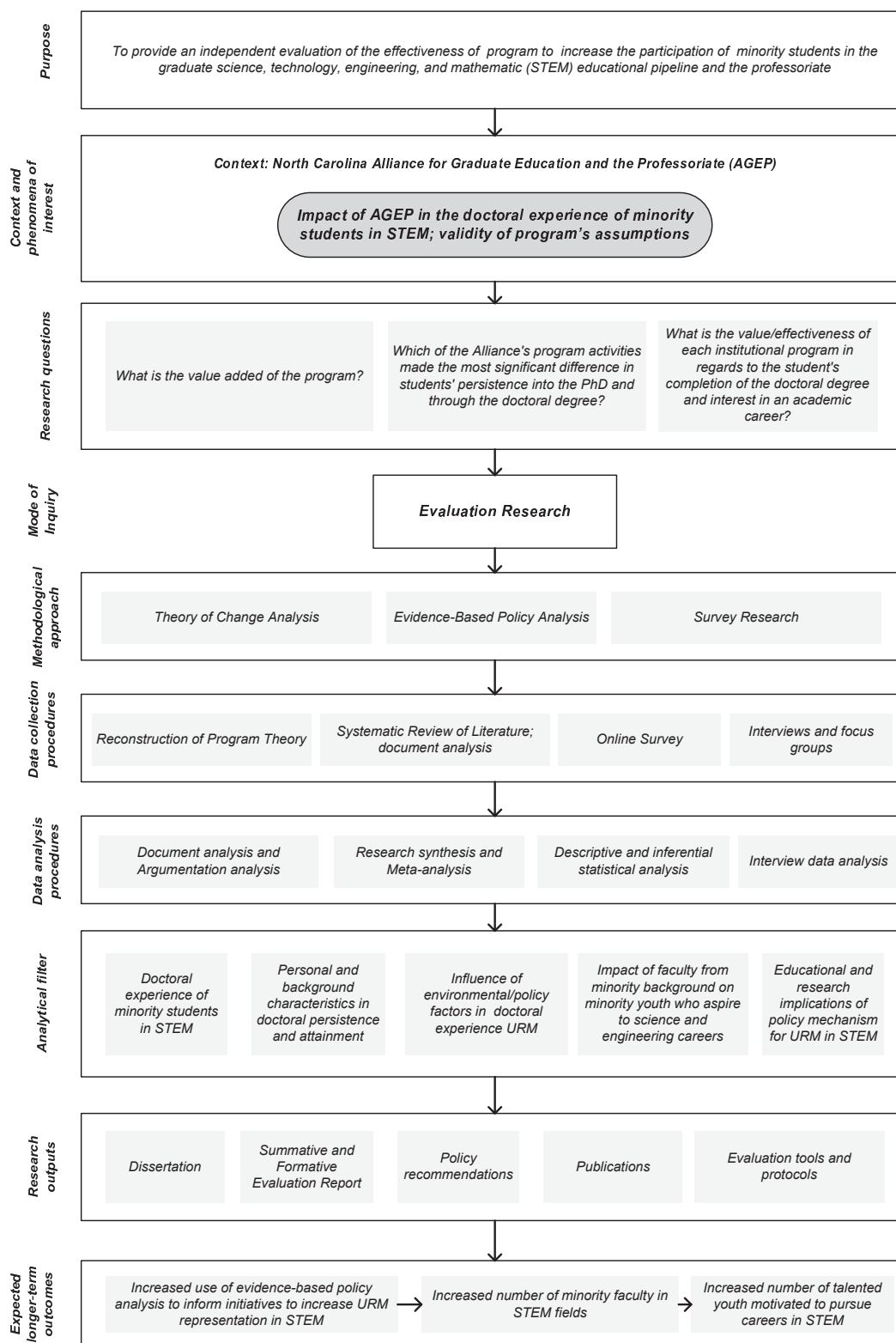


Figure 1. Study design logic

CHAPTER 1

POLICY CONTEXT

1.1 Policy Context

Increasing diversity in STEM is partly a social justice issue to improve the distribution of the benefits accruing to the society, and ensure that a wide range of the citizens of the United States play an active and informed part in the control and use of the assets of the society. And it is partly an equality issue to ensure that the best and most able people from all backgrounds are provided with the necessary education to contribute to the further development of knowledge and to maintain the country's global leadership and competitiveness (National Research Council, 2011).

Recent projections (Carnevale, Smith, & Melton, 2011) show that STEM occupations will grow from 6.8 to 8 million total jobs by 2018 (see Figure 1.1).

Approximately 2.4 million of those will be new job openings and replacement jobs due to retirement, and 92% of those jobs will be for people with postsecondary education. However, current enrollment and graduation rates will not produce enough skilled workers to fill those positions: of 100 students who enter college to obtain a bachelor's degree, only 19 graduate in a STEM major, and only eight end-up working in a STEM-related career (Carnevale et al., 2011).

As a result, the United States now relies heavily on international talent to fulfill its scientific and research needs. Foreign-born nationals are receiving science and engineering degrees at a higher rate than native-born Americans. As of 2010, 46% of the foreign-born population in the U.S. had bachelor's degrees in STEM fields, compared to 33% of the native-born population (Gambino & Gryn, 2011). In the

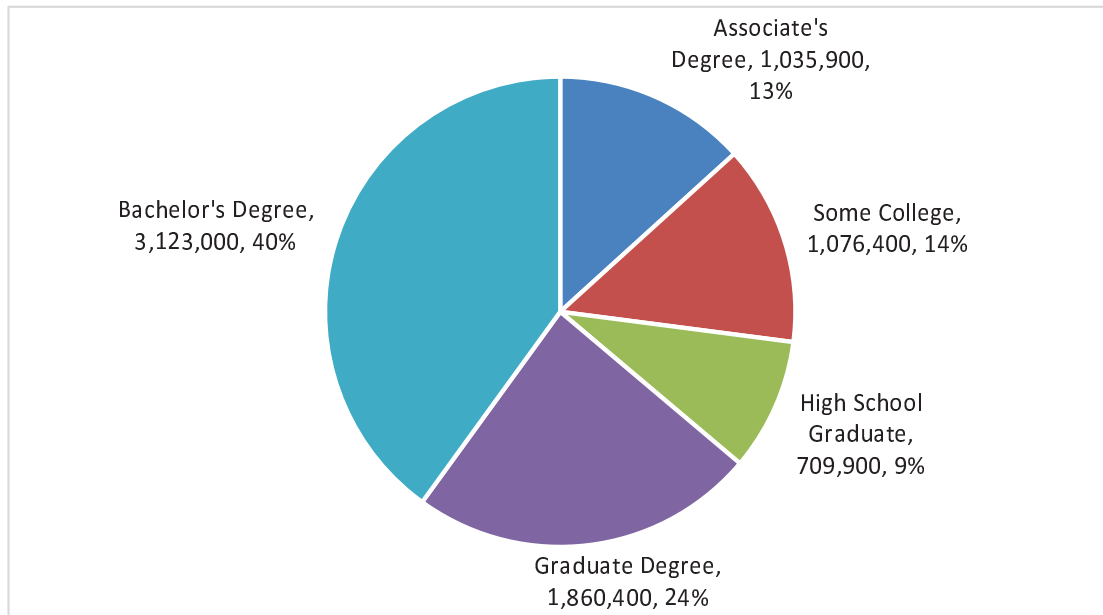


Figure 1.1. Employment projections of STEM jobs by level of education in 2018. Source: Georgetown University Center on Education and the Workforce forecast of occupational growth through 2018.

same period more than half of the PhD degrees in STEM fields were awarded to foreign students (Figure 1.4).

Paradoxically, every year, approximately 600,000 talented youth—mostly women, individuals from minority and low-income background, and disabled people—who graduate in the top half of their class and who are very likely to succeed in STEM fields—as indicated by Scholastic Achievement Test (SAT) scores—do not go on to get a postsecondary degree (Carnevale et al., 2011). This disparity is not limited to access to higher education. It also extends to retention and graduation in undergraduate and graduate programs (Figure 1.5), participation in the job market (Figure 1.6), and salaries (Figure 1.7).

With the passing of the Science and Engineering Equal Opportunities Act 1980, the US Congress created the political and financial support needed to develop policy mechanisms to reduce social, ethnic, and gender disparities in STEM education. This Act gave federal agencies the mandate to “assist the United State Government in the

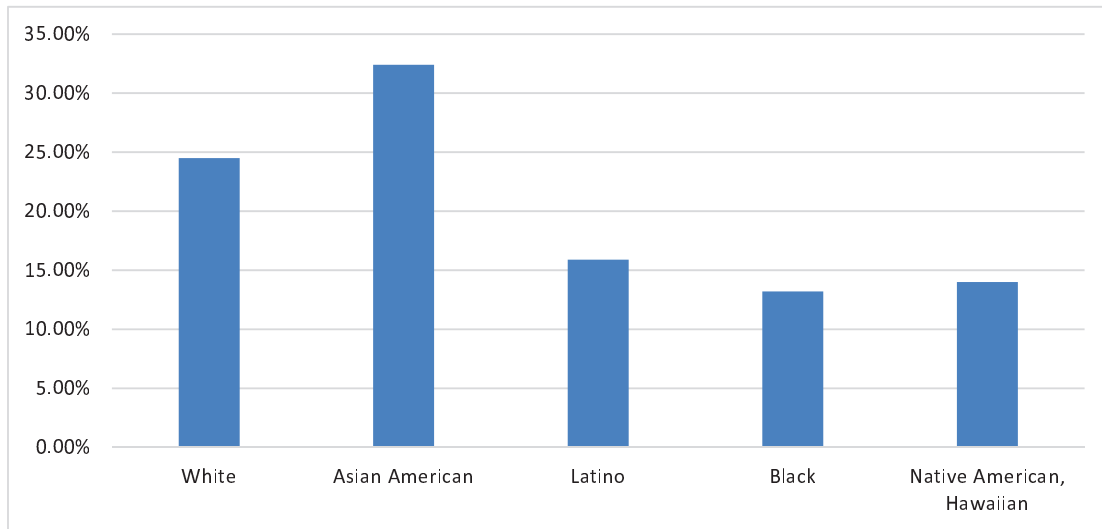


Figure 1.2. Percentage of 2004 STEM aspirants who completed STEM degrees in 4-5 years. Source: Higher Education Research Institute (2010)

full development and use of the science and engineering talents of men and women , equally, of all ethnic, racial, and economic backgrounds.” Almost two decades after the passing of this Act, the National Science Foundation established the Alliance for Graduate Education and the Professoriate (AGEP).¹

This program seeks to develop a pool of suitable individuals from traditionally underrepresented groups in STEM who can become faculty and mentors. One of the assumptions of the program is that faculty who share the same background as their students can serve as effective role models (Carrell, Page, & West, 2010) since they are in a better position to understand their needs, expectations, and challenges, and this, in turn, can translate to higher enrollment and retention rates, and better race relations on campus (Alger, 1999; Dubin, 2000; George, Neale, Horne, & Malcolm, 2001; MacLachlan, 2006).The next section provides a description of the NC AGEP and includes information related to the background and history of the initiative, the

¹Started in 1998 as the Minority Graduate Education Program (MGE).

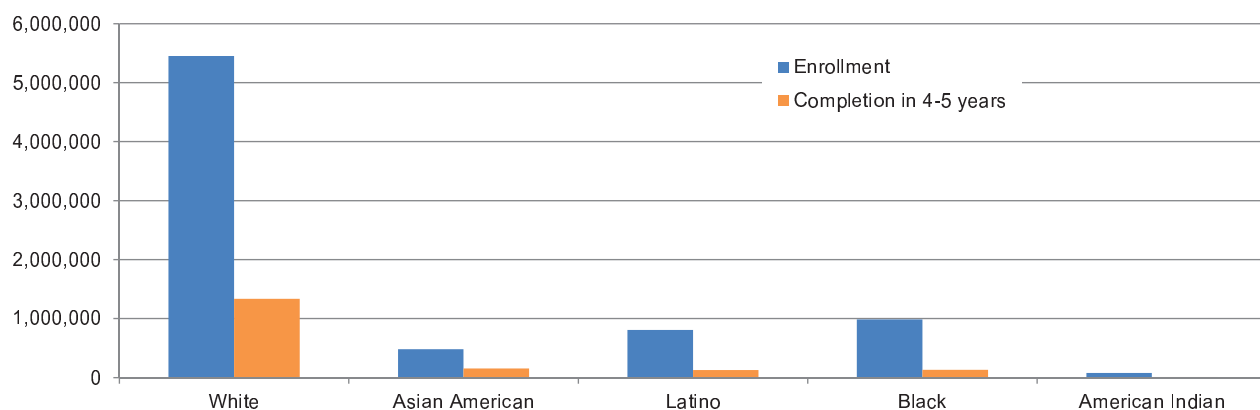


Figure 1.3. Percentage of 2004 STEM aspirants who completed STEM degrees in 4-5 years. Source: Higher Education Research Institute (2010).

scope of the evaluation, the problems that the initiative was designed to address, and the components that define the NC AGEP.

1.2 The Evaluand: Alliance for Graduate Education and the Professoriate

Defining and describing the evaluand is the first step in the preparation of an evaluation study (Fitzpatrick, Sanders, & Worthen, 2004). The characterization of the evaluand defines the scope and extent of the evaluation and serves as the basis for a common understanding among evaluator, program administrators, and stakeholders.

For this evaluation, several sources of information were used to characterize the program. First, information was compiled, based on initial conversations with program administrators and interviews students and faculty. During this process specific questions were asked with regard to the program objectives and activities. Next, printed and digital literature pertaining to the program was reviewed. Finally, the evaluator also interviewed the Director of the New England AGEP program, to understand how the program has been implemented in other locations.

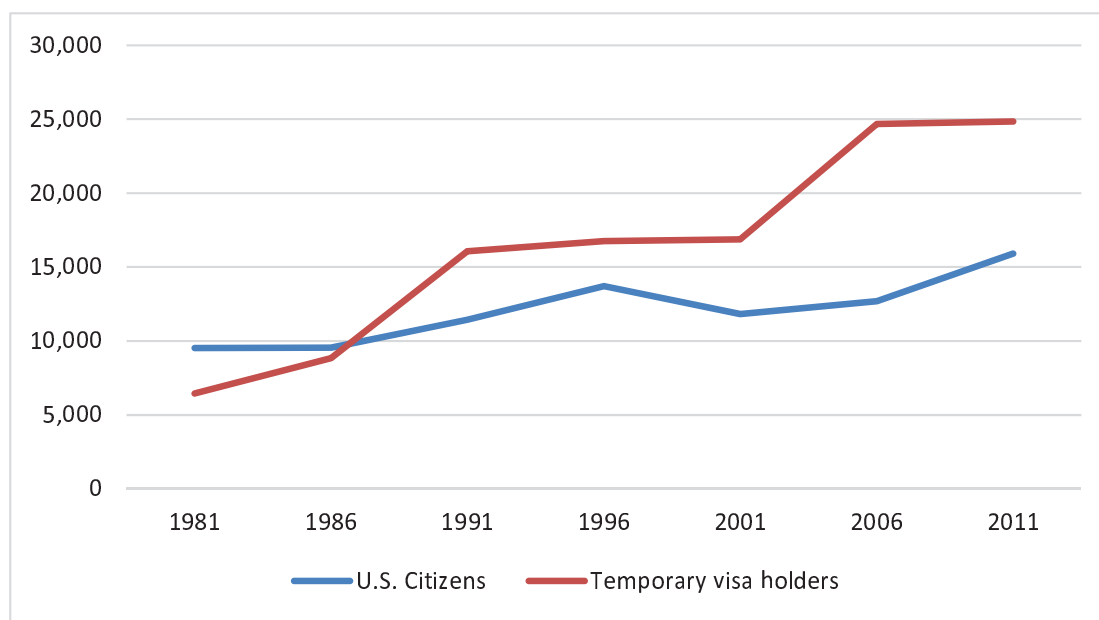


Figure 1.4. Doctorates awarded in science and engineering fields, by citizenship: 1991-2011. Source: NSF/NIH/USED/USDA/NEH/NASA, Survey of Earned Doctorates.

1.2.1 Alliance for Graduate Education and the Professoriate

The Alliance for Graduate Education and the Professoriate (AGEP) program is a National Science Foundation (NSF) initiative that seeks to increase the number of domestic students receiving doctoral degrees in science, technology, engineering and mathematics (STEM) fields, with special emphasis on those population groups underrepresented in these fields (i.e. African-Americans, Hispanic-Americans, American Indians, Alaska Natives, Native Hawaiians or other Pacific Islanders).

The AGEP program was launched in 1998 and provides funding for the establishment of institutional alliances to develop and to implement strategies for recruiting, mentoring, and retaining minority students in STEM doctoral programs. The program accomplishes this goal by bridging STEM undergraduate-graduate programs that seek to broaden minority student participation in STEM fields; building linkages between undergraduate and graduate research and education institutions; providing academic and limited financial support for participating students; and offering pro-

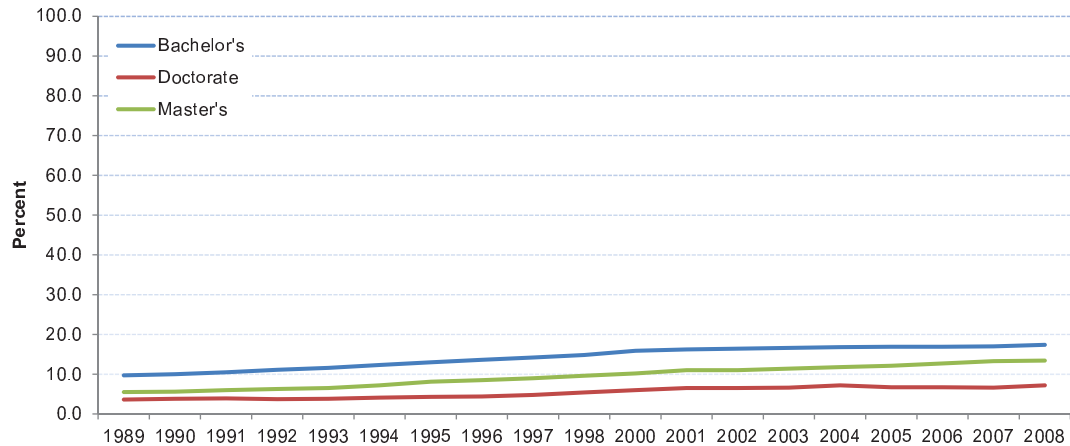


Figure 1.5. Science and engineering degrees earned by underrepresented minorities: 1989-2008 Source: NSF (2012)

professional development for students to enter the professoriate. In addition, one goal of AGEF is to institutionalize the program elements to promote sustainability after NSF funding has ended.

As of September 2012, there were 178 colleges and universities grouped in 37 alliances nationwide (“Alliance for Graduate Education and the Professoriate,” 2012). All underrepresented minority doctoral students who attend alliance institutions are considered AGEF fellows. Therefore, the alliances service approximately 22,000 minority doctoral students. The focus of this evaluation is primarily on two members of the North Carolina OPT-ED program: North Carolina State University (NCSU) and University of North Carolina at Chapel Hill (UNC-CH).

1.2.2 The North Carolina Alliance for Graduate Education and the Professoriate

In 1999, the North Carolina Alliances for Graduate Education and the Professoriate (AGEF) was initially established as an alliance between North Carolina Agricultural and Technical State University (NC A&T), NCSU, and UNC-CH with it being expanded to include several other institutions and programs in 2001 but the initial

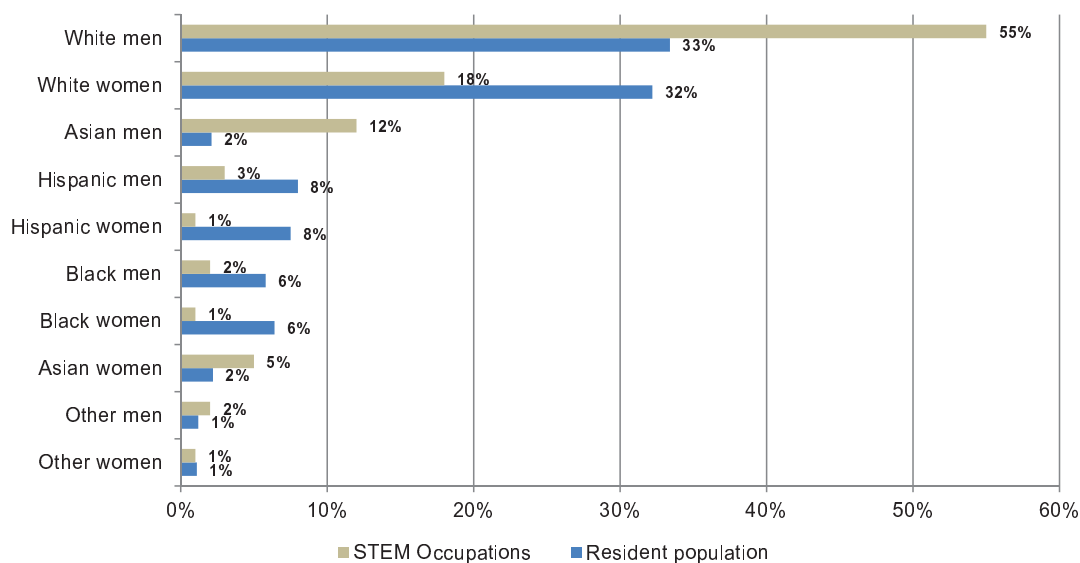


Figure 1.6. Resident population of the US vs. Scientists and engineers in STEM occupations 2009. Source: NSF and U.S. Census Bureau (2012)

three institutions retained their alliance within the broader OPT-ED alliance (see Figure 1.1). However, AGEF goals, activities, and proposed outcomes aligned closely with the greater alliance effort, and this introduced the potential for the AGEF program and OPT-ED alliance to impact each other. Though an evaluation of the entire NC OPT-ED alliance is beyond the scope of the current evaluation, it is relevant to position the AGEF program within a larger system of activities and goals. This relevance is further explicated with regard to evaluation questions below as demonstrated by the AGEF Program Map in Table 1.1:

Aligned with the goals of NSF’s AGEF program, specific objectives of the NC AGEF are (a) to develop and implement innovative models for recruiting, mentoring and retaining URM students in STEM PhD programs and, (b) to develop effective strategies for identifying and supporting URMs who wish to pursue academic careers. The program seeks to achieve its goals and objectives through a series of professional development activities for undergraduate and graduate students. Among others, program clients participate in professional development workshops, conferences, mentoring ses-

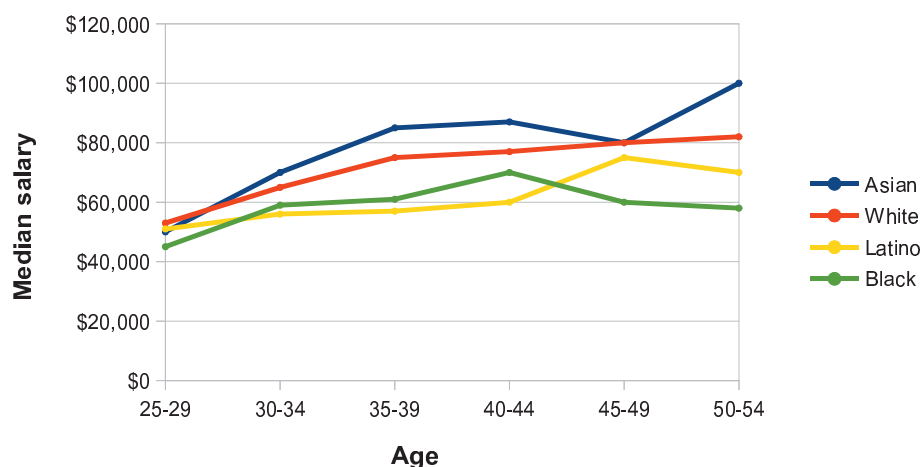


Figure 1.7. Wage gaps among STEM workers. Source: U.S Department of Labor 2011

sions, and summer research camps. They also receive financial support for activities such as attending professional conferences. Figure 1.9 shows a logic model of the program. The model was developed from program documentation, interviews, Internet searches, and responses from surveys.

1.3 AGEP’s Theory of Change

This evaluation study uses a program’s theory-driven approach to investigate the impact of the AGEP program on the educational outcomes of doctoral students from underrepresented minorities in STEM disciplines. By using a theory-driven approach, this evaluation seeks to make “explicit the underlying assumptions about how programs are expected to work...and then [uses] this theory to guide the evaluation” (Rogers, Petrosino, Huebner, & Hacsí, 2000, p. 5).

A program theory explains the planned outcomes of the program and how those outcomes will be accomplished. It describes the program, explains the conditions necessary for the program to work, predicts the outcomes of the program and specifies the activities necessary to realize the predicted outcomes (Sidani & Sechrest, 1999).

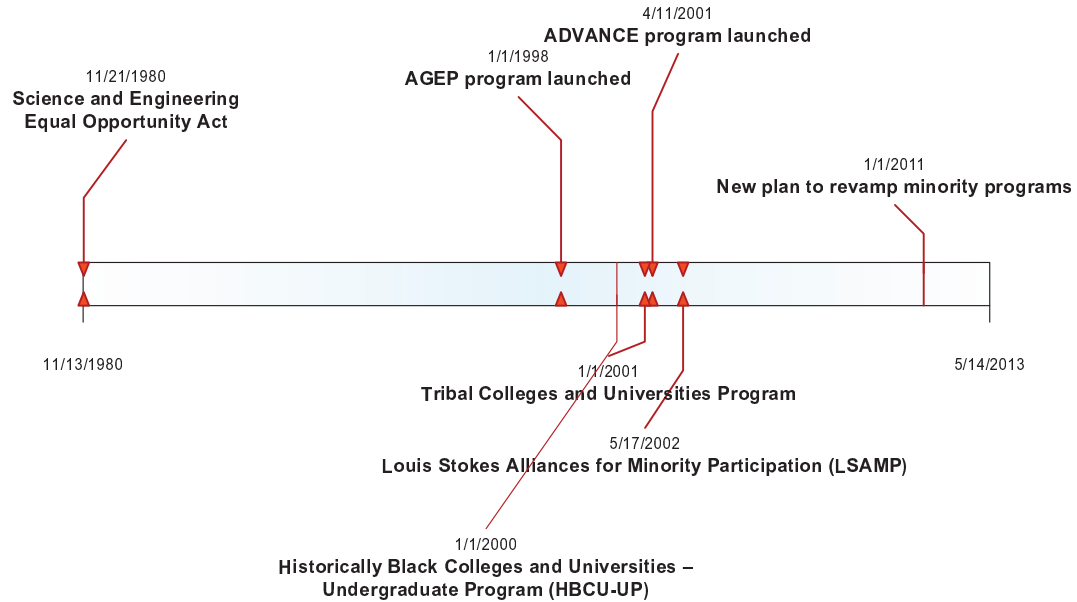


Figure 1.8. Timeline of Federal initiatives for broadening participation in STEM fields.

Weiss (1998) defines program theory as “set of hypotheses upon which people build their programs plans. It is an explanation of the causal links that tie program inputs to expected program outputs” (Weiss, 1998, p. 55). It is expected that if the program is implemented as designed, the desired outcomes will be produced by participation in the program.

This evaluation follows Leeuw’s (2003) policy-scientific approach to reconstruct the program’s theory of change. The policy-scientific makes use of formal and informal documents, interviews, and argumentation analysis to reconstruct the program’s underlying assumptions. The program theory is also captured in a logic model, which visually identifies the different components of the program and how they are thought to make the program work to achieve the desired outcomes (see figure 1.9).

The logic model links components of a program with program outcomes, and by doing so illustrates the program theory from which the program was designed. A program logic model should include the inputs, activities, outputs and outcomes of a pro-

gram. Finally, the outcomes are the desired or intended results or behaviors that can be attributed to having participated in program activities. “Once developed, a logic model can be used in multiple ways, including evaluation planning, program design, goal setting, communication with stakeholders, and program improvement” (Kellogg Foundation, 2004).

1.3.1 AGEP’s Theory of Change

The relationship of the program activities to their intended outcomes is described in the program’s logic model on the previous page. A logic model is a graphical display of what the program or project intends to do and what it seeks to achieve. The logic model for the AGEP program was developed based on Knowlton and Phillips (2012) guidelines for logic model development. Inputs for the logic model included the review of 169 AGEP grants proposals submitted to the NSF, policy and programmatic documents made available by program staff, and interviews with program officers, program coordinators, staff, and students.

1.3.2 Visualization of Program’s Theory

Based on the findings of the theory of change, AGEP’S theory of change can be summarized in the following six statements:

Theory of Change 1. *Mentoring:* *If graduate URM students are provided with mentoring by faculty and more experienced students, then retention and graduation rates and interest in academic careers will increase.*

Theory of Change 2. *Financial Support:* *If students have access to financial support services, then retention and graduation rates will increase.*

Theory of Change 3. *Academic Support:* *If students are provided with academic support services (e.g., academic writing, public speaking, research workshops, etc), then retention and graduation rates will increase.*

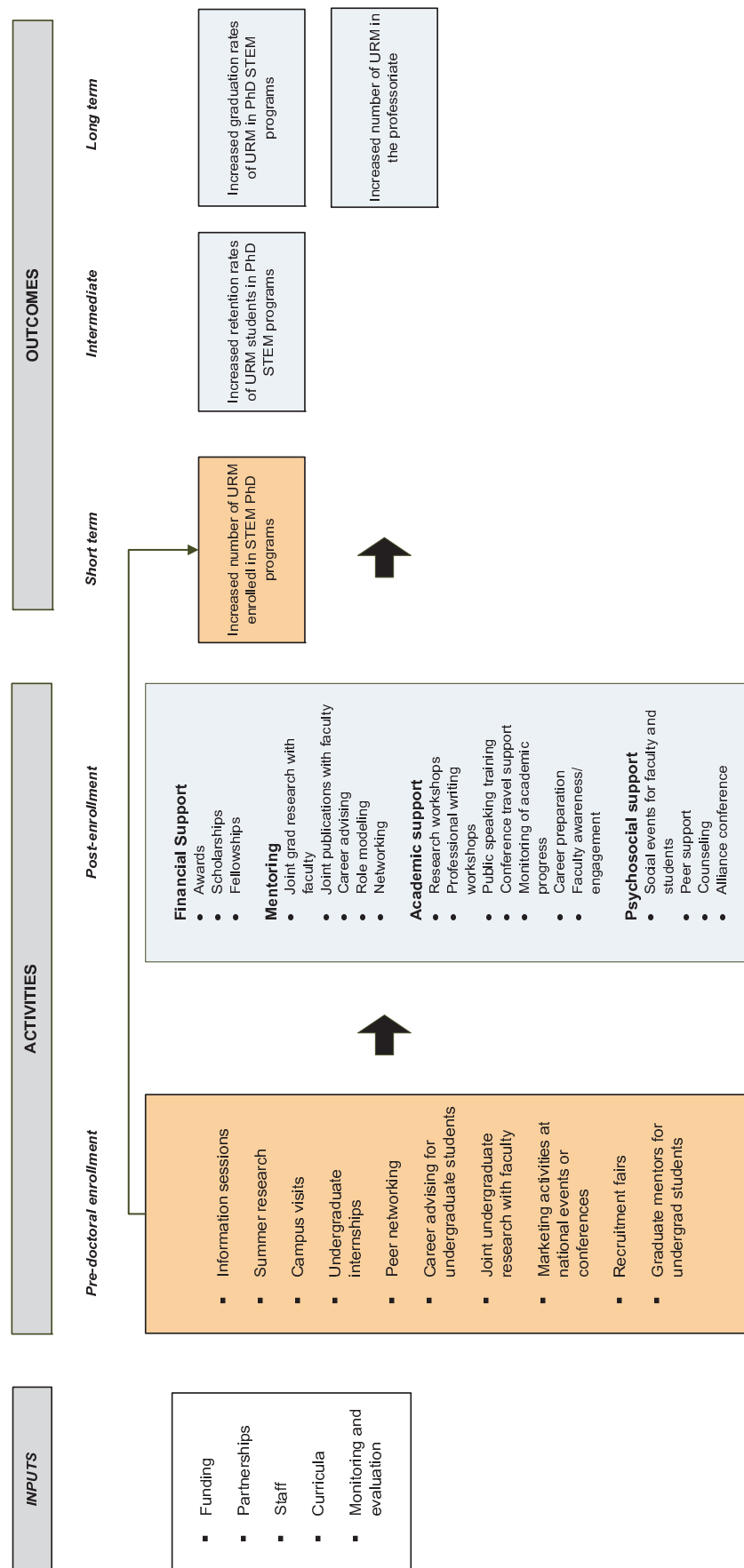


Figure 1.9. AGEF's Logic Model

Theory of Change 4. *Psychosocial Support:* *If students are provided with psychosocial support services (e.g., peer support, counseling), then retention and graduation rates will increase.*

1.4 Purpose of the Study

The purpose of this evaluation is to provide an independent evaluation of the effectiveness of the NC AGEF program in achieving its stated goals and objectives. As stated above, the NC AGEF is a component of a larger statewide alliance—North Carolina Alliance to Create Opportunity through Education (NC OPT-ED)—and as such, the evaluation discussed herein, though primarily an evaluation of the NC AGEF, also provides insight into the OPT-ED Alliance. This evaluation focused on the NC AGEF’s programmatic activities, experiences of participants (current students and alumni), and experiences of institutions/programs as members in the OPT-ED alliance.

As an outcome evaluation, the focus was on the state of the participants and the social conditions that the program was expected to have changed (Rossi, Lipsey, & Freeman, 2004, pg. 204), and sought to provide program administrators with data that would facilitate decision making (e.g., determining the next steps in implementation) as well as making initial determinations regarding the worth of the program (e.g., the effects on participants). At the core of the evaluation process was the search for evidence that would help program administrators to determine if (a) the program was implemented as planned; (b) if activities and services were delivered in the intended way; and (c) to understand the impact of the program as experienced and lived by program participants (Becker & Vanclay, 2003). To achieve this purpose, the evaluation included a series of interviews and focus groups with faculty, students and program staff; reviewed program documents; and administered an online survey for current students and alumni.

The evaluation did not seek to determine the impact of the program—defined as “the change of an outcome solely attributed to the program controlling for other confounders” (Nam, 2008, pg. 10). Rather, this evaluation sought to identify the variables impacting the implementation and outcomes of the program, discover the relationships and themes among those variables, and then use that information to make decisions about and improve upon the program.

Based on in-depth consultations with program staff, it was surmised that there were three areas of primary interest to this group of stakeholders: (a) value added of the program, (b) program’s impact on clients and their perceptions of program impact, and (c) the factors or variables impacting the implementation and outcomes of the program. Hence the evaluation sought to answer the following questions related to the above mentioned areas:

1. What is the value added of the program?
2. Which of the Alliance’s program activities made the most significant difference in students’ persistence into the PhD and through the doctoral degree?
3. What is the value/effectiveness of each institutional program in regards to the student’s completion of the doctoral degree and interest in an academic career?

The following chapter, Method, will review the evaluation plan that was proposed to support the above identified goals and questions of the evaluation study.

1.5 Reasons for the Evaluation

The evaluation was commissioned by the two partner institutions leading the Alliance. During the preparatory discussions, the program administrators and the evaluator discussed the purpose of the evaluation, the approach, and the logistics. The Alliance was interested in documenting the process and procedures and in gathering information regarding the implementation of the initiative, as well as in gaining

a greater understanding of the strengths, weaknesses, and initial outcomes of the program in order to facilitate future decision making. They were also planning on using the evaluation as an input for the preparation of a grant proposal to seek funding for another cycle of the program.

Additionally, the evaluator was also interested in evaluating this initiative due to its personal interest on the topic. The evaluator expressed his interest in using this evaluation for the purpose of meeting the requirements for dissertation research. Permission was granted after providing assurances of confidentiality and anonymity. Based on the discussions the evaluator agreed that the reasons for conducting the evaluation were ethical, feasible, and reasonable.

Table 1.1. NC OPT-ED Alliance: Institutions and focus of intervention

Academic Level	Name of program	Institutions aligned with the program	Focus of intervention
Middle/High school	North Carolina Math Science Education Network - Pre-College Program (Grades 6-12) (NC- MSEN)	<ul style="list-style-type: none"> Elizabeth City State University (ECSU) Fayetteville State University (FSU) North Carolina Agricultural and Technical State University North Carolina State University (NCSU) University of North Carolina at Chapel Hill (UNC-CH) University of North Carolina at Charlotte (UNC-Charlotte) Winston-Salem State University (WSSU) 	Individual
		<ul style="list-style-type: none"> Bennett College (BC) Johnson C. Smith University (JCSU) North Carolina Agricultural and Technical State University (NC A&T) North Carolina Central University (NCCU) (PDF Document) Saint Augustine's College Winston-Salem State University (WSSU) 	Institutional
Undergraduate students	Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)	<ul style="list-style-type: none"> Fayetteville State University (FSU) North Carolina Central University (NCCU) North Carolina Agricultural and Technical State University (NC A&T) North Carolina State University (NCSU) University of North Carolina at Chapel Hill (UNC-CH) University of North Carolina at Charlotte (UNC-Charlotte) University of North Carolina at Pembroke (UNC-Pembroke) Winston-Salem State University (WSSU) North Carolina Agricultural and Technical State University (NC A&T) North Carolina State University (NCSU) University of North Carolina at Chapel Hill (UNC-CH) 	Individual
Graduate students	Alliances for Graduate Education in the Professoriate Program (AGEP)	<ul style="list-style-type: none"> North Carolina Agricultural and Technical State University (NC A&T) North Carolina State University (NCSU) Center for Advanced Materials and Smart Structures (CAMSS) 	Individual
		<ul style="list-style-type: none"> North Carolina Agricultural and Technical State University (NC A&T) North Carolina State University (NCSU) Center for Advanced Materials and Smart Structures (CAMSS) 	Institutional
Pre-professoriate	North Carolina Louis Stokes Alliance for Minority Participation - Bridge to the Doctorate (NC-LSAMP)	<ul style="list-style-type: none"> Fayetteville State University (FSU) North Carolina Central University (NCCU) North Carolina Agricultural and Technical State University (NC A&T) North Carolina State University (NCSU) University of North Carolina at Chapel Hill (UNC-CH) University of North Carolina at Charlotte (UNC-Charlotte) University of North Carolina at Pembroke (UNC-Pembroke) Winston-Salem State University (WSSU) 	Individual

CHAPTER 2

REVIEW OF THE LITERATURE

Without a theory of change our efforts to better things may be futile—trying to change what can't be changed, trying to do fast what has to be done slowly, or trying to do slowly what has to be done fast is bound to lead to disappointment.

Geoff Mulgan, *The locust and the bee*, p.129

This chapter is organized around the four core hypotheses that underpin AGEP's Theory of Change, identified in Section 1.3.1 on page 13. Therefore, the purpose of this chapter is find and assess evidence that supports the assumptions that financial, educational, psychosocial, and mentoring interventions lead to increased enrollment, retention and graduation of URM in graduate STEM programs and their transition into the professoriate.

A comprehensive search of literature spanning from 1990 through 2012 relating to the identified components of the program theory was conducted. The review was conducted using Noel Cards (2012) approach for systematic reviews of the literature and outlined in Figure 2.1. For quantitative studies, an attempt was made to measure the extent of their effect size and statistically correct for systematic errors and biases that may be occurring to attain an accurate a view as possible of the true population effect size scores. The procedures for calculating measures of effect size are outlined in Appendix B.

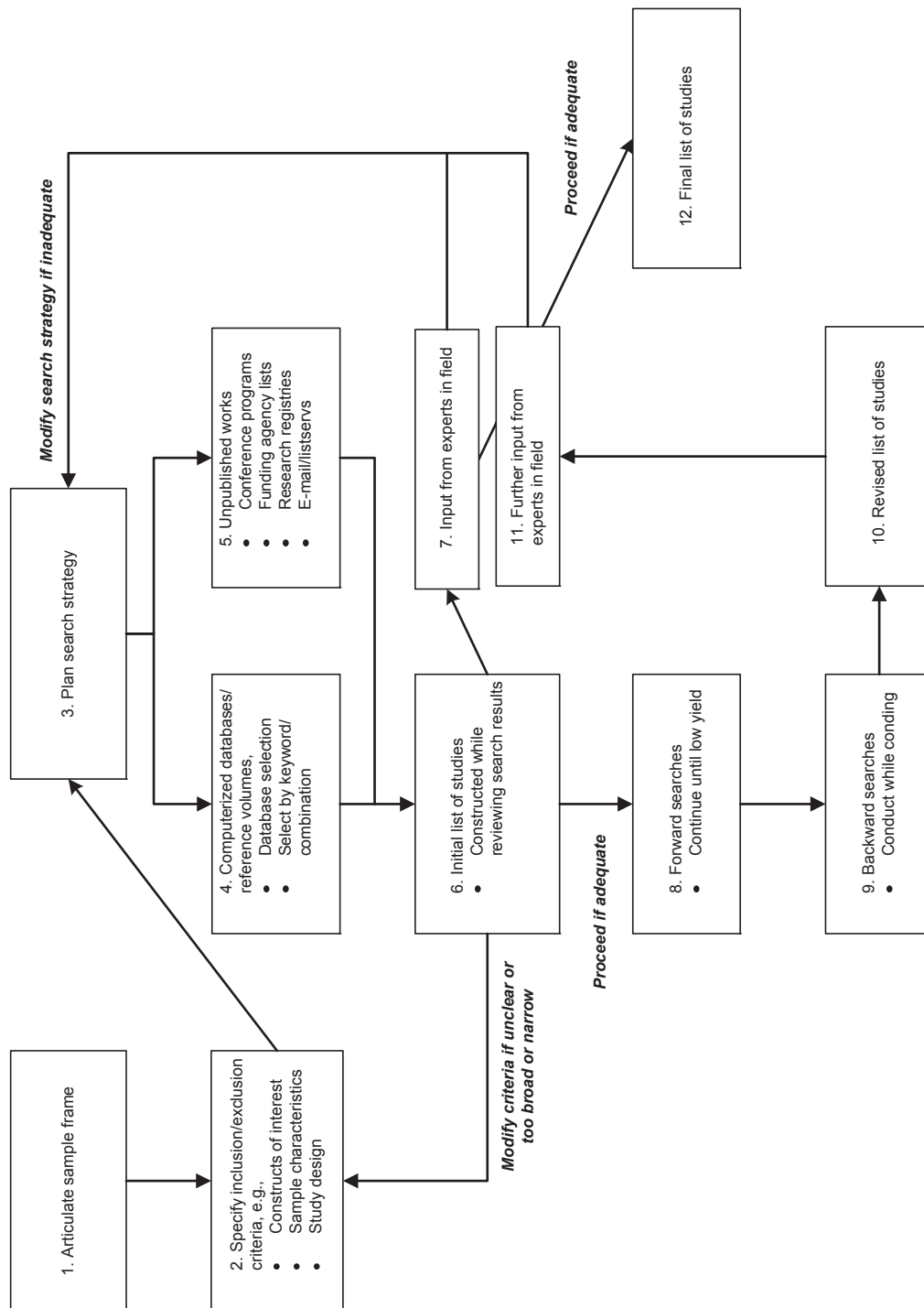


Figure 2.1. Steps for searching the literature(Card, 2012, pg. 35).

2.1 Inclusion and exclusion criteria

The selection of papers for analysis follows an iterative process, whereby all papers related to the each element of AGEF’s theory of change are considered potentially relevant. The initial search is then followed by a review of titles and abstracts to eliminate irrelevant literature. Then, papers that are likely to be relevant to the topic are thoroughly assessed against the inclusion criteria. Finally, papers that meet the inclusion criteria are included in the final review. Studies were included in the literature review if (a) they were empirical or evaluative in nature; (b) provided explicit definitions and operationalizations of predictors and outcomes, and (b) focused specifically on doctoral students or provided enough information to extract data relevant to doctoral students (Card, 2012).

The quality of the evidence was assessed by rating the studies in terms of the strength of their methodological design and quality using a scale from 1 to 5 (Oliveira-Cruz, Hanson, & Mills, 2001) as follows:

Table 2.1. Criteria for assessing strength of evidence. Adapted from Oliveira-Cruz et al. (2001)

Rating	Type of Evidence	Definition
1	Descriptive, analytical, comparative	Study describes program or intervention. No attempt to measure or assess impacts or outcomes is done.
2	Peer reviewed study or evaluation	Studies published in peer reviewed journals
3	Study or evaluation using control group	Study or evaluation uses a segment of people who is not exposed to the conditions or variables tested.
4	Study or evaluation of changes over time	Studies use baseline measures and observe the effects of an intervention over a certain period of time.
5	Studies or evaluation reporting effect sizes or measures for calculating effect sizes.	Studies provide measures of effect size or statistics for easy computation of such measures.

2.2 Results

2.2.1 Theory of Change 1

If graduate URM students are provided with mentoring by faculty and more experienced students, then retention and graduation rates and interest in academic careers will increase.

Mentoring constitutes a very important component of the AGEP program and institutions seeking funding for graduate and postdoctoral AGEP initiatives must include a plan with “. . . a description of the mentoring activities that will be provided for [doctoral students and postgraduate researchers]” (National Science Foundation, 2012). Proposals missing such a plan will not be accepted.

But, what is mentoring and how can it contribute to improve postgraduate students’ outcomes in STEM? Although there are different definitions of the term, they all have certain identifiable common factors. Mentoring is usually defined as “a nurturing process in which a more skilled or more experienced person, serving as a role model, teaches, sponsors, encourages, counsels and befriends a less skilled or less experienced person for the purpose of promoting the latter’s professional and/or personal development” (Anderson & Shannon, 1988, p. 40).

The purported benefits of mentoring seem to spread across all fields of human activity. For instance, during the critical time of adolescence mentoring can help, inter alia, to keep youth in school, improve their academic performance (Thompson & Kelly-Vance, 2001), delay use or decrease involvement with alcohol and other drugs (Sale, Sambrano, Springer, & Turner, 2003), decrease the likelihood of engagement in criminal activities, reduce teenage pregnancy (Haydon, 2003), and reduce gang violence and recidivism (Medina, Ralphs, & Alridge, 2012).

In the workplace, mentoring is often mentioned to be a key factor for work satisfaction, productivity, and retention of professionals in a variety of settings (Sutherland, Hamilton, & Goodman, 2007). Successful individuals are often cited as having reached the top of their careers thanks to a particularly meaningful mentoring relationship that played an important role in their own personal success. In addition, mentoring is often described as a crucial intervention for developing a diverse workplace and diversity among investigators (Kahn & Greenblatt, 2009).

In the literature of higher education, mentoring is often cited as “a powerful means of enhancing the professional well-being of faculty members” (Sorcinelli & Yun, 2009, p. 1); or as an effective strategy to increase the retention and graduation of students, particularly if those students are from ethnic minorities (Hurte, 2002, p. 49). The benefits of mentoring, others claim, can be even stronger if faculty mentors share the same racial or socioeconomic background of the students, because they would be “able to connect with students of color in deep meaningful ways based on shared experiences in higher education” (Griffin, Pérez, Holmes, & Mayo, 2010, p. 95).

Using the inclusion and exclusion criteria defined in section 2.1, the search for literature related to this theory of change returned 172 potentially relevant papers, including 172 from databases and 57 from forward and backward searches (see Table 2.2).

Potentially relevant papers were carefully examined and assessed against the inclusion criteria. However this search did not yield a suitable pool of studies for conducting a meta-analytic review within the parameters of this evaluation.

Examination of the papers revealed that only one study¹ focuses on mentoring and educational outcomes for doctoral students, complies with inclusion criteria, and provide adequate data to calculate effect sizes. In this longitudinal study, the au-

¹Paglis, L., Green, S., & Bauer, T. (2006). Does adviser mentoring add value? a longitudinal study of mentoring and doctoral student outcomes. *Research in Higher Education*, 47, 451–476

Table 2.2. TOC 1: Database search parameters and potentially relevant papers found

Database	Search Parameters	Results
Ebsco	Mentoring AND graduation	0
	Mentoring AND retention	28
	Mentoring AND STEM	4
	Mentoring AND career	43
Proquest Dissertation and Thesis	Mentoring AND graduation	0
	Mentoring AND retention	0
	Mentoring AND STEM	0
	Mentoring AND career	0
Proquest Education	Mentoring AND graduation	24
	Mentoring AND retention	23
	Mentoring AND STEM	2
	Mentoring AND career	48
Total		172

thors investigate the impact of mentoring on student research productivity, career commitment, and self-efficacy. For their study, the authors distinguish between three types of mentoring: (a) psychosocial mentoring, defined as “the extent to which the adviser engaged in coaching, acceptance, confirmation, role modeling, and counseling;” (b) career-related mentoring, a measure of “the protection, exposure and visibility, sponsorship, and challenging assignments provided by the adviser;” and (c) collaborative mentoring, or the extent to which the adviser invited the student to collaborate in different types of research projects, including research paper, conference papers, papers to be submitted to a journal, grant proposals, books. The authors found that “psychosocial mentoring had a modest correlation with [...] self-efficacy ($r = .17, p < .10$).” They also found that “advisers’ collaborative mentoring, measured at the end of program year two, predicted protégé’s research productivity (i.e., research publications and submissions) 4 years later.” The authors did not find evidence “for the proposed influence of adviser mentoring on students’ later career commitment (Paglis et al., 2006, p. 451)”

Although the findings reported above seem positive, at least in terms of statistical significance, their actual effect sizes are very negligible: the overall effect size of mentoring on research productivity is 0.17, on career commitment is 0.02, and in self-efficacy is 0.01.

Another study², published in the highly regarded journal *Research in Higher Education*, has become a foundational study on the impact of mentoring. Although the focus of the study was on undergraduate students, it has become the most widely cited paper in other studies and interventions addressing the issue of mentoring and students' outcomes in higher education, both at the undergraduate and the post-graduate level. At the time of writing this review, Campbell and Campbell's study 1997 paper had been cited in 166 peer reviewed papers and yielded 1530 entries in a Google search. This paper is often cited to support claims that mentoring has a positive impact on academic outcomes.

In their study, the authors evaluated the impact of a faculty mentoring program on undergraduate students' academic success, as measured by GPA scores, retention rates, and graduation rates. The investigators used matched pairs design in which 339 undergraduates assigned to mentors were paired with non mentored students based on gender, ethnicity, GPA, and entering enrollment status. The authors found "consistent differences in GPA favoring mentored students" (2.45 vs. 2.29, $t = (338) = 2.85, p < .01$) and that the dropout rate "among protégé was about half of that for students in the control group, 14.5% versus 26.3%, $\sum^2(1) = 14.56, p < .001$." The authors did not find any difference in graduation rates between the two groups (T. A. Campbell & D. E. Campbell, 1997, p. 727).

²Campbell, T. A. & Campbell, D. E. (1997). Faculty-student mentor program: effects on academic performance and retention. *Research in Higher Education*, 38(6), pages. Retrieved from <http://www.jstor.org/stable/40196285>

The evaluation and research community has long encouraged authors to report measures of effect size or confidence intervals in addition to probability values or to provide sufficient detail to enable effect size and confidence interval computation (American Psychological Association, 2010). The reason for this is that significance tests are dependent on sample size, so when the sample size is small strong and important effects can be non significant and when the sample size is large “even trivial effects can have impressive looking p -values” (Levine & Hullett, 2002, p. 214). Furthermore, as stated by Schuyler and Cormier (1996)

... a researcher’s statement to the effect that “the results are significant” simply means that the null hypothesis being tested has been rejected. It does *not* necessarily mean that the results are *important* or that the absolute difference between the sample data and H_0 was found to be *large* (Schuyler & Cormier, 1996, p. 186).

And this seems to be the case here. When the test of effect size described in formula B.1 (Appendix B) is applied to the results of this study, we find that the GPA difference is 0.001 and for the dropout rate is 0.004 respectively. In other words, there are no differences between the two groups.

2.2.1.1 Discussion

Although 172 potential studies for a meta-analytic review were identified, the studies varied in quality, design, methodological approaches, and outcomes, and, as such were not suitable for meta-analytic procedures. Most of those studies are based on ethnographic or ethnographically informed research methods, where case studies, self-evaluations, accounts of personal experiences, interviews and co-located interviews are central. These studies tend to report positive results and significant experiences related to mentoring programs. However, when other types of evaluation designs have been applied—for example, designs requiring comparisons among groups or random assignment of participants to different groups—results are consistent in showing no impact on the program outcomes being evaluated. These results

are consistent across different fields and programs including mentoring services for socially isolated elder people (Dickens et al., 2011), mentoring programs for changing youth behaviour (Liabo, 2005), mentoring programs to improve educational attainment of young children (Cummings et al., 2012), or mentoring programs for career advancement (Thabane & Oduyungbo, 2009; Arkutu & Rock, 2006).

2.2.2 Theory of Change 2

If students have access to financial support services, then retention and graduation rates will increase.

Under the AGEF program, participant institutions can use up to 20% of the grants to providing graduate students with financial support for activities that promote the recruitment or retention into STEM programs. This financial support is available to participants in the form of full or partial stipends, scholarships, fellowships, recruitment bonuses, retention bonuses, and tuition and fees for their training program. Other types of incentives are offered that are not considered direct financial support to ensure graduate student and/or postdoctoral scholar participation in project's activities. An example may be access to travel funds for professional conferences and meetings in exchange for participation in a peer mentoring program. The assumption behind this feature of the program, as stated in the TOC2 is that providing financial support as described above will result in increased rates of enrollment, retention, and graduation. Results from the alumni survey show that within each group, bachelor's master's and PhD, for 68% (n=28) of PhD, 71% (n=67) masters, and 55% (=51) of the alumni who responded the survey, the financial package offered by the university was main reason that contributed to their decision to enrollment in their program of studies. This reason was ranked higher than factors such as reputation of the pro-

gram or institution, and their research interests at the moment of matriculation in the program.

The positive relationship between financial support and students' decision to enroll has been amply documented in the literature (van der Klaauw, 2002). However, literature on the impact of financial support on retention and graduation of doctoral students is almost non-existent. As with most of the issues related to doctoral education, literature on this topic is often focused on specific institutions, departments or academic fields, making efforts to generalize or reach robust conclusions very difficult (Ferrer de Valero, 2001).

Perhaps the most comprehensive evaluation of an initiative aimed at improving the outcomes of doctoral education was conducted by Ehrenberg, Zuckerman, Groen, and Brucker (2010). Their evaluation focused on The Andrew W. Mellon Foundation's Graduate Education Initiative (GEI). During a 10-year period, the foundation invested more than \$85 million dollars to provide financial support for doctoral students and create structural changes in doctoral programs in the social sciences and humanities. The program was implemented in 54 departments or programs in 10 research universities in the United States. In total, their longitudinal evaluation study covered 16 years and included data of more than 30,000 students. The authors used an experimental design, in which participants of the study were matched with students with similar characteristics who did not participate in the GEI program.

Results show that, overall, the impact of the financial support on attrition, time to degree and graduation rates was very modest when compared with the control group. For example, the average probability of attrition increased almost equally over the years for both GEI and non GEI participants, with a difference of only less than 3 percentage points between GEI and non GEI participants.

Despite the modesty of the findings they can shed some light on the impact of financial support and doctoral outcomes. The study shows that improved financial

support was associated with increased probability of students completing their degrees. It also shows that improved financial support was associated with a reduction of early attrition (before the fourth year). However reduced attrition rates during the early years of the doctoral program did not lead to higher completion rates. In fact, attrition rates increased among students who were on or beyond their fifth year of graduate study and were on multiyear scholarships/fellowships. Authors also found that the number of students on multiyear financial aid who neither graduated nor left schools after their fifth year increased remarkably when compared with students with same characteristics in the control group. This led the authors to conclude that attrition is not necessarily due to inadequate financial aid, a finding that can be counterintuitive to efforts by institutions to reduce late attrition rates, which are costly to students and institutions.

In another study, Aimee Dorr (Dorr, Arms, & Hall, 2008) and colleagues evaluated the impact of the Spencer Foundation's Research Training Grant (RTG). This initiative provided multi-year fellowships to 52 education PhD students at the University of California at Los Angeles (UCLA). These students were matched to a group of 52 students with similar characteristics who did not receive the Spencer scholarship. Students were matched on six characteristics: year of entry into the PhD program, education division, advisor, interest in research career, race/ethnicity and gender. The only difference between the treatment and control group is that the treatment group had 3 years of full financial support, including full funding for all education fees, any out-of-state tuition, and living expenses, as well as a discretionary professional development fund.

The results of this experiments are also modest. The evaluators found that both Spencer and non-Spencer students made similar progress through the three major milestones of the PhD program. On average, Spencer fellows took 7.7 quarters to pass the qualifying examination after completion of all required courses, 10.4 quar-

ters to pass the dissertation proposal defense, and 15.0 quarters (5 years) to complete the dissertation and earn the PhD. The students in the comparison group took 8.0, 10.9, and 16.1 quarters to achieve the same milestones and differences were not significant. The study does not report attrition, retention, or graduation rates; it only mentions that “Spencer students made good progress through the three major milestones of the program.” AGEP and other doctoral initiatives provide students with different types of financial support, including summer research grants, travel allowances, recruitment bonuses, full or partial stipends, and multi-year scholarships, fellowships, and assistantships. However, there is little literature that provides evidence on how different types of financial support impact educational outcomes of doctoral students. The only paper that met the criteria to be included in this review suggests that not all types of financial support have the same impact on students’ outcomes. Ehrenberg and Mavros (Ehrenberg & Mavros, 1995) analyzed data on PhD students in economics, mathematics, English, and physics at Cornell University over a 25-year period to investigate how different financial support schemes affected students’ completion rates and times-to-degree. They found that financial support affects primarily time-to-completion and has little effect on dropout rates. In their study they found that 59 percent of the individuals who receive fellowship support are likely to complete their degrees within 6 years. In contrast, only 29 percent of individuals who received teaching assistantships completed their degrees in 6 years. Qualitative data from ethnographic studies seem to validate these findings. In a series of interviews conducted by Jennings and Gumport (Jennings & Gumport, 1998) with eighteen graduate students, the authors found that participants linked research assistantships to higher program satisfaction, greater financial stability, and higher completion rates.

2.2.2.1 Conclusion

Anecdotal evidence suggest that availability of financial support is a strong predictor of the decision to enroll in a graduate program of study. However, more research is needed about the impact of financial support on PhD attrition and completion. So far, the few studies that have been published show that fellowships and research assistantships are more likely to decrease dropout rates and increase completion rates relative to teaching assistantships. They also show a modest relationship between financial support and doctoral outcomes such as retention, time-to-completion, and graduation. The studies found indicate that the outcomes for students with multi-year financial support are not different than those of students with other types of support or no support. Also, more research is needed on the impact different types of financial support have on doctoral outcomes.

2.2.3 Theory of Change 3

If students are provided with psychosocial support services (e.g., peer support, counseling), then retention and graduation rates will increase.

One of the salient aspects of AGEF initiatives is their portfolio of Psychosocial Support Services (PSS) aimed at helping graduate students students cope with negative non-academic factors that can hinder their academic progress.

A review of funded programs across the country shows that most of the psychosocial support activities funded under the AGEF program are related to helping students adapt to their new environment, meet the demands of higher education, manage time to meet the demands of work, family, and study; plan their personal and family finances; keep their physical and mental health; and manage stress; and

expand their personal and professional network through informal social events with faculty and peers.

The impact of psychosocial support (PSS) was first studied in the field of psychosomatic medicine and focused on the mechanisms that helped patients cope with illness-related stressors. This seminal research on this field defined PSS as “information leading the subject to believe that he is cared for, and loved, and esteemed, and a member of a network of mutual obligations” (Cobb, 1976, p. 300).

The term has evolved and now PSS is associated with assistance provided to a person by those in their personal or professional circles, and serves as a psychosocial coping mechanism that leads to increased self-esteem, self-efficacy, and prevents or reduces the effects of stress (Thoits, 1986; I. G. Sarason & B. R. Sarason, 2009). This assistance can be of four types:

- Emotional support: listening, trust, appreciation
- Instrumental support: the provision of tangible assistance or goods
- Appraisal support: feedback, social equality, affirmation
- Informational support: information giving, guidance suggestions (Laakso & Paunonen-Illmonen, 2002; Sanderson, 2004)

This systematic search did not yield any literature addressing the relationship between PSS and educational outcomes of underrepresented minority doctoral or graduate students, as defined by retention, time-to-degree and graduation rates. Claims about PSS and doctoral education outcomes are mostly extrapolations from organizational psychology research. Some scholars in this field claim that when PSS comes from colleagues and supervisors, it can lead to a sense of attachment to a work group, profession, or organization; feelings of professional identity; or sense of self-efficacy which, in turn, have a positive impact on individuals’ career advancement and workplace satisfaction and productivity (Arthur & Rousseau, 1996).

Although there is some literature covering PSS and educational outcomes, the majority of these studies are related to primary, secondary, and undergraduate education and focus on the relationship between PSS and mediating psychological factors. This line of inquiry contends that the nature and extent of certain psychological factors can influence the likelihood that educational outcomes can be achieved (Golde, 2005; Golde & Dore, 2001; Lovitts, 2001; Nettles & Millet, 2006).

For example, some researchers surmise that PSS can increase students' achievement motivation (Ryan & Deci, 2000; Wentzel, 2004); or can have a positive impact on students' self-esteem. And increased motivation and self-esteem can, in turn, have a positive impact on students' academic performance (Keefe & Berndt, 1996) and lead them to attain higher academic goals.

Some examples of psychological support mentioned in the literature that can lead to increased motivation and self-esteem include emotional support, assistance making the transition to professional careers, and academic supervision (Clark, Harden, & Johnson, 2000; Fisher, Fried, & Feldman, 2009; Schlosser & Gelso, 2001; Tenenbaum, Crosby, & Gliner, 2001). Other researchers suggest that PSS can increase chances of academic success for students who face difficulties related to relationships with faculty and peers, feelings of stress, lack of family encouragement, or are experiencing feelings of alienation or discrimination (Pascarella & Terenzini, 2005).

The empirical evidence to support these claims is sparse, though.

2.2.4 Theory of Change 4

If students are provided with academic support services (e.g., academic writing, public speaking, research workshops, etc), then retention and graduation rates will increase.

The final theory of change includes the hypothesis that if doctoral students are provided with academic support services such as tutoring, academic writing workshops, study groups, peer-led study sessions, their retention and graduation rates will increase. The literature search did not yield any empirical evidence to support this theory of change.

It has been a common practice among researchers to propose interventions or to speculate about the predictors of doctoral education outcomes based on theoretical models designed to explain the undergraduate experience (Sweitzer, 2009; Gururaj, Vasquez, & Sommers, 2010; Girves & Wemmerus, 1989; Herzig, 2002). This observation also applies to AGEP funded programs and interventions. Most of the programs that seek to broaden participation in doctoral programs or improve doctoral retention and graduation rates are based on theoretical models initially proposed to explain the undergraduate experience and the factors that influence the outcome of undergraduate education. Among the most cited models are Tinto's model of student retention (Tinto, 1975) and Pascarella's model of student engagement (Pascarella & Terenzini, 1980).

One central feature of these theoretical models is the concept of academic and social integration. Academic integration is defined as "the degree to which students identify with the institutions academic requirements and effectively utilize tutorial and other programs that provide academic assistance (Lynch, 2009, p. 50). According to the proponents of this model, the quality of this identification is reflected on student's academic performance and intellectual development as measured by GPA, interest in their program of study, academic self-esteem, and identification with academic and institutional values and norms.

Social integration, on the other hand, refers to the nature and extent of students relationships with peers and faculty and the extent to which the student feels that she is part of the academic community (Pascarella & Terenzini, 1980). The main

assumption underlying these models is that if students are well integrated within an academic community, “they are likely to be influenced by a communicated commitment to their welfare, which can serve to heighten the students motivation to achieve an institutions goals (Gamble, 2007, p. 37).

The influence of these models is clearly seen in the activities and interventions proposed for the AGEP program. Activities such as mentoring, academic writing workshops, campus visits, social events, mentoring, peer mentoring, peer advisors, etc., are all aimed at helping students identify with a new institutional environment, develop academic and study skills that result in better grades, and forging close relationships with faculty and peers. All this seems like a logical approach with individuals who have not been exposed to norms, culture, and expectations of higher education. However, the structure of doctoral programs, their requirements, the objectives they pursue, and the characteristics and motivations of individuals who decide to start a PhD are different from those of undergraduate students.

In the case of AGEP participants, in particular, they are US citizens who have been admitted in STEM PhD programs in the United States. So we are talking about a pool of individuals who have already gone through several years of formal schooling, including undergraduate and graduate education; who are likely to have an extended professional and personal network; and who have proved their suitability for advanced education in a competitive process in which test scores, references, previous academic performance, writing skills, etc. are assessed. And it is a competition in which only a few are chosen.

An analysis of IPEDS data on application, acceptance, and enrollment rates for the academic year 2011-2012, shows that of the 7,642 individuals who applied for admission to PhD programs at the 90 universities classified as Doctoral-Research universities according the Carnegie Classification of Institutions of Higher Education, only 1,315 were accepted, for an acceptance rate of approximately 17% (U.S. Depart-

ment of Education, National Center for Education Statistics, 2012). This indicates that only the most highly qualified individuals are admitted to PhD programs and there is reasonable basis to believe that they have the skills, experience, and motivation to complete a doctoral degree.

Therefore, strategies to increase retention and graduation of undergraduate students are not likely to be relevant for doctoral students. Doctoral interventions need to focus on addressing those structures of the PhD that ultimately lead people to drop out or linger in school for years longer than necessary. Unlike undergraduate programs, a doctoral program of study includes a period of advanced courses or seminars, preparation of qualifying exams, proposal writing, and data collection, analysis and dissertation writing. Furthermore, one of the distinguishing characteristics of doctoral programs is the expectation that students will work independently during the course of their research, usually after they have completed mandatory courses or seminars.

Some studies and anecdotal evidence show that, for many students, the dissertation writing is one of the most difficult stages on their way to the doctorate. Between 50-75 percent of students drop out during the dissertation stage (Livingston, 2011; Terrell, 2011; Goodchild, Green, Katz, & Kluever, 1997). During the dissertation stage there are no courses or seminars, and students are expected to work independently. For most students, dissertation writing becomes an unstructured and solitary process, in which the candidate usually works away from peers and teachers, and without clear expectations from their department (Sternberg, 1981). It is also a phase in which less financial support is available (Valverde, 2002). The lack of structured academic advising, unclear expectations, and limited financial support seem to be the factors that most contribute to doctoral attrition.

In a recent study conducted by the Council of Graduate Schools called “The PhD Completion Project” (Council of Graduate Schools, 2010), investigators collected data

from 9,369 students who entered doctoral programs from 1992-93 through 1994-95 and completed their studies within the following ten years. Data show that for 80 percent of the participants the factors that most helped them in completing their studies were financial support, followed by academic advising (63%), and family support (60%).

Another factor worth mentioning is the importance of departmental expectations about dissertation writing. Nascent literature on this issue suggests that advisors and departments that stress the importance of finishing dissertations quickly have lower attrition rates than departments that do not communicate clear expectations about the dissertation to students. Also, departments that overemphasize on the quality of dissertation or getting published while in graduate school have higher cumulative attrition rates (Ehrenberg, Jakubson, Groen, So, & Price, 2007; Carlino, 2012; Kniola, Chang, & Olsen, 2011).

The conclusion that emerges from this literature is that doctoral students are more likely to finish their degrees if they have a steady source of income during the time of their studies; a supportive family willing to tolerate 5 or more years of “student life;” and structured academic advising, with clear rules and expectations, a realistic schedule, and scholarship or assistantship privileges tied to successful achievement of specific goals or delivery of expected outputs. There is no evidence that abstract and unstructured mentoring programs, writing or public speaking workshops, campus visits, social events, etc. have any effect on the academic success of doctoral students.

2.2.5 Conclusion

Empirical evidence shows that a large number of students are likely to dropout during the dissertation stage, which is extremely costly, both for the student and the institution. Strategies to address this issue are usually based speculative theoretical models, which do not take into consideration the characteristics, expectations, and experience of graduate students. Interventions that are more likely to contribute to

increasing retention and graduation rates of doctoral students are those that bring structure to the dissertation writing stage, with clear goals and expectations. Therefore, institutions should focus on the creation of formal strategies for guiding students during the dissertation writing process. These could be formal seminars or meetings, where students can present their progress and receive feedback and criticism from peers and teachers, thus combining the independence of the doctoral research with expected performance structure. Also, large scale surveys of doctoral graduates indicate that financial stability during the time of the studies is an important predictor of graduation. Institutions should try new approaches to providing financial assistance, for example tying scholarship stipends to successful progress in the dissertation writing, and consequences for not completing assignments or not making significant progress.

CHAPTER 3

METHODS

3.1 Evaluation as a Mode of Inquiry

Program evaluation is defined as “the application of evaluation approaches, techniques, and knowledge to systematically assess and improve the planning, implementation, and effectiveness of programs” (Chen, 2005, p. 5). Hence, this study does not seek to validate or confirm relationships between variables and then to generalize that information to the larger population. Rather, the purpose of this evaluation is to provide recommendations intended to optimize the program in relation to its intended purposes, or to help stakeholders determine whether the program is worthy of adoption, continuation, or expansion (Fitzpatrick et al., 2004).

This study is approached from the perspective of the Theory of Change (TOC) analysis (Donaldson, 2007; Leeuw, 2003; Weiss, 1998), and incorporates elements of evidence-based policy analysis (Pawson, 2006) and survey research (De Vaus, 1996) to direct the collection and analysis of data. Also, evaluation activities were planned from a Culturally Responsive Evaluation (CRE) perspective (Hood, Hopson, & Frier-son, 2005) that coincided with the goals of both AGEF and OPT-ED to increase the presence and persistence of underrepresented minorities (URMs) in STEM fields. Consequently, the evaluation plan was designed using culturally responsive evaluation strategies. For example, the evaluator took great care to be culturally sensitive in the identification of a diverse group of stakeholders and incorporated methods of data collection and analyses that are essential elements of CRE. These and other culturally

responsive principles guided evaluator interactions and activities with program staff and participants as well as.

At the core of the TOC approach is the view that policies and programs are “theories incarnate” (Pawson, 2006, p. 13), and are designed and implemented because someone believes that if X is done, then Y should result. For example, the AGEF program assumes that if graduate students are provided with certain services, such as mentoring, travel allowances, summer research seminars, and access to professional networks, they will be more likely to complete their degrees and move into academia. Therefore, by using a TOC approach, this evaluation not only examines whether or not the outcomes of a program were achieved, but further whether or not those outcomes are likely to be the result of the assumed causal mechanisms of the program.

3.2 Evaluation Design

This study evaluated the effect of the program on student recruitment, retention, and transition into the professoriate. Data collection and analysis were guided by a protocol for empirical analysis of policy interventions (Pawson, 2006), and made use of quantitative and qualitative methods, including interviews, focus groups, document analysis, database analysis, surveys, and interviews and focus groups with program stakeholders.

The first stage of this evaluation was the **reconstruction of the program’s theory of action** (Leeuw, 2003). The objective of this phase of the evaluation was to visualize the underlying causal mechanisms that are believed to make the program work, and draw conclusions about their plausibility (van Noije & Wittebrood, 2010). This step followed an empirical “policy-scientific” approach as described by Leeuw (2003) and included searching formal and informal program-related documents for ideas and assumptions that link the program’s inputs to attainment of desired outcomes. The outcome of this stage was a model which visualizes how the pro-

gram works (Pawson, 2006) and the factors that are believed lead to its effectiveness (Leeuw, 2003).

The reconstruction of the program theory was followed by a **systematic review of the literature**. The purpose of this stage was to investigate how plausible the program's assumptions are (van Noije & Wittebrood, 2010) by searching for evidence in published and unpublished literature that supports the assumptions underlying the program (Pawson, 2006). This stage of the evaluation followed Cooper's 2009 methodology for research synthesis: 1) Formulating the problem, 2) obtaining studies, 3) making decisions about study inclusion, 4) analyzing and interpreting study results, and 5) presenting the findings from the research synthesis.

An **online survey** was administered to both current and former clients of the program. The sample included former and current bachelor's, master's, and PhD students. Due to IRB regulations, the survey was administered by the program staff, who distributed the survey among their clients. The survey was informed by the program theory analysis and the systematic review, and included variables in dimensions of graduate school experience such as selection and admission, advising and mentoring, financial support, curricular processes and procedures, program environment, research experience, career placement, and professional development.

Finally, a series of audio taped **interviews and focus groups** were conducted with program stakeholders during the period from May 2012–September 2012.

3.3 Data collection and analysis

The evaluation included a combination process/outcome formative evaluation on the NC OPT-ED Alliance Program. The goal of this evaluation study was to determine if the program was implemented as planned and it delivered its activities and services in the intended way, and to understand the impact of the program as experienced and lived by program participants (Becker & Vanclay, 2003). To achieve this

purpose, we conducted a series of interviews and focus groups with faculty, students and program staff; reviewed program documents; and administered an online survey for current students and alumni.

Appendix A shows the type of evidence, indicators, sources of data, and data collection methods that were used to answer each question.

As an outcome evaluation, we focused on “the state of the target population or the social conditions that a program is expected to have changed” (Rossi et al., 2004, pg. 204). The evaluation did not seek to determine the impact of the program, or “the change of an outcome solely attributed to the program controlling for other confounders” (Nam, 2008, pg. 10). An evaluation of this type would require the comparison of individuals who participated in the program with those who did not, controlling for confounders such as background of the participants or environmental characteristics (Rossi et al., 2004). Furthermore, such a definite assessment of impact should be based on micro-data not available to the evaluator. Although getting a license to use micro-data from the NSF might be possible (National Science Foundation, 2008), it requires a complicated licensing process that is beyond the scope, time, and resources allocated to this evaluation.

3.4 Qualitative Methods Used

Collection of qualitative data consisted of audio taped interviews and focus groups during the period from May 2012–September 2012. The majority of interviews and focus groups were conducted during site visits to UNC and NCSU at the end of May. Interview protocols were developed and interviews and focus groups were conducted with the help of colleagues from the Culturally Responsive Evaluation Collaboration. The interview team was comprised of Wanda Casillas, Summer Jackson, Obeidat Khawala, and Ricardo Gómez, under the supervision of Professor Rodney Hopson. Interviews were conducted with Principal Investigator (PI), AGEF and NC-OPT-ED

staff , faculty and students from respective institutions and affiliate partners from Pisgah Astronomical Research Institute (PARI), Louis Stokes Alliances for Minority Participation (LSAMP), North Carolina Mathematics and Science Education Network (NC-MSEN), and Historically Black Colleges and Universities–Undergraduate Program (HBCU-UP), as well as a key partner and PI from NCA&T.

Additional interviews were completed via telephone during the month of June with other affiliate partners who were not available at the time of the site visits. Telephone interviews were also conducted in July and September with former AGEP students who currently hold professoriate positions as well as interviews with the founding PI of the NC-OPT ED Alliance and former corresponding program officer at the National Science Foundation. In total, 19 interviews and focus groups were conducted during the evaluation project period for key stakeholders at participating AGEP and NC-OPT ED institutions in North Carolina. A total of 76 people were interviewed between May and September, 2012. Below find a summary table of the interviews and focus groups conducted:

Table 3.1. Qualitative data collection

Focus Groups	Interviews
NCSU AGEP Staff & PI	UNC AGEP Alumni Faculty
UNC AGEP Staff & PI	NCSU AGEP Alumni Faculty
NC OPT ED Alliance Staff	National Science Foundation Program Officer
MSEN NC OPT ED Affiliate	NC OPT ED Alliance Founder
HBCU UP OPT ED Affiliate	
LSAMP NC OPT ED Affiliate	
PARI NC OPT ED Affiliate	
NCSU AGEP Student	
UNC AGEP Student	

3.4.1 Analysis plan for qualitative data

Qualitative data collected during each interview was analyzed using a coding scheme and stored in ATLAS.ti (6.0). The coding scheme was developed from key

elements of the project evaluation questions. The following categories were initially proposed:

1. AGEP or NC-OPT-Ed Involvement and Duties
2. AGEP or NC-OPT-Ed Development and Challenges
3. AGEP or NC-OPT-Ed Value and Impact
4. Partnership and Collaborative Impact
5. AGEP or NC-OPT-Ed Recommendations

In addition to these initial key codes, sub-codes further disaggregated themes in the interviews. For instance, the value and impact key code had several sub-codes such as the value and impact to the STEM discipline, the institution, faculty, staff, alumni, and undergraduate and K-12. A copy of the coding scheme used in the qualitative data analysis is provided in Table 3.2.

ATLAS.ti (6.0) was used to store and manage over half of the interviews and was used to provide summaries of the codes relative to the evaluation questions. Of the major and minor codes organized from the interview data, the value and impact codes were the more predominant codes (and the under/grad student subcode was the most predominant identified code) of the entire code list which suggests that most interviews identified a key value and impact was related to undergraduate/graduate students pursuing STEM careers.

3.5 Quantitative Methods

Electronic online surveys were developed for current AGEP students and alumni across the two AGEP institutions. The surveys sought to capture respondents' perceptions regarding (a) cultural nuances of the OPT-ED Alliance as an organization, (b) nationally recognized dimensions measured by the College Seniors Survey (CSS),

Key codes	Sub-codes
AGEP or NC-OPT-Ed Involvement and Duties	<ul style="list-style-type: none"> • PI duties • Supporting staff duties • Challenges in carrying out duties (by PI or staff) • AGEP recruitment
AGEP or NC-OPT-Ed Development and Challenges	<ul style="list-style-type: none"> • Initial developments of program • Challenges in carrying out or receiving (in case of students) program developments
AGEP or NC-OPT-Ed Value and Impact	<ul style="list-style-type: none"> • STEM disciplinary value and impact • Institutional value and impact • Faculty value and impact • AGEP Staff value and impact • Alumni value and impact • Student (K-12, undergraduate, graduate) value and impact
Partnership and Collaborative Impact	<ul style="list-style-type: none"> • Partnership impact • Affiliate staff impact • Community benefit and presence • Benefit to affiliate institutions
AGEP or NC-OPT-Ed Recommendations	<ul style="list-style-type: none"> • University infrastructure, ownership • Program development

Table 3.2. NC OPT-ED evaluation Qualitative Coding Scheme

(c) ratings of core AGEF specific supports, environmental variables (e.g., mentoring and advising) and, (d) other student outcome variables including PhD graduation rates, time to completion, and interest in pursuing academic or research careers in higher education in the United States.

The evaluator, in collaboration with the program team, first developed draft survey instruments and piloted them with four current AGEF students and four AGEF alumni. Pilot participants completed the surveys and provided comments to refine the questions for clarity and calibrate completion time. After refinements were made to the surveys a total of $n = 85$ current AGEF students (NC State $n = 29$ and UNC-CH $n = 56$) and $n = 315$ AGEF alumni (NC State $n = 144$ and UNC-CH $n = 171$ of $n = 559$ total). The alumni group included: a) $n = 30$ RES undergraduate from a total population of $N = 49$; b) $n = 29$ AGEF graduate from a total population of $N = 86$; and c) $n = 112$ SPGRE2 (2000-2008) from a total population of $N = 424$. Numeric data from the survey were analyzed using simple addition, frequency counts and percentage calculations using SPSS, and responses to open-ended questions were reviewed and tallied to identify emerging themes.

In compliance with Institutional Review Board (IRB) regulations, AGEF staff at NCSU and UNC-CH identified AGEF current students and alumni, contacted them via email, and provided links to the surveys. AGEF staff was responsible for launching the surveys and sending reminders to participants encouraging their completion of the surveys. The UNC alumni survey was open for the period of 08/06/2012 through 09/09/2012 and the one for current AGEF UNC students from 5/31/2012 to 7/15/2012. The NCSU surveys for both AGEF alumni and current students were open from 5/18/2012 to 7/15/2012 to maximize respondent completion of surveys.

A total of 230 surveys were completed by AGEF current students and alumni across both institutions. The response rate from NCSU was 59% and 56% from

UNC-CH. Table 3.3 shows the demographic breakdown of survey respondents by institution, enrollment status, gender, highest degree achieved, race and ethnicity, and whether or not they are first-generation college students. A detailed discussion of quantitative and qualitative findings follows with the results being presented and organized in relationship to the evaluation plan's three evaluation questions.

Table 3.3. Demographic characteristics of survey respondents.

	Surveys returned	NCSU current	NCSU alumni	UNC current	UNC alumni	Total
		22	81	31	96	230
Gender	Female	8	38	18	54	118
	Male	4	21	7	16	48
	N/A	10	22	6	26	64
Degree	Bachelor's	0	30	0	22	52
	Master's	4	36	3	34	77
	PhD	12	4	28	27	71
	N/A	6	11	0	13	30
1st Gen. Student	Yes	4	13	6	15	38
	No	6	42	19	47	114
	N/A	12	26	6	34	78
Race	American Indian or Alaska Native	0	2	2	4	8
	Asian	0	4	1	1	6
	Black or African American	7	42	16	59	124
	Native Hawaiian or Pacific Islander	0	1	1	0	2
	White	4	7	6	6	23
	Other	1	5	2	3	11
	N/A	10	20	3	23	56
	Hispanic or Spanish origin	5	12	8	11	36
	Non Hispanic or Spanish origin	6	44	18	54	122
	N/A	11	25	5	31	72
Ethnicity	Hispanic or Spanish origin	5	12	8	11	36
	Non Hispanic or Spanish origin	6	44	18	54	122
	N/A	11	25	5	31	72
	Married or living with partner	1	18	8	19	46
	Separated	0	0	3	0	3
Marital status	Widowed	0	0	0	0	0
	Single	10	41	15	50	116
	N/A	11	22	5	27	65

CHAPTER 4

FINDINGS

4.1 Evaluation Question 1: What is the value added of NC-OPT-ED AGEF model?

4.1.1 Impact of the NC OPT-ED/AGEF Alliance

Reflections of value-addedness were offered by AGEF staff, NC-OPT-ED staff, NC OPT-ED affiliated organizations, as well as current students and alumni at UNC and NCSU during interviews regarding the impact of the unique NC OPT-ED AGEF partnership model. Each stakeholder shared individual and collective views of the values of the NC OPT-ED model.

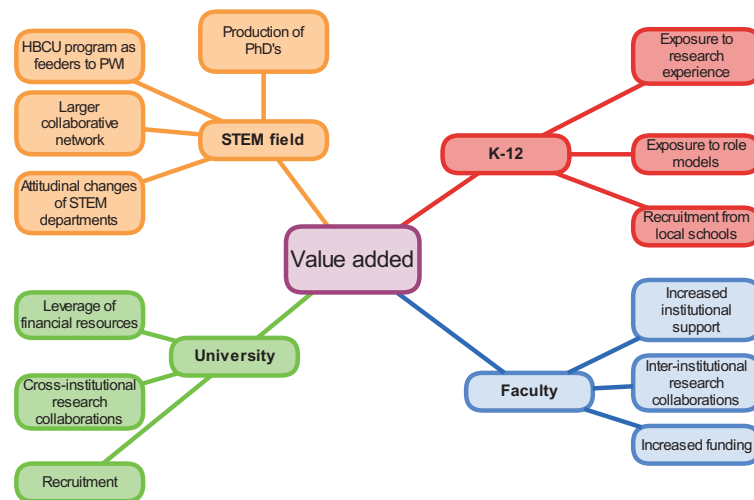


Figure 4.1. Graphical summary of findings for question 1

Role of community engagement

It was apparent that the AGEP institutions believed that were successful in their engagement efforts with the broader North Carolina community, even though this was not an explicitly articulated goal of AGEP. One staff member reflected on the nature of AGEP's community engagement:

I think that we have some community engagement, but it is not on purpose. We don't have a programmatic component that says our public outreach with the citizens of the state of North Carolina is a part of our broader mission. The way that we consider ourselves serving the community of North Carolina is that 80 percent of our students on this campus are North Carolinians, undergraduates. . . (UNC PI, May 29, 2012)

However, other affiliated members believed that AGEP was successful in engagement efforts with younger stakeholders: evidence of community engagement that reached younger stakeholders.

During our summer we do some [community service]...they have to do some research project. And that year it was community based. We had a junior and her sister. They came up with that program and they just implemented it. She has been in the program since middle school and she formed an organization called Healthy Girls Save the World. She gave a presentation at our Saturday academy. She and her sister wrote a grant. She also gives presentations on Chapel Hill campus and Durham. (MSEN Affiliate, May 30, 2012)

Our students that are in our minority student organizations like the National Society of Black Engineers (NSBE); the American Indian Science and Engineering Society (AISES); and the Society of Hispanic Professional Engineers (SHPE), they all go out and interact with high school, middle schools by tutoring. They take everything that they've learned and go and share it with the younger students. (LSAMP Affiliate, May 30, 2012)

The predominate focus on mentorship and reaching out to underrepresented populations has served as a value system , evident across the participants in the AGEP program.

Development of extended network of partners

The NC OPT-ED model provides an extended network of partners that aid students at various academic growth and developmental milestones. In addition, such a network enhances the collaboration among different partners and making substantive contribution to achieve the broader goal of increasing the number of URM in STEM. As illustrated below, the collaboration and regular Steering Committee meetings between STEM focused institutions and organizations expose partners to new STEM related opportunities.

Any time somebody got a new program, a new grant, we'd share this information with the other P.I.'s and coordinators thereby educating everybody else. If you have a student here and you got funding for this program, you can establish a linkage with that student by telling the P.I., "Hey, I have a student who's interested in this and that." We definitely have gotten more students into internship positions because of OPT-ED. We didn't know about some of the opportunities right here in the state. (UNC Project Staff, May 29, 2012)

The NC OPT-ED collaborative model also gives affiliates from smaller or remote institutions access to state of the art science resources and experts in the field. The value of those partnerships between academic institutions is reflected in the statements below:

We were allowed to take our students to North Carolina State and to do labs over on centennial campus because we didn't have the same facilities. We didn't have the equipment and they were so generous to allow us to go and centrifuge our samples. Their graduate students showed our students how to do the labs for our genetics course. (Affiliate HBCUP, May 30, 2012)

We supply chemicals to a high school programs and allow our undergraduates to do demos for high school students and supply chemicals from UNC that they wouldn't be able to get their hands on. (UNC PI, May 29, 2012)

The collaborative values and partnership of the OPT-ED model extend beyond usage of space and resources; they use their collaborative paradigm to enhance their

programs' visibility and competitiveness. As a result of extending partnerships to other stakeholders, some organizations have been able to attract and obtain new funding relationships/sources. As illustrated below, the OPT-ED model was adapted to serve the community at large which garners support from a broader range of groups. One such example is how a group of LSAMP scholars were able to collaborate receive funding for mentoring a group of girls in high school with the possibility of the program being extended to include elementary and middle school girls.

The relationships built through the partnership have led to possible collaborations to pursue funding opportunities as reflected in the following quotes. The affiliate partners use the network to increase their competitiveness as AGEF project staff provides encouragement and letters of support for grant proposals:

We are a nonprofit and write a lot of grant proposals, several of those are along the same vein as NC OPT-ED. Larry is very supportive of that sort of thing. He is always writing support letters and helping us in pursuing funding that has the same goal as NC OPT-ED. (Affiliate-PARI, June 8, 2012).

Shaw University was looking for scientist to do a scientific study and we put them in contact with a scientist here at UNC. They went on to write a collaborative grant between UNC and Shaw University. (UNC Project Staff, May 29, 2012)

There are a lot of different aspects that I consider to be invaluable. For instance, the contact that the Director of the OPT-ED gives us by being smaller colleges or universities, a lot of times we are not aware of some of the research opportunities that are right here in the state of North Carolina. If I need a letter of support for a grant that I might be writing, I'll call Larry up and ask do you know someone? (HBCU-UP Affilate, May 30, 2012)

When you mention OPT-ED it gives you some level of credibility. Everybody knows OPT-ED and what OPT-ED means. So if you're affiliated with OPT-ED...off the spot you're credible for whatever. Whether it's a grant initiative or whatever you're requesting. When we did the renewal of HBC-UP at Winston Salem State, we got a letter of support from Larry Campbell and Valerie Ashby to support the proposal at that time. When reviewers see that you are affiliated with OPT-ED, it really helps. (HBCU-UP Affiliates, May 30, 2012)

4.1.2 Value of AGEP to the University

The concept of collaboration evolved over time and led to increased partnerships within and across institutions. For example, today's "Visit NC State Day" is a reflection of combined departmental recruitment efforts that started when programs across campus began leveraging their resources. The AGEP and Research Internships in Science and Engineering (RISE) programs combined many of their professional development programs in an effort to be more cost effective and reduce programmatic inefficiencies. While faculty members leveraged intellectual talents across campus to pursue grant opportunities, examples of collaboration emerged in other areas:

Collaborative programming helped to efficiently leverage financial resources

Initially we had our own professional development workshops. Other programs would have exactly the same workshop... Well, it's much better for that all to happen collaboratively. You save money and resources that way. (NSCU Staff, May, 29, 2012)

It took us a long time to get faculty buy-in. Now Visit NC State Day is institutionalized. (NCSU Staff, May 29, 2012)

Cross institutional research collaboration and leveraging faculty talent

I think it has also helped in terms of fostering more research collaboration especially among some of these institutions. For instance, NC Central has a number of collaborations with UNC Chapel Hill and Duke University. We are also collaborating with North Carolina State to write proposals. (HBCU Affiliate, May 30, 2012)

St. Augustine is so close to North Carolina State so it became a feeder. Their faculty came on campus, interacted with our faculty and even included our faculty in grants. And the training for undergraduate research between the two was unbelievable. (HBCU Affiliate, May 30, 2012)

Recruitment

The collaboration between AGEP institutions and state wide STEM affiliates significantly impacted recruitment efforts for affiliated institutions. In many ways the OPT ED Alliance is viewed as a commodity for institutions seeking talented

minority students. As illustrated below, AGEF funds influenced minority recruitment in several ways:

Cross Institutional Recruitment

The North Carolina LSAMP and HBCU-UP programs helped feed our graduate programs. When AGEF started ...I didn't have any interest from any undergraduates because no one knew about it. I contacted Vivian Hampton, the Director of LSAMP over at A&T... and I had about six or seven students. (NCSU Project Staff, May 29, 2012)

Most of the impact is on the undergraduate students... who have opportunities to apply to other institutions that have graduate programs within the Alliance. When there are programs on those campuses they inform our students. For instance, some students from Winston Salem State applied to the master's program at NC Central, North Carolina A&T, and North Carolina State University. (HBCU Affiliate, May 30, 2012)

AGEF Institutional Recruitment

That's the biggest impact that we have seen is that departments actually pay close attention to minority students. For example, chemistry has several minority students that they wanted to go after and they're coming to ask us, "Can we have more fellowships?" (UNC Project Staff, May 29, 2012).

AGEF...is a very powerful and important mechanism to use to help bring in minority students. This year... we had the best group of under-represented minority people apply to our program... Unfortunately, we don't have funding for the coming year to support them and... there were those that we couldn't make an offer to. If we had had the AGEF funding... we would have felt better about being able to make strong offers to those folks. (UNC Faculty, May 30, 2012)

AGEF brought an understanding of the importance of how this could help us attract the strong students and diversify the department, and keep it strong in that regard. (UNC Faculty, May 30, 2012)

STEM Field Recruitment

One of the things that we started seeing across the AGEF community within the first eight years was they started realizing what they (AGEF schools) could do as a sort of ecosystem, as a community. AGEF institutions started going to recruitment fairs requesting that their tables be set

up together. So you had the whole AGEF community recruiting. (NSF Program Director, July 23, 2012)

4.1.3 Value of NC OPT-ED/AGEP alliance to STEM field

HBCU programs and institutions as feeders and links to NCSU and UNC

Stakeholders of the alliance note how the historically Black colleges and university (HBCU) programs and institutions serve as feeders to the predominately white research institutions, UNC and NCSU. The programs, for instance, such as LSAMP and HBCU-UP serve as direct feeders and links to the AGEF affiliated institutions for students, faculty, and institutions. Faculty from affiliated institutions manifest this feeder relationship through interactions, joint programming, research, and other developing or sustained networking opportunities. As identified by one project staff member that asserts that this relationship produced students in the program from a nearby HBCU and even beyond the state:

...the LSAMP program and the HBCU-UP program in North Carolina and across the country, they help feed our graduate programs. When we first started AGEF and I was just trying to get the summer program up and running and I didn't have any interest in it from any undergraduates...I contacted Jennifer (fictitious name) over at A&T. She was the director of LSAMP... And lo and behold I had about six or seven students. (NCSU Project Staff, 29 May 2012)

In fact, this was the stated purpose of one of the original PIs from A&T as captured in an interview. He states that while there were various ways which institutions benefited from the alliance relationship and ways in which the STEM field benefited (through increasing the number of persons from underrepresented groups pursuing STEM programs and going on for PhD), he describes: "the broader benefit of this alliance was our link to NC State and UNC Chapel Hill" (NC A&T PI, 30 May 2012).

Larger coordinated and collaborative network and alliance within NC and beyond

The stated coordinated and collaborative network has anticipated benefits for all its members, especially students in the STEM field. The STEM network created through AGEF plays an important role in building an academic and organizational infrastructure. This is evident in a focus group of affiliated partners. In this case HBCU-UP program stakeholders who envision opportunities as a result of the network and alliance comment about the benefits of the research infrastructure, base, and pipeline for students as follows:

...that's exactly the kind of impact I have seen. The kind of community, the collaborative opportunities available to participants is what that's really opened up for us. (HBCU-UP, 30 May 2012)

Influencing change of attitudes in STEM departments

A key value added as identified by one of the original PIs is noted in the manner with which the AGEF program influenced a change of attitudes in STEM departments. Reflecting on the attitudinal changes manifested in departments, the PI notes how increased attention to AGEF in faculty and departmental meetings and the recruitment success of students in STEM fields were important indicators of change. He described common responses within these departments and programs regarding an inability to find competitive applications, and it was not uncommon for departments to reflect an attitude of inferiority:

...the first time we had our meeting, the director of graduate students almost pounded the table and explained, "We cannot find any." And so we changed that. Another thing that happened was there was a program that didn't think they needed to deal with minority students at all. The attitude they had was...they're not smart enough; that was the impression I got for the most part based on what we see.

One of the key answers that AGEF provided were opportunities to engage students developing high level cutting edge STEM research with faculty, matriculating students

into other top notch STEM programs based on productive research experiences from the NC OPT-ED and AGEPE affiliated programs.

Production of PhDs in STEM through AGEPE

A key observation as noted by the then NSF AGEPE Program Officer was the success of the AGEPE program in producing PhDs in STEM. In the following, he states the impact of AGEPE on the production of STEM PhDs :

by the tenth year of AGEPE, the AGEPE community was producing 60% of the minority PhDs in STEM They were producing 80% of the Black PhDs in engineering. So, the name of the game for me was if 30% of the PhD producing institutions are producing 60% of the minority PhDs in STEM, you really don't need the rest of the institutions out there doing much because you can now produce an ecosystem where you have post-docs and faculty members being produced like crazy (NSF Program Officer, 23 July 2012).

In addition, the program officer provides other examples and highlights regarding the value addedness of AGEPE to STEM in his example of the small number of minority math PhDs produced. In summary, he notes that of (no more than) minority 20 math PhDs per year produced across the country, in one year, one single institution AGEPE institution contributed at least 25% of the total minority PhDs in math.

4.1.4 Value of NC OPT-ED/AGEPE to faculty

Institutional support and collaboration through family and community-oriented network

According to faculty at the participating AGEPE institutions and the NC OPT-ED affiliate faculty members, a main value of the program relates to an ability to access other faculty at their own and other institutions in the collaborative network. For instance, one project staff member notes how the faculty-faculty relationship between and across departmental units is beneficial. Having access to other faculty is a valued aspect according to the quote below:

So, it's a benefit to us because [as a faculty member if] they need to talk to a faculty member, that's me. The other thing is that if the students need...faculty listens to faculty...they do not listen to administrators, and so it's a different conversation. (UNC Project staff, May 29 2012)

The access to other faculty fosters faculty buy-in and collaboration in specific ways that benefit students in the program and in leveraging grant support, to name a few benefits. One project staff highlights the beneficial nature of having had developed an institutional climate supportive of diversity and inclusion at key administrative levels so that by the time AGEF was developed, there was already support and collaboration within the institution. Moreover, an affiliate faculty member notes how the connections between the collaborative network is useful even to the extent of gaining letters of support for competitive grants or making connections with other colleagues in the STEM field. As the AGEF and NC OPT-ED evaluation participants note, the family and community-oriented nature of the program is apparent at the faculty and institutional levels. One project staff for instance refers directly to the program's underlying philosophy as characteristic of a family:

One of our philosophies is a family oriented philosophy. Once you're a part of us you're a part of the family, not just through graduation but even into their post-doc and faculty careers or whatever career that they choose. (UNC Project Staff, May 29 2012)

One affiliate member echoes the same sentiment in which she refers to the larger collaborative network within NC OPT-ED where affiliate members rely on each other to mentor and retain students in the STEM disciplines and to address cross-institutional opportunities. This is captured in the following statement:

I definitely feel that we are a community that relies on each other... even if it's just tossing an idea around. I remember in an NC OPT-Ed meeting we had a major discussion on [the] retention [rates] of students in the STEM disciplines and [we gathered] a lot of suggestions that we could take back to our respective schools. (HBCU-UP Affiliate, May 30 2012)

4.1.5 Value of NC OPT ED/AGEP to K-12 Students and Institutions

The NC OPT ED alliance helped expand the role of the AGEP program beyond the undergraduate /graduate minority students. As a result of this partnership, students, AGEP staff, and affiliate members were able observe the impact of this network to increase the K-12 students exposure to STEM. These points are illustrated by several reflections that follow:

4.1.5.1 Exposure to resources and opportunity to recruit K-12 students

The Alliance was instrumental in brokering access to resources and opportunities for under-served youth. For youth being exposed to education and career opportunities has a lasting influence in their future goals, while adults found that their ability to direct students to diverse opportunities increased as a result of their growing knowledge.

We extend support to some middle school and high school students that come from one of the lower resource areas in eastern Carolina Bertie County, and we put them up. .. They come into an environment on a college campus...and it gets them thinking different...When I come to the hotel they have so much energy because they're away from home at a major conference and they are going to see something they don't see at home. (NC OPT ED Director, May 29, 2012)

For my program, my assistant and I call students to do exit interviews. One of the students interviewed is a senior and going to major in biology...because she wants to be a food scientist. She said, back when she was in sixth or seventh grade we did this tour with the food science department at North Carolina State and that was the thing that got her hooked on going on to be a food scientist. (MSEN Affiliate, May 30, 2012)

Participation in OPT ED activities also serve as opportunities for service providers to learn about resources, share, and recruit more youth.

I think there is an awareness at multiple levels that was not there before...we didn't know that all these programs were around...Now we pass that information on to our friends and they get their kids involved. So you see the pipeline is increasing for STEM. (HBCU UP Affiliate, May 30, 2012)

In middle school I didn't know that graduate school existed and this is the same for some of the middle school students who went to OPT-ED Day. . . Now they know what research is . . . and the speakers who talk to the middle schoolers . . . get them excited. We're showing them that there is a next level . . . why they should go to the next level. . . and creating the opportunity for them to go to the next level through different programmatic opportunities. (NC State Staff, May, 29, 2012)

4.1.5.2 Mentorship

AGEP students and alumni found great value in the opportunity to serve as a mentor while equally being inspired by the next generation of STEM scholars. The unique opportunity is captured below in student responses that speak to the opportunities to mentor students:

I enjoy OPT-ED Day because the middle schoolers are showing their research. It amazes me how excited they are about presenting their data. . . It also gives me an opportunity to share my experience with them. Last year I sat on the panel and we had a lot of great questions and a lot of interests from high school students trying to decide on what field they should go into and what school they should attend. (NCSU Student, May, 29, 2012)

I think the peer mentorship definitely was a positive element that assisted me in completing my degree. There is no doubt about that. Just having that group support system, knowing what another Black female scientist was going through, that helped me to the max. (NSCU AGEP Alumni, July 10, 2012)

I remember either advanced level graduate students or post-docs came to talk about what graduate school is really about and what it's like and what you need to do in terms of preparing yourself?hen once you sort of get into the environment, how you need to handle yourself and handle issues that arise with your research and getting credit for the work that you're doing. Those kinds of seminars I particularly enjoyed those when you had someone in the process and just getting their feedback. (UNC-CH AGEP Faculty Alumni, September 4, 2012).

4.2 Evaluation Question 2: Which of the Alliance/joint program activities made the most significant difference in students' persistence into the PhD & through the doctoral degree?

4.2.1 Factors that influence decision to matriculate

Data from the Alumni Survey show that for PhD holders rank the financial package offered by the university $n = 19$ (68%) as the most important factors that contributed to their matriculation. This was followed by reputation of the institution, their own motivation and determination, and the program faculty $n = 17$ (61%). Finally, students reported the reputation of the program and research opportunities $n = 14$ (50%) as an important factor that contributed to their matriculation.

AGEP seems to have been a more important matriculation factor for students who completed master's degrees than for holders of PhD or bachelor's degrees. Fifty percent ($n = 33$) of the master's alumni survey respondents reported that the AGEP program was a determining factor in their decision to matriculate, while 40 percent of the PhD respondents ($n = 11$) and 26% of bachelor's holders ($n = 13$) held the same opinion (see Figure 4.2).

4.2.1.1 Benefits of Financial Support

Data from the current students survey show that financial support offered by AGEP makes the most significant difference in their students' studies. Students mentioned that the financial support allows them to focus on their studies and research without having to worry about money.

These statements are further supported by current students' responses to the survey as they reported that their three primary sources of income for current students

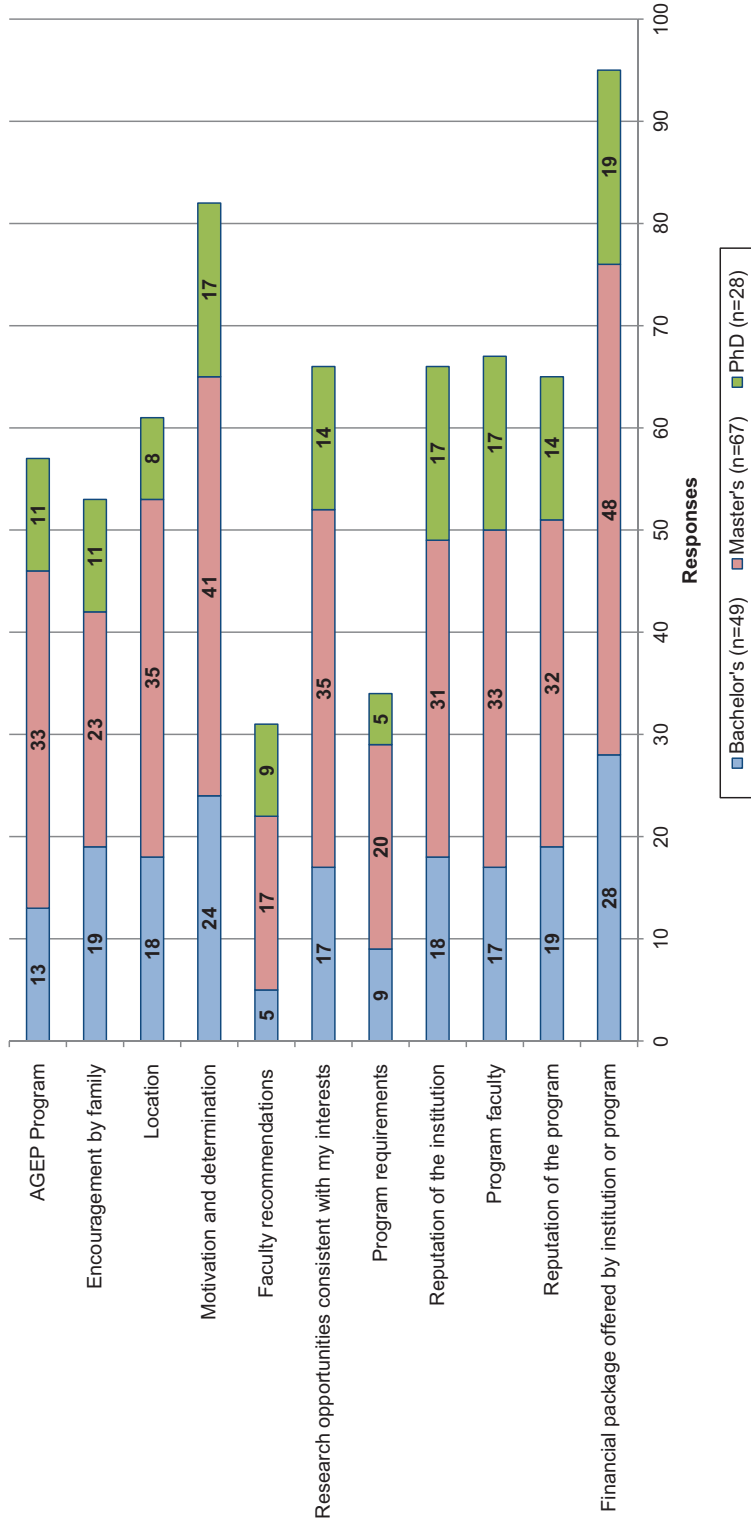


Figure 4.2. Factors that influenced decision to matriculate in program of study. Based on 144 valid responses from alumni. Frequency of responses $> n = 144$ due to multiple responses.

who filled out the survey are (1) university (non-AGEP) scholarships, (2) AGEP fellowships, and (3) research and teaching assistantships. Other sources of income include loans, external or private scholarships, personal or family savings, and paid internships. See Figure 4.3.

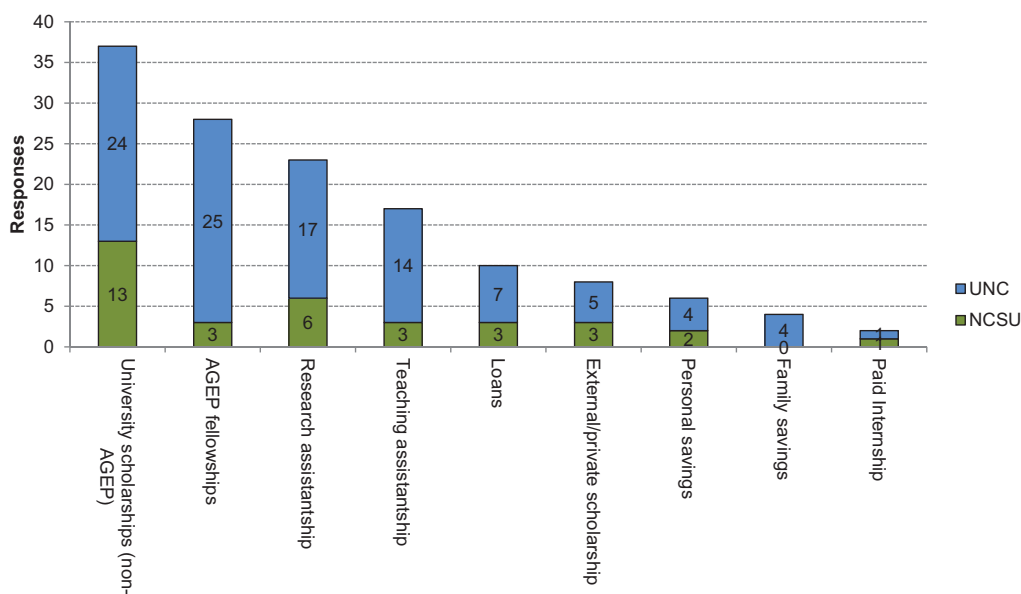


Figure 4.3. Primary sources of income for current students. Based on 40 valid responses. Frequency of responses $> n = 40$ due to multiple responses.

The alumni survey respondents similarly reported that their primary source of income as students was non-AGEP university scholarships followed by research assistantships and then private external scholarships. AGEP funding was ranked fifth after teaching assistantships, see figure 4.4.

Other important aspects of the AGEP program that both current students and alumni emphasized as positive, include: networking, the ability of the program to leverage resources for students, and a staff that cares about the emotional and social wellbeing of students.

4.2.1.2 Social and academic support as critical to matriculate

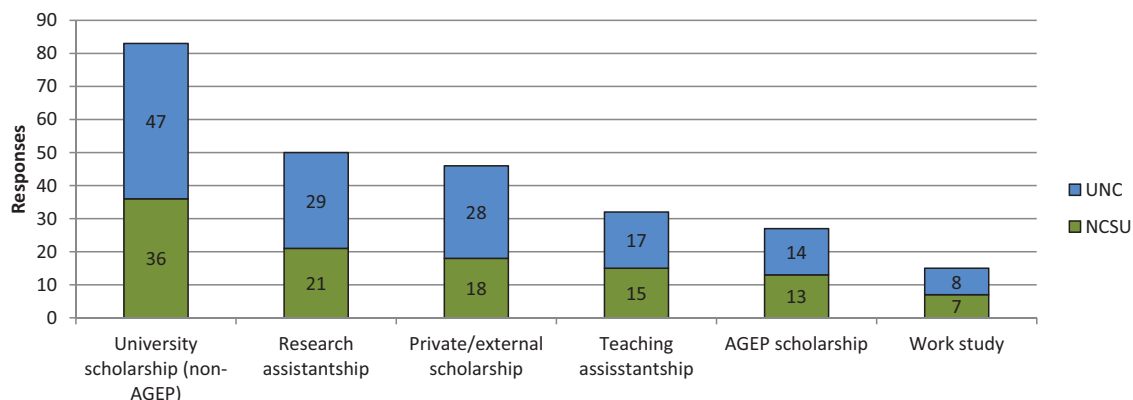


Figure 4.4. Primary sources of income for former AGEP students. Based on 122 valid responses. Total responses $> n = 122$ due to multiple responses.

From the open-ended responses to the student survey, student participants also emphasized the positive role of AGEP in helping students expand their professional and academic networks and in leveraging resources that otherwise would be difficult for them to access.

Another important characteristic of the AGEP program as stated by current students and alumni is the social and emotional support it provides to students. Having a dedicated and caring staff has been instrumental for many students. For example, students mentioned the constant guidance and support the program's staff offer to them during their studies, and their ability to help students adapt to their new environment.

Students would like to see the following program improvements: *inter alia*, more funding, more networking and social events, more support for SBE students, and more information about the services offered by AGEP. See Appendices D and E for the full listing of students' open ended responses about positive and less positive aspects of the program.

4.2.2 AGEP program activities that contributed to student persistence to PhD

4.2.2.1 Entrée into AGEP

For many student participants, AGEP served as an entrée into postsecondary education expectations. Two components were most often referenced by each institution's students as impactful to their acclimation to the rigors of their new educational journey—the first being the Initial Summer Experience. This program component served to initiate students to the campus and graduate life. Several students each year are invited to spend a summer at their respective graduate institutions. This opportunity affords them the privilege to learn the campus, department, and complete research with a professor. As illustrated below, this unique opportunity for early exposure to the campus was beneficial in several ways:

One thing that was good for me, when I came the summer before I started, I picked a lab, and I worked in that lab. But that wasn't the lab I ended up joining. It was really helpful for me to be able to come in, with sort of, my own funding, and work for a professor. It made it kind of better when I decided that wasn't the lab for me. It was nice having [that experience] right there at the beginning. (UNC Student, May 30, 2012)

AGEP helped because it allowed me to come to NC State earlier than everybody else in my entering class and I got a feel for the department. Initially, the goal was to work with this particular professor, but because I came in early and I got a feel for each advisor I was able to pick the best labs to rotate in. AGEP has been one of my best decisions here at NC State. (NCSU Student, May 29, 2012)

Through AGEP I was able to actually get a summer research experience with the professor at that time, which I wanted to work with in that particular department. After having that research experience and the opportunity I realized that I fit in that department. I liked the research that was going on and it was in line with what I wanted to do, and I liked the atmosphere of the department. (NCSU Student, May 29, 2012)

4.2.2.2 AGEP sponsored workshops

Other AGEP and NC OPT-ED sponsored activities were often referenced when students were asked to recount their most impactful experiences. While some work-

shops were not equally applicable to all students, AGEF staff focused on using student feedback to develop responsive programs for students at all graduate levels. These workshops focused on key topics related to professional development skills. One staff described how a writing workshop helped a student compete for a national fellowship opportunity:

One of our current AGEF students got an NSF fellowship. Not only because of her hard work, but also because we helped her with the application. After asking the students to write their statement of purpose, their broader impact statements and all of that of the grant, we have a peer review panel and faculty panel that get together [to] discuss over the summer and at the beginning of the academic year for the undergrads. They could have an opportunity to make lots of changes and to get feedback early [enough] so that everything [is] done. Most of the heavy work was done when the grant was due. (NCSU Project Staff, 29, May 2012)

4.2.2.3 Cross-institutional workshops and events: Towards mentoring and professional development

Inter-institutional Cross Talks and NC OPT-ED Alliance wide events help students manage the challenges of matriculating. These events were viewed as spaces for students to share experiences and receive informal and formal peer mentoring. Student and staff share their reflections on the value of the workshops:

They get to talk to each other, which is significant, creating a non-isolation kind of environment, which is a huge deal for success of any PhD student no matter what your origin is. We create that so that they are not alone and we also address things that are really specific and important to them at any particular time. For instance, when the students from the HBCUs get with the students from Chapel Hill and State, all of a sudden now they realize they [experience] the same problems, the same challenges. (UNC Project Staff, May 29, 2012)

I think AGEF as an experience really helps you to think about your future and it gives a window into what the possibilities are and you make a decision based on that. (NCSU student, May 29, 2012)

I like being able to present our research [at Alliance Day] with other research programs on campus too. It was really good to see what everyone else was doing. (NCSU student, May 29, 2012)

Participation in the OPT ED Alliance Day presentation also served as another professional development opportunity.

I think it causes them to have more ease in going to conferences and presenting. I think that it is a really was a big plus for our students, to help them when they go to larger conferences. (UNC Project Staff, May 29, 2012)

Student AGEP program requirements and expectations were increased as they progressed through their academic career.

Actually I remembered that some people have to do a poster, but if you've already done a poster then you have to do the oral presentation. That was the first time [that I presented] in English. It was a great experience. I was so nervous, but it was great just to get the exposure and how it feels. All the workshops I think really helped me develop some of my skills. (NCSU Student, May 29, 2012)

In addition to professional development related activities, students described the impact of the formal and informal mentor opportunities. The AGEP program embedded several opportunities for students to receive mentoring, hone skills at mentoring, and opportunities to become mentors as they matriculated through their programs. AGEP students found peer to peer mentorship to be valuable as it helped them relate to and encourage students at all educational levels.

Mentorship is definitely ingrained through AGEP. It's just something that is your responsibility because you've been afforded an opportunity. Sim it's your responsibility to pass that on to someone else. I didn't even mention that 'cause it's kind of just second nature. (NCSU Student, May 29, 2012)

In April of this year, we had one of our post-docs talk and I think everybody was probably in tears when he left. He was talking about how the naysayers told him what he couldn't do it. How everyone told him "You can't do it" and telling him "you don't need all this education." He completed his post-doc here and just got a position at the University of Charlotte as Assistant Professor. (UNC Project Staff, May 29, 2012)

4.3 Evaluation Question 3: What is the value/effectiveness of each institutional program in regards to the students' completion of the doctoral degree?

4.3.1 Effectiveness of institutional program in regards to completion of doctoral degree

4.3.1.1 Measures and sources of data

Completion of doctoral degree. Thirty-one doctoral recipients completed the alumni survey with this group being comprised of 13 who completed their degree at UNC-CH, one at NCSU and the remaining 17 receiving their doctorates from institutions in other states. They reported that they had received their degrees between 2005 and 2012.

For the purposes of this evaluation, completion of doctoral degree is defined as the number of members of a cohort that complete their PhD in the time established by the University's statute of limitations.

The evaluator did not have access to micro-data which would have allowed the tracking of degree recipients by their doctoral cohorts since enrollment into the PhD until graduation. Hence, in order to assess PhD completion rates at UNC and NCSU a proxy measure was used (Petersen, Kraus, & Windham, 2005). This proxy is defined by

$$GR = \frac{PhD}{PhDEnroll} \quad (4.1)$$

Where:

GR: is the the graduation rate, as a result of...

PhD: the number of PhD recipients divided by...

PhDEnroll: the total number of enrollees five years earlier.

For example, the graduation rate for the period 1996-2001 was 9.38%. This is the result of dividing 6 students who graduated in academic year 2001-2002 by 64, or the total number of PhD enrollees in science and engineering degrees at NCSU in the academic year 1996-1997.

4.3.1.2 Results

Applying the proxy described above to the data provided by UNC and NCSU shows that graduation rates of URM and non-URM in sciences and engineering are similar since 1996 (see Figure 4.5).

Although this approach allows us to make a comparison of completion rates for the period 1996-2009, it is not possible to determine the effectiveness of the program in regards to completion of the doctoral degree. Inferences about effectiveness require (a) a baseline of graduation rates prior to 1996, (b) that AGEF participants and non-participants be identified in the dataset, and (c) a careful control for background and contextual characteristics.

Also, a more in-depth analysis requires disaggregation by ethnic/racial group within the URM group. The dataset provided by the AGEF program does not allow for disaggregation among ethnic groups. It is necessary to ensure the exclusion of Asians in these datasets since they are not an underrepresented minority group in STEM fields. According to the National Science Foundation, “Asians are not considered underrepresented because they are a larger percentage of science and engineering degree recipients and of employed scientists and engineers than they are of the population” (National Science Foundation, 2011, p. 2).

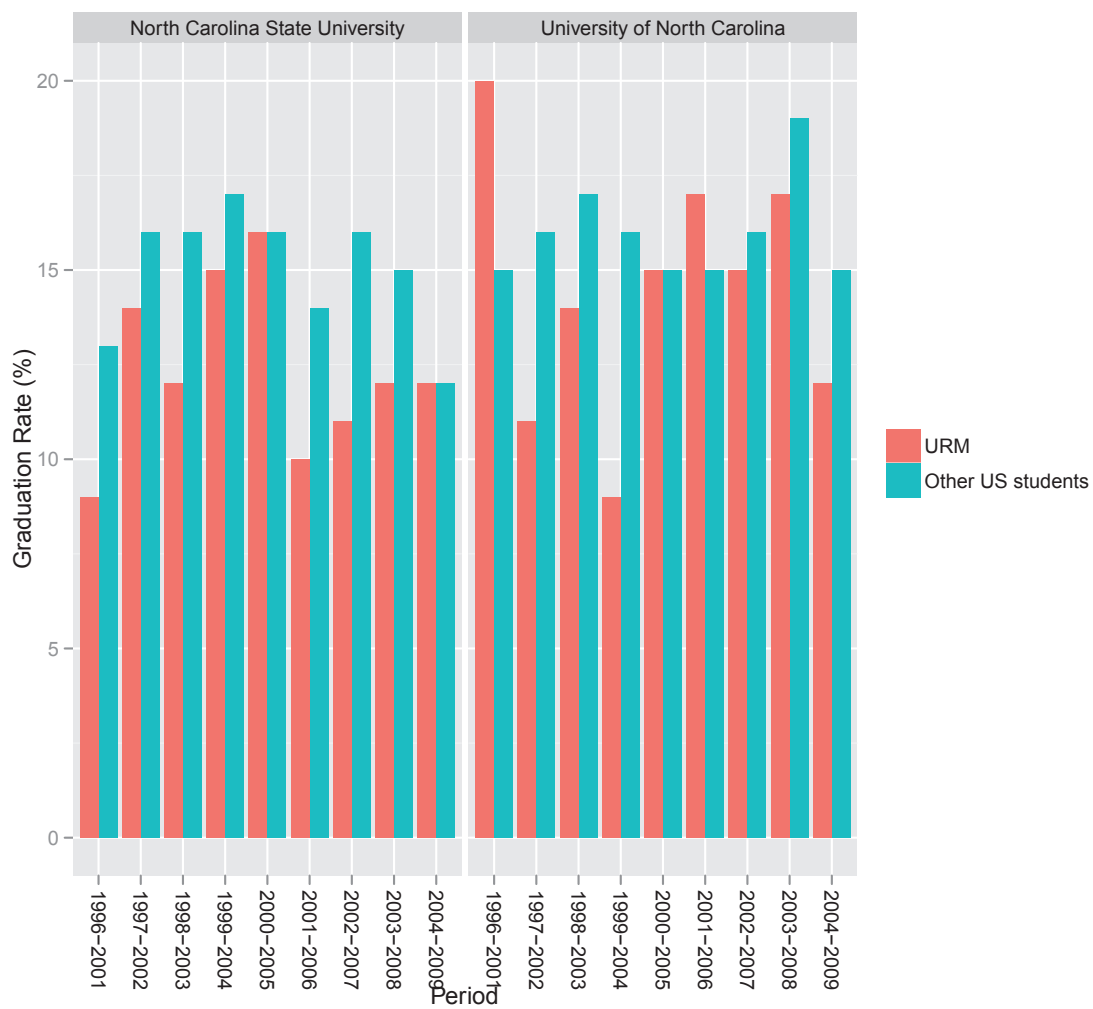


Figure 4.5. PhD graduation rates at NCSU and UNC. Data provided by AGEF program

4.3.2 Effectiveness of institutional program and interest in academic career

4.3.2.1 Measures and sources of data

For current master's students, measures of interests in academic career in higher education in the United States were obtained from Question 39 in the current student survey "What are your future plans after getting your master's degree." Participants who selected Option 5, "enroll in a PhD," are assumed to be interested in a research or academic career in higher education since a PhD degree is a requirement of this kind of job.

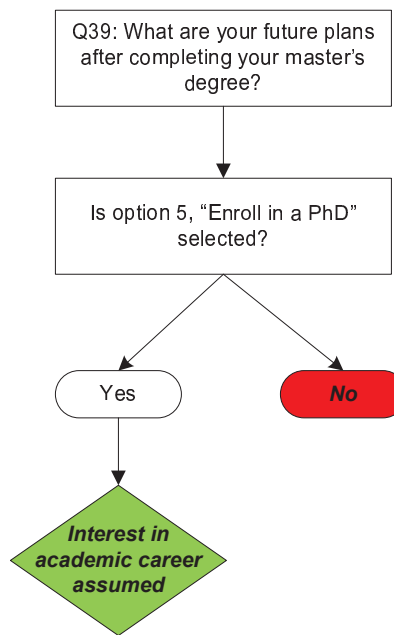


Figure 4.6. Measure of interest in academic career in higher education for current master's students.

For current PhD students, measures were obtained from Question 37 in the current student survey, "What are your future plans after completing your PhD." Participants who selected Option 1, "Academic or research career in higher education in the US" or Option 6, "Postdoctoral fellowship," are assumed to be interested in an academic

career. The “Postdoctoral fellowship” option was selected as a proxy because postdoctoral positions provide a stepping stone to academic positions (Akerlind, 2009).

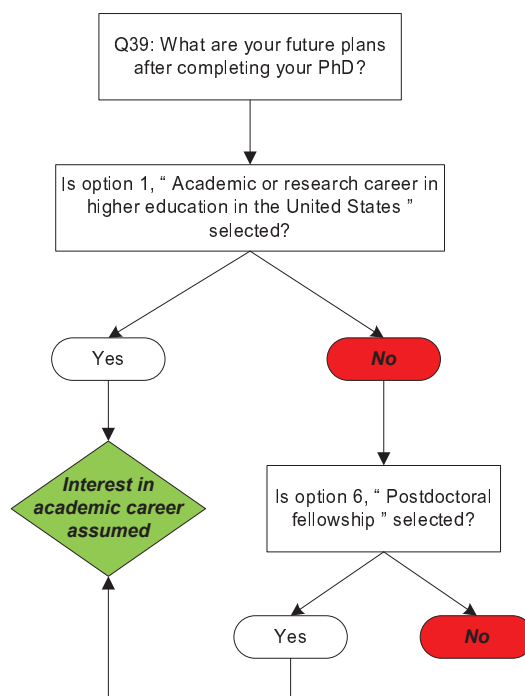


Figure 4.7. Measure of interest in academic career in higher education for current PhD students.

Alumni’s interest in academic career in higher education was evaluated using the following logic:

Former master’s students are assumed to be interested in academic careers if they are currently enrolled in a PhD program, or graduated from a PhD and now hold any of following positions: (a) postdoctoral, (b) research faculty, (c) academic faculty, (d) university or college administrator, or (e) teaching at a community college (see Figure 4.8).

Similarly, the measure of former AGEF PhD students’ interest in academic careers is given by their current work environment and include teaching, research, or administrative positions in higher education (see Figure 4.9).

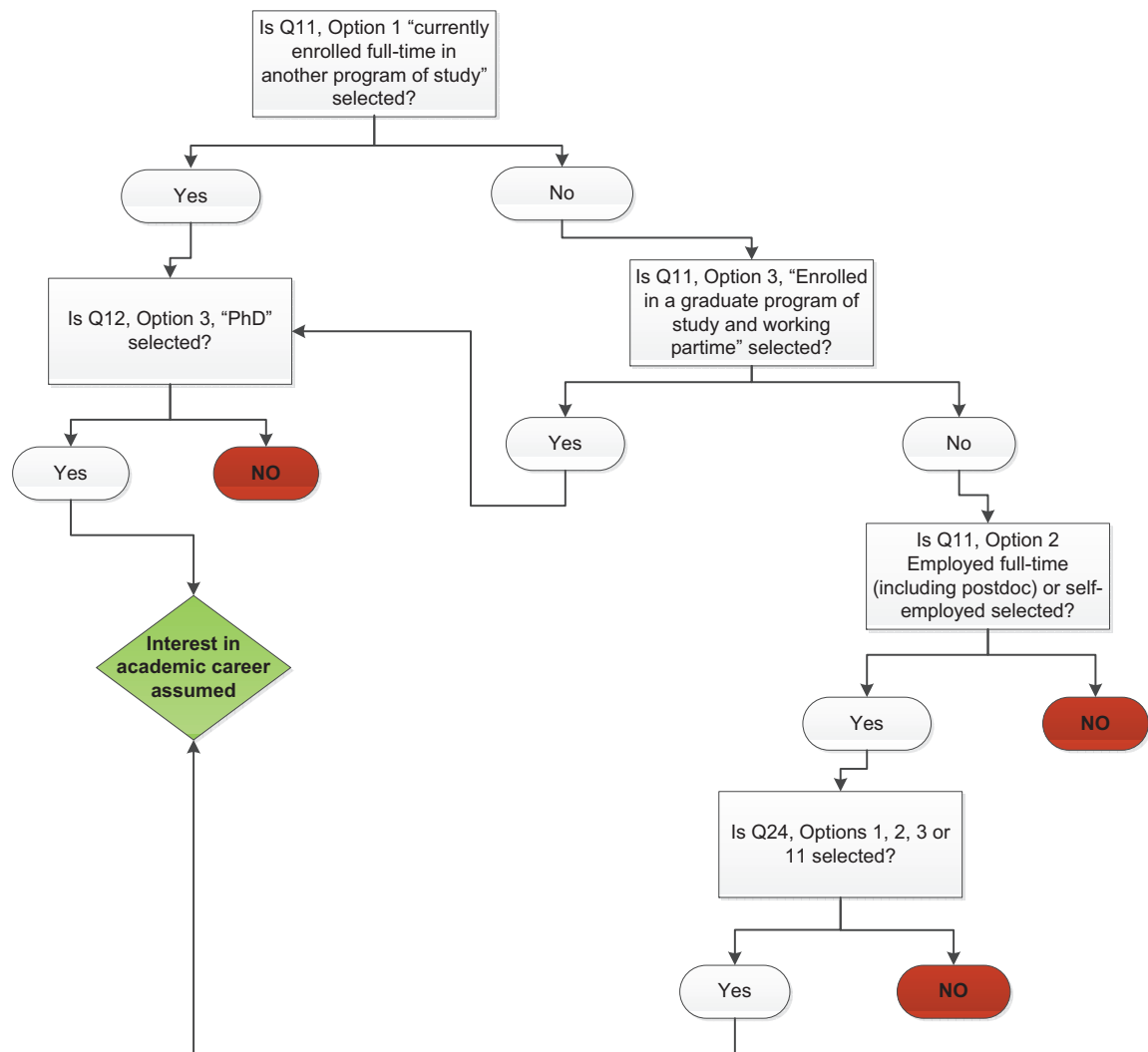


Figure 4.8. Measure of interest in academic career in higher education for former master's students.

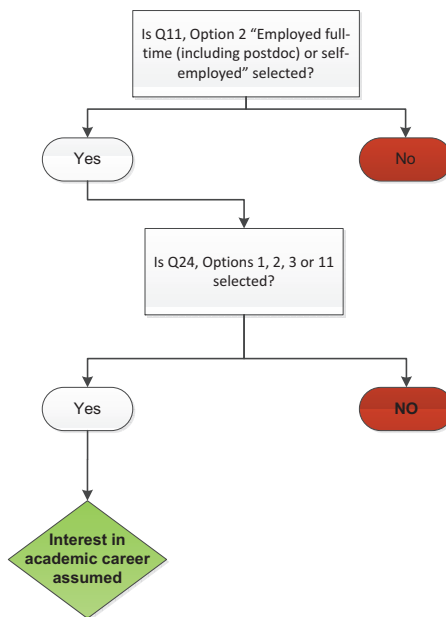


Figure 4.9. Measure of interest in academic career in higher education for former PhD students.

For participants who were undergraduates at the time of their participation in AGEF, their measure of interest in an academic career includes that they are currently enrolled in a graduate program of study and that they have expressed interest in becoming a STEM faculty in the future. (Figure 4.10)

4.3.3 Results

4.3.3.1 Interest in academic career alumni

There are a total of 52 respondents who were pursuing undergraduate studies at the time of their participation in AGEF. Of those $n = 6$ are currently pursuing master’s degrees, and $n = 20$ are enrolled in PhD programs. Of those $n = 26$ who are currently enrolled in graduate studies, $n = 18$ expressed that participation in AGEF sparked their interest in becoming STEM faculty in the future. Based on the operational definition in Figure 4.10, 35% of former undergraduate participants who responded to the survey seem to be interested in pursuing academic or research careers in higher education in the future.

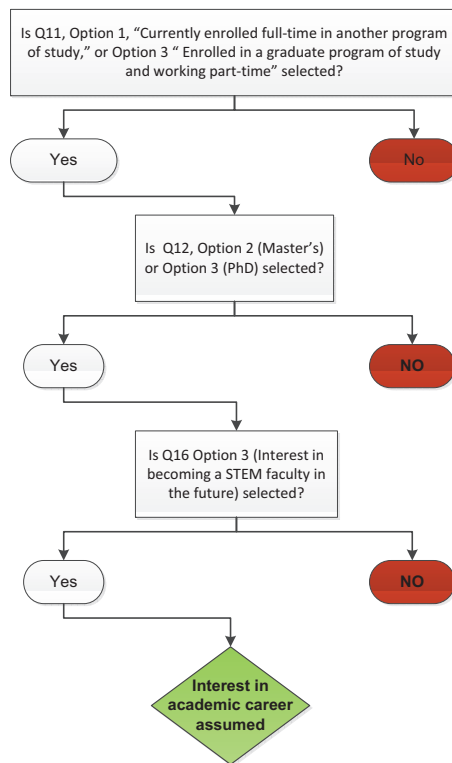


Figure 4.10. Measure of interest in academic career in higher education for former undergraduate students.

Of the $n = 67$ people who participated in AGEP when they were pursuing a master's degree, 5 pursued PhD degrees and are working as academic faculty at 4-year institutions ($n = 4$) or community college ($n = 1$), and $n = 31$ are now pursuing PhD degrees. Based on the decision shown in Figure 4.8, approx. 54% of former master's participants who responded to the survey are interested in pursuing academic careers in higher education.

Eighteen respondents who were pursuing PhD degrees at the time of their participation in AGEP reported on their current employment setting. $n = 11$ are currently working on research or academic positions in higher education and $n = 7$ are working in the industry or corporate sector. Ten respondents did not answer this question.

4.3.3.2 Interest in academic career current students

Seven master's student and 33 current PhD students reported post-graduation plans. Applying the working definition on Section 4.3.2.1, it can be deduced that $n = 28$ (70%) of PhD students and 2 master's students who completed the survey are considering pursuing an academic or research career in higher education in the United States.

4.3.4 Value of AGEP Program to Undergraduate Students

The AGEP program has developed a series of outreach activities for undergraduate students. Data from the alumni survey show that $n = 48$ respondents participated in one or more AGEP-sponsored activities including, but not limited to, meetings with AGEP faculty and students, attending AGEP-sponsored career development workshops focusing on applying to graduate school, conducting joint research activities with students or faculty from other schools, or AGEP sponsored conferences or professional meetings (see Figure 4.11).

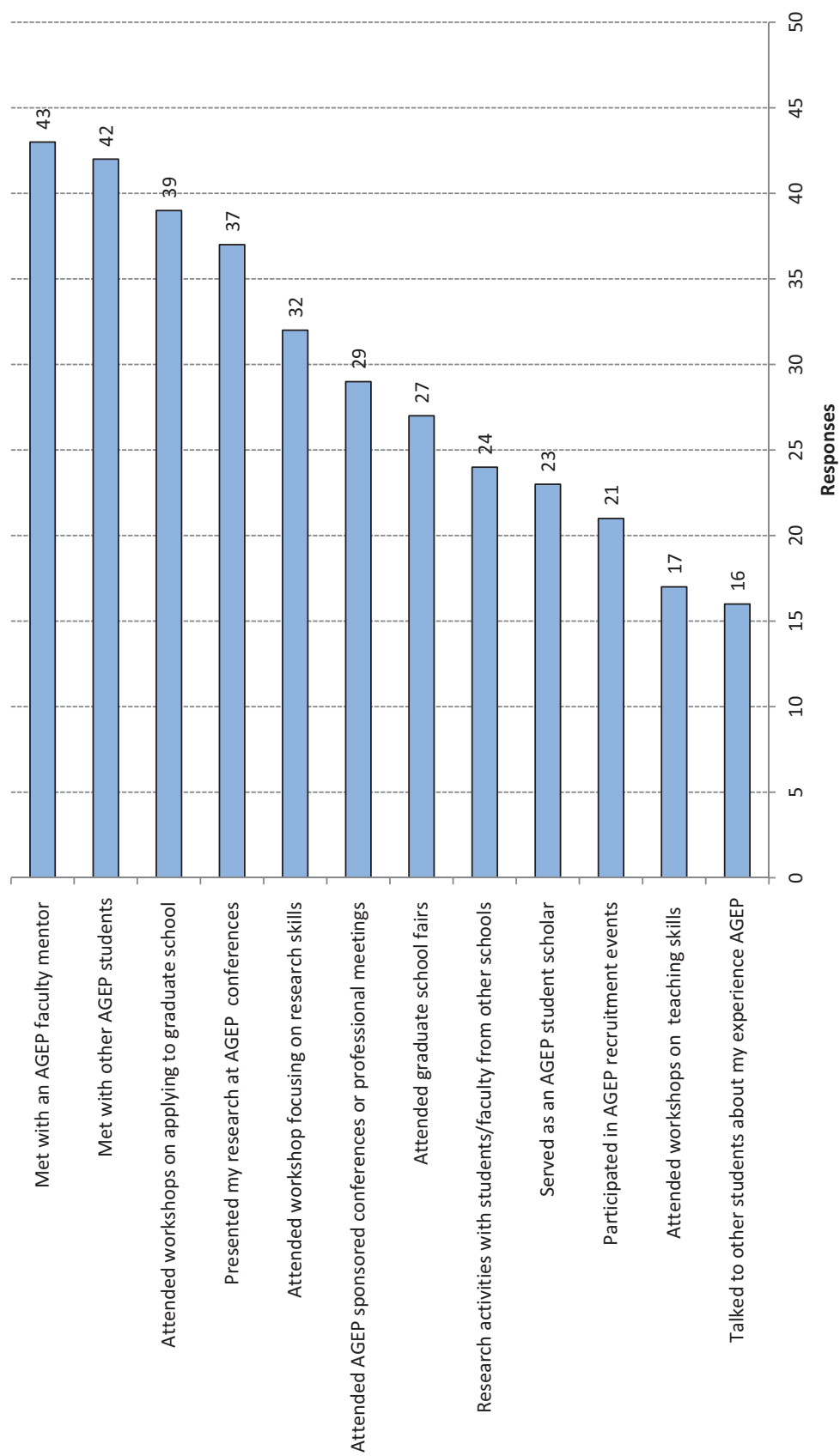


Figure 4.11. Participation of undergraduate students in AGEP activities. Based on 48 valid responses from $n = 51$ participants. Frequency of responses $> n = 48$ due to multiple responses.

Of those 48 respondents who participated in any type of AGEF activities as undergraduate students, $n = 30$ are currently enrolled in a graduate program of study, $n = 8$ are enrolled part-time in graduate program of study and working part-time, and $n = 10$ are working full time and not enrolled in school. Of those who are currently pursuing a graduate degree, $n = 22$ are enrolled in doctoral programs and $n = 8$ in master's programs.

The majority of students who participated in AGEF activities during their undergraduate studies reported that their participation in AGEF contributed to a great or considerable extent in their decision to apply to a graduate or professional school ($n = 41$), to improve their skills for academic and research work in graduate or professional school ($n = 39$), to their decision to select their current career, and for sparking their interest in becoming STEM faculty in the future ($n = 28$).

Also, the AGEF program and NC OPT-ED Alliance provide considerable resources to support student perseverance and completion of a doctoral degree. Both programs seek to embed a collective culture that extends beyond traditional financial support. While financial resources were one of the most valuable resources for degree completion, financial support alone was not sufficient to provide a sustainable model for students and staff. Some of the most important resources included socio-emotional support, professional coaching and mentoring, and a network of cross institutional relationships that played critically important roles in students' identification and pursuit of their academic and professional endeavors.

According to staff and students, AGEF provides a safety net for program participants.

You are much more likely to leave here with a PhD because the places where students get stuck that's where we are at every single step. If it's their oral exam, we're there. If it's their PhD writing we're there. If their P.I. just ran out of money, we're there. So for the students that's significant. It's the place where they would normally drop out where they know that we are going to be from the moment they walk in the door to the time that they leave. If they need to travel to conferences and their

P.I. didn't have any money, we're there. (UNC Project Staff, May 29, 2012)

One student described the AGEF program as a safety net, a place to get financial and moral support, "It's always been a safety net for me to go outside of the department to get moral or financial support." (UNC Student, May 30, 2012)

4.3.4.1 Timeless relationships/collective family theme across institutions

Both institutions shared similar values around creating a space of inclusivity and support despite a student's level of involvement with the AGEF program . This value addedness exists across both student's and staff's accounts as indicated below:

I always say once you're in the AGEF family you're always in the AGEF family whether, you know we're funding you or not. (NCSU Project Staff, May 29, 2012)

They know you independently. They know you by name. They know your particular situations. Any big life events they'll ask you, "How's life going?" It's a community. (NCSU Student, May 29, 2012)

4.3.4.2 Financial Resources

Because AGEF grants were institutionally-based, each school had autonomy of how to allocate funds for students. Students and faculty found this flexibility of great value as funds were variably available to offset unexpected funding gaps that traditionally challenge a student's ability to complete their academic endeavors. Funds were available to offer traditional support. As illustrated below, both staff and students recount the impact of their nonrestrictive AGEF funds:

Like she mentioned some students fall short of funding their last year. We've been fortunate enough to have enough money to fill in the gaps for that. (UNC Project Staff, May 29, 2012)

One of the things that AGEF gives a student is a stronger sense of independence of what kinds of research they might be able to work on, and there's a little bit of money that they can use to go to meetings, and stuff like that. Those kinds of things help them do things that a non-AGEF student might not be able to do. (UNC Faculty, May 30, 2012)

This past year, because of budget cuts, I wasn't going to be able obtain a job. The UNC AGEF program found a way to get me money, so I could stay. (UNC Student, May 30, 2012)

AGEF has financed trips to conferences for me, which has been immensely helpful. It helped me go to two conferences in the last two years...It's a huge help in terms of professional developments. (UNC Student, May 30, 2012)

I went to a couple of conferences that my department couldn't fund. I actually received an award for the poster. (UNC Student, May 30, 2012)

The funding was great because I didn't have to teach a bunch my first year. You have a lot of classes your first year, but it was nice to break that up and just kind of alleviate the stress. (UNC Student, May 30, 2012)

Another thing that was helpful about having summer funding was it didn't matter if the lab already had a student, they'd take you. So you didn't have to worry about that. (UNC Student, May 30, 2012)

I've always had my own funding however, my advisor ran out of grant money and I actually went and talked to the NSCU coordinator and she informed me that she could give me some assistance with my research project. If I had talked to her, that semester maybe I wouldn't have had money to do my research, but because I did I was able to continue doing my research and then my advisor found funding shortly thereafter. (NCSU Student, May 29, 2012)

4.3.4.3 Socio emotional support

AGEF support extends beyond the financial resources. Stakeholders offered examples of how the staff, faculty, and peer support networks were beneficial in the student retention and perseverance through their respective programs. When asked about the impact of the program, one staff member described the program as a, "support system that is every bit as important as something else for them to have. Not just the one person but their community." (NCSU Project Staff, 29 May 2012)

One UNC staff shared her experiences as a confidant to students,

Often they show up in our offices with nothing to do with school-work. Everything is personal stuff they're trying to get through in order to let them finish graduate school. I think a lot of that comes into our

office... whether it be [through] email, phone, face-to-face, and some of that has to be escalated to Valerie as well. (UNC Project Staff, May 29 2012)

Current students and alumni shared similar memories of the socio-emotional support that extended beyond traditional funding:

I can remember getting confused about having to have all of my medical shot records [and] going to the AGEF office, and being like, I don't know what to do about this. I think I'm going to get kicked out. They helped me with that. (UNC Student, May 30 2012)

AGEF staff is just really important, having people here to sort of celebrate your successes, and the moral support that they provide outside of the funding. I think is motivational. (UNC Student, May 30, 2012)

For me, it's nice to know that I have those other people that I don't have to keep certain things to myself. (UNC Student, May 30, 2012)

When I first got here and I didn't know what I was doing, and I didn't know who to go talk to. Even now, I'll call my mother with some weird problem that I've had, and she'll be like, "oh, just go ask those AGEF people." (UNC Student, May 30, 2012)

They're always there, and even if you don't email they will email you, "We're working on this. Don't stress." It's very, very helpful, more than my family I guess. When I was in that situation, switching departments, they were always there to help, funding and all that. During that stressful period of time they were there. (NCSU Student, May 29, 2012)

Dr. Frierson... was basically one of my mentors at UNC in graduate school... They were also part of my extended family, I would participate in activities... That was my social balance and also professional development balance at graduate school working with the program. (UNC CH AGEF Faculty Alumni, September 4, 2012).

4.3.4.4 Extended Networks

Participation in the AGEF program served to broker long lasting relationship that extended beyond a student's academic matriculation. Student networks served to boost camaraderie but also served as opportunities to broker professional connections in the future. The values of such relationships are illustrated below by students and alumni:

When it was time for me to get a job in the industry I had requested a letter of recommendation. . . I got to read the letter and because of the interaction that I had with the staff he could write it from such a perspective that the employer would be able to see exactly what it is that I did. I will never forget some of the items in that letter to this day. (NSCU AGEF Faculty Alumni, July 10, 2012)

I have students who tell me, you know I'm still friends with people that they were in AGEF with in 2005. And they went to different universities and things like that. So just sort of promoting unity I think helps students because they feel more a part of something. (NCSU Project Staff, 29, May 2012)

If I ever wanted to find someone in chemistry, I'm just going to call AGEF, and say, "I need someone in chemistry." For me, mentoring is part of what I study, but also, what I'm passionate about. So knowing that I might never see Marsha on campus, but if I needed a connection to someone in chemistry across the country, there's AGEF that I can call at different universities. So that's important to me. (UNC Student, May 30, 2012)

One summer, there was a statistical training institute that was really instrumental in my training, because it linked me to people here on campus that I could later consult with in terms of statistical - my stats on the dissertation (UNC Student, May 30, 2012)

Just by saying you're a part of AGEF you meet other AGEFers from other schools, not necessarily here, so that's helped me to create an even bigger network. (NCSU Student, May 29, 2012)

Currently most of the people that I was in the program with, we're friends on Facebook. So I spent maybe about six to eight weeks with people I've never met and most of them were students of NC State and we still remain friends even though we've taken different paths. I think that was definitely a benefit from that program to be able to build those kind of networks as one moves on personally and professionally. (NSCU AGEF Alumni, July 10, 2012)

When I came, I was the only one in my department that was African American. AGEF was my support group. When you see others graduate, we all celebrate, we had cookouts and a lot of different events. When I help my department recruit other minority students, the first thing I talk about is AGEF and then the other communities that come along with it. (NCSU Student, May 29, 2012)

It introduced me to a bunch of other professors and graduate students who are further along in their program. I was able hear their opinions about things, why they decided to become a professor. I have some friends who are now teaching professors who I met when they were graduate students. I met all these people through AGEF. (NCSU Student, May 29, 2012)

4.3.4.5 Cross Institutional Partnerships leads to recruitment and matriculation

Finally, in addition to the values of the traditional AGEF model, affiliate partners, staff, and students found that the NC OPT-ED Alliance served as a valuable resource for students across the state in helping students navigate their academic and professional endeavors. Relationships between NC OPT-ED Alliance partners served as a resource for new information about research, teaching, and funding opportunities. The Alliance events also served as recruitment for programs seeking qualified students and essentially invaluable resource to students who were looking for opportunities to further their academic or professional careers. The value of this larger network is illustrated below:

Several students come each year to some of our research programs, research for undergraduate experiences at Elizabeth City. They know they have a direct contact because of the relationship built through the OPT-ED Alliance. Therefore, it's easy to pick up the phone and say, "One of my students is applying to your summer research program. Can you look at them if you have the space? Can you accommodate them?" That's helpful, especially at last minutes when another student may drop out and you have a space available that you need to fill and here you are with one of our OPT-ED partner schools with their students who will get an opportunity that they probably would not. We may have selected another school somewhere else. Not even in North Carolina. (HBCU-Affiliate, May 30, 2012)

This is great for when they get ready to go to grad school. A lot of them ended up going to North Carolina State or to Central. They just ended up going there because they've built a relationship there. (HBCU Affiliate, May 30, 2012)

NC Central always comes to recruit students at NC OPT-ED. So that pipeline piece I think is very important. But, again, I've seen that the

recruitment has grown over the years. So it's not just [schools in] North Carolina that come to recruit anymore. . . now others are coming to recruit. Now people are coming to show scholarship and fellowship opportunities and they generally give a presentation as well as man a table. (LSAMP Affiliate, May 30, 2012)

Two years ago, Larry mailed me an opportunity [about] a Bridges to Doctorate at University of California, Santa Cruz. These people just got funded and they needed students and I had this wonderful valedictorian that was not placed at any graduate program. Now she is a second-year in the Bridge to Doctorate. This kind of network can place your students in the best possible situation. (LSAMP Affiliate, May 30, 2012)

4.3.5 NC OPT-ED/AGEP program development challenges

Several programmatic developments and changes were identified as challenges by AGEF staff, NCOPT-ED staff, and students at UNC and NCSU during interviews. These challenges included issues related to transitions, lack of full understanding of program practices, and other challenges that are external and internal to the program.

4.3.5.1 Transition issues

Initial transition from MGE to AGEF was identified as a program development challenge. As illustrated below, the transition from MGE to AGEF required a shift in thinking about how to administer the program:

The catalyst for bringing us together in my opinion, was really NSF. You know that was the original catalyst to bringing us together. It went from a university focused program to an alliance based program. Then we had to focus on what is the most efficient and effective way to put together, especially effective way, to put together an alliance. . . How can we work together to achieve our goals and objectives? (NCSU Project Staff, 29 May 2012).

4.3.5.2 Lack of understanding of program practices

Lack of understanding impacted program level practices, such as the faculty mentoring or coaching programs, including the lack of a staff member devoted to evalua-

tion. The evaluation capacity gap and the lack of evaluator staff are illustrated below in the following quotes:

So if I could give somebody else advice on what I did wrong and what I did right in that situation, I would do so that they wouldn't have to necessarily go through a trial and error. More the match up—not that students didn't match up well. But just sort of how to evaluate that. And how to know that some people are doing what they're supposed to be doing with their mentoring and whether or not—you know what advice is being given and is the advice being listened to?(NCSU Project Staff, 29 May 2012).

That's a very different approach because Rebecca actually was...like you guys in the sense of really be a scholar, in the sense of really doing evaluations at the level where it could be published, and that was a great idea and we just never got as far down the road with that because of either funding and also because of her changes in what she wanted to do...We just never got there...We started approaching it more from what do we need as far as reporting is concerned, or either to give us feedback on some programmatic improvements for ourselves but not from a scholarly way. (UNC Project Staff, 29 May 2012).

4.3.5.3 Internal and External Challenges within and beyond Program

Students had challenges both internal and external to the program. For instance, personal issues were identified as external challenges to the program. Internal challenges existed such as unfamiliarity with funding and tax guidelines that accompanied their AGEF funding support.

I also ran into an issue...with the funding the first summer. It was like a weird tax thing. A lot of funding, I guess part of the summer, I was self-employed. I'm not really complaining about being self-employed and having to pay the extra taxes, because it was still worth it but I didn't know that was going to happen (UNC student, 30 May 2012).

Another item that was addressed as a challenge included lack of budget for NC OPT-ED for infrastructure, travel, and other associated expenses in operating NCOPT-ED. As illustrated below, the lack of budget support for NCOPT-ED had several implications:

The central office is probably affected the most because it didn't have a budget. The NC OPT-ED model was affected...in the sense of losing their separate office space of getting integrated, [and] no longer having that autonomy and...losing budget in regards to travel... (UNC Project Staff , 29 May 2012).

The lack of university ownership of AGEF operation was a programmatic challenge that was discussed by members of one project staff team. The challenge of having flexibility as a program and being owned by the university administration is perceived as a double-edged sword:

It's a beautiful thing because I don't work for anybody I mean technically when it comes to this grant. It's not a beautiful thing when we need to be owned by somebody. When they want to own us they own us, but then when they have to own us it's hard, and so the university has had the benefit of us being here... (UNC Project Staff , 29 May 2012).

Lastly, transition from the current AGEF model to an anticipated one is an existing challenge as understood by project staff from both schools.

So what that means for us is we spend all that money on students, we will not. One, because NSF has said, "We don't want it to be a graduate fellowship program." We will focus on what we think makes a difference anyway, which is all the programming and all the interactions and everything else. We will support staff and programs very similarly to the way we've done before, but we won't have fellowships (UNC Project Staff , 29 May 2012) .

CHAPTER 5

CONCLUSIONS

5.1 Conclusions and Implications

This section provides conclusions and implications of the evaluation report findings. Presented below are general comments about the evidence of success achieved by the NC OPT-ED and AGEF programs. In addition, this section provides conclusions relative to the three evaluation questions that framed the study.

There is considerable evidence that the NC AGEF program has been largely successful in contributing to the number of URM receiving STEM graduate degrees at both the masters and doctoral levels in North Carolina since its inception in 1999. Those who have received their graduate degrees are employed in academic and non-academic settings as practitioners, researchers, and as university faculty.

One of the major strengths of the NC AGEF program is clearly the commitment of the principal investigators and staff. There is an unquestionable passion and excitement about their respective programs, the importance of the work they have done, and the sense of family that has transmitted to those students who have participated in AGEF over the years during its funding. The AGEF partners have done a masterful job of managing their financial resources to provide a reasonably comprehensive set of services to support their facilitation of recruitment and retention efforts. It was impressive to see how the AGEF alliance saw the potential to maximize its resources within the state of North Carolina by partnering with the other North Carolina NSF programs that had the shared goal of increasing the number of

STEM degree recipients from the bachelors through the doctorate at each point of the respective education system pipeline through NC OPT-ED.

While there were major strengths identified as a result of the evaluation there were indeed areas where the AGEF came up short. Probably the most significant weakness was the absence of a systematic or coherent evaluation design of the program that could be found throughout the history of the program. While there were some efforts that were evaluative in nature periodically there was no systematic thoughtful evaluation design that had been implemented. The absence of a systematic evaluation of AGEF from a formative or summative perspective impacted the present evaluation. As a result there was limited availability of data to respond to the report's evaluation questions.

5.2 Conclusions regarding each evaluation questions

5.2.1 Evaluation Question 1: What is the value added of NC OPT-ED AGEF model compared to traditional AGEF programs?

Qualitative narrative from the NSF program officer indicates that the AGEF national model often results in collaboration and networking among AGEF programs across institutions. It is not clear from our data if other AGEF institutions outside of NC have also included affiliates to the extent that NC has (although, our hunch is that they have not). Although our qualitative data indicate that affiliate partners and partnering universities perceive a great benefit from belonging to the NC OPT ED network, it is not clear how this network differs from other states/institutions implementing the national AGEF model. Our data does, however, characterize to a great extent what types of relationships have formed within the network among all levels of the NC OPT-ED system and what benefit various relationships and collaborations have for stakeholders and participants of OPT-ED.

Additionally, the quantitative data indicates that both UNC and NCSU have similar and consistent graduation rates of URM students in STEM fields. However, we do not have data to compare the graduation rates of URMs within North Carolina AGEF universities to AGEF universities outside of North Carolina and outside of NC OPT-ED. Neither can we determine if these rates differ from the period before AGEF or NC OPT-ED become institutionalized at either university to the time after it was institutionalized.

5.2.2 Evaluation Question 2: Which of the Alliance/joint program activities made the most significant difference in students' persistence into the PhD and through the doctoral degree?

When used in tandem, the qualitative and quantitative data indicate two areas of program support that are key to student matriculation: financial support and emotional support. There exist variations in the extent to which each of these areas contribute to student success relative to the academic level of a student (i.e. whether they were pursuing a bachelor's, master's, or PhD). While the current student and alumni surveys emphasized the role of financial assistance to varying degrees between Master's and Doctoral students, qualitative data from focus groups and interviews made it clear that emotional support was an essential element of their persistence. Additionally, it was worth noting that the change in the type of financial support between current students and alumni were apparent. For instance, research assistantships and private sources of funding were more available to alumni.

It was also clear that due to the extent to which NC OPT-ED successfully built a network and community, emotional support was available from a variety of sources. Program staff, especially program coordinators that had the most opportunity to engage directly with students, were an essential source of support. Peer-to-peer rela-

tionships that formed among AGEP students within their own institution and across institutions equally were also essential.

5.2.3 Evaluation Question 3: What is the value/effectiveness of each institutional program in regards to the students' completion of the doctoral degree and interest in an academic career?

The only areas in which these two universities differ in their implementation of the AGEP program are with respect to mentoring relationships in which graduate students mentor undergraduates as a soft requirement of receiving some sort of AGEP funding and with respect to funding, in which UNC students would receive full RA-ships for one year through AGEP.

As noted in the qualitative interviews, NCSU students not only enjoyed their mentoring relationships and felt that it was a learning experience, but they also found the relationship with undergraduates embarking on their graduate journeys to be inspiring. It seems that this experience was impactful for NCSU students and the fact that UNC students do not have a similar opportunity could have implications for their learning as AGEP students.

Another potential implication of this difference in programming is that NCSU graduate students, as a result of not being funded, participated in AGEP through other activities. Focus groups conducted with these students indicated that they were more aware of AGEP workshops and activities. It was clear from interviews with UNC students that they were aware that AGEP provided funding but were not very aware of other AGEP activities in which they could engage.

APPENDIX A
EVALUATION DESIGN SUMMARY

Evaluation question	Type of evidence	Indicators	Data sources	Data collection methods
What is the value added of NC OPT-ED AGEF model compared to traditional AGEF programs?	Track programmatic changes in both AGEF and non-AGEF affiliated institutions/programs by looking at any existing data related to program theory and outcomes in terms of documentations:	Indicators of increases in program outcomes:		Interviews:
	1. In 2 NC AGEF institutions;	1. Changes in N of graduate students enrolled (AGEF v. OPT ED).		a) Program staff (directors and managers) at AGEF institutions esp. early stage administrators (pre-post Alliance);
	2. in the affiliated partner programs/institutions; and	2. Changes in N of participants in workshops.		b) program staff in partnered programs and affiliated institutions;
	3. NSF documents and archive.	3. Changes in N of PhD graduates.	Internal documents that represent changes in program processes (i.e. website, other?)	c) NSF staff (personnel/officer).
		4. Changes in number of graduates working as STEM faculty.		
		5. Compare the URM enrollment and graduation pre-post Alliance.		
		6. Responses to interviews.		
				Review documents Examine quantitative data of the non-AGEF organizations (pre-post Alliance)

(Table continues...)

Table A.1: Evaluation plan (continued)

Evaluation question	Type of evidence	Indicators	Data sources	Data collection methods
What is the value added of NC OPT-ED AGEF model compared to traditional AGEF programs?(Continued)	Partner institutions (affiliate organizations) in the Alliance changes, such as:			
	a) Extent of partnerships in terms of collaborative activities.			Interviews: a) Program staff (directors and managers) AGEF institutions esp. early stage administrators (pre-post Alliance). b) Program staff in partnered programs and affiliated institutions. c) NSF staff (personnel/officer). Review documents Examine quant data of non-AGEF organizations (pre-post Alliance particip.)
	b) Increasing in their presence and engagement in the community.	Indicators for changes in program implementation and program theory:		
	c) Change in the nature of their programs in terms of activities/events they run, interaction with students.	a) Increases in resources (staff, faculty, funds, etc.). b) Changes in use and administration of materials and support.	Internal documents that represent changes in program processes (i.e. website, other?)	
	d) Increased opportunity to leverage additional resources by affiliated partners.	c) Responses to interviews.		
	e) Increased feeling of community/networking across alliance among students and program staff.			

(Table continues...)

Table A.1: Evaluation plan (continued)

Evaluation question	Type of evidence	Indicators	Data sources	Data collection methods
AGEP programming within the three AGEp universities				
Which of the Alliance/joint program activities made the most significant difference in students' persistence into the PhD and through the doctoral degree?	What is the impact of AGEp on: 1. Fully enrolled/participated students 2. Partially participated in AGEp activities and events such as Alliance day	Indicators of impact include: <i>a)</i> N of applications <i>b)</i> N of admissions <i>c)</i> N of newly enrollments <i>d)</i> N of graduates <i>e)</i> N of dropouts <i>f)</i> amount of time enrolled in program. <i>g)</i> duration before dropping out	1. NORC DATA-11 22 2011 2. 2010 UNC-Chapel Hill-JRE-DataRequestTemplate-NSFAGEP 3. 1996-2009 AAASRpt Overall Alliance Excel data file	1. Extract data from available data set and databases 2. Interview all alum that currently hold faculty positions 3. Conduct a focus group of students that fully/partially participated in activities

(Table continues...)

Table A.1: Evaluation plan (continued)

Evaluation question	Type of evidence	Indicators	Data sources	Data collection methods
Which of the Alliance/joint program activities made the most significant difference in students' persistence into the PhD and through the doctoral degree? (Continued.)	Level of students' participation/involvement	N of functions attended out of those available to them	<ol style="list-style-type: none"> 1. NORC DATA-11 22 2011 2. 2010 UNC-Chapel Hill-JRE-DataRequestTemplate-NSFAGEP 3. 1996-2009 AAASRpt Overall Alliance Excel data file 	<ol style="list-style-type: none"> 1. Extract data from available data set and databases 2. Interview all alum that currently hold faculty positions 3. Conduct a focus group of students that fully/partially participated in activities
Institutional Program (for internal purposes)				
(Table continues...)				

Table A.1: Evaluation plan (continued)

Evaluation question	Type of evidence	Indicators	Data sources	Data collection methods
What is the value/effectiveness of each institutional program in regards to the student's completion of the doctoral degree and interest in an academic career?	Post-graduation engagement with future cohort or in local community to push the agenda of STEM	<p>Indicators of engagement include:</p> <ul style="list-style-type: none"> a) N of enrolled students in STEM fields b) N of graduates in faculty positions c) N of graduates in other STEM industries 	<ol style="list-style-type: none"> 1. Alliance Day Evaluation 2005-2011 2. Tracking data: Do these graduates of AGEF stay within the region after finishing their PhD or this might highlight the importance of AGEF three participating institutions in NC role model for coming generations 	Interviews or focus groups with AGEF alumni

APPENDIX B

COMPUTATION OF EFFECT SIZE

B.1 Search methods for identification of studies

In order to ensure an exhaustive search for relevant studies, a three-step process was used. First, relevant studies were identified through computerized literature searches of ProQuest, ERIC, and EbscoHost using key words, and key words connected with boolean statements. Statements included “OR,” “AND,” and “NOT” (Card, 2012). For each theory of change, the databases were searched using key words in different combinations. For example, for literature relating to mentoring and doctoral outcomes, the words and combination of words included in the search included: **include words here**

Second, in a effort to identify both published and unpublished studies and reduce publication bias, the following search strategy was used:

1. The electronic databases Dissertation & Thesis (ProQuest) and WorldCat Dissertation and Thesis were searched using the same keywords and date range.
2. NSF’s AGEP program officer was contacted with a request for copies of studies or evaluation reports related to the program. The NSF did not share reports citing concerns about “confidential/proprietary business information.” The program officer suggested that individual PIs be contacted or to submit a Freedom of Information Act (FOIA) for studies not available on the Internet.
3. Forty-three AGEP PIs were identified through NSF’s awards database. They were contacted via email with a request for reports, evaluation studies, or papers

on AGEF. Two grantees responded and submitted copies of documents, one responded saying that they could not release documents without NSF consent, 29 responded that they did not have such documents, and 11 did not respond. A FOIA was also submitted to the NSF but the request was denied. In denying the request the FOIA officer cited that the program officer “does not have the authority to release any records.” An appeal was not pursued.

Finally, backward searches (i.e., searching for works cited in identified studies) and forward searches (i.e., attempt to find studies that cite a selected study) or conducted to locate additional relevant studies.

B.2 Data collection and coding

B.3 Computation of effect sizes

The effect size of correlational studies—studies that report on the relationship between two variables—will be calculated using the Pearson correlation (r) defined by

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{(N - 1)s_x s_y} = \frac{\sum Z_x Z_y}{N}, \quad (\text{B.1})$$

where:

x_i and y_i are scores of individual i on the two variables.

\bar{x} and \bar{y} are the sample means of the two variables.

N is the sample size.

s_x and s_y are the population estimated standard deviation of the two variables.

Z_x and Z_y are standardized scores, computed as $Z_X = \frac{(x_i - \bar{x})}{s_x}$.

The effect size of studies reporting group differences—or associations between a dichotomous group variable and a continuous variable—will be calculated using the Hedges’s g , Cohen’s d , or Glass’s g_{Glass} . These indices are defined, respectively, by

$$g = \frac{M_1 - M_2}{s_{pooled}}, \quad (\text{B.2})$$

$$d = \frac{M_1 - M_2}{sd_{pooled}}, \text{ and} \quad (\text{B.3})$$

$$g_{Glass} = \frac{M_1 - M_2}{s_1}, \quad (\text{B.4})$$

where:

M_1 and M_2 are the means of groups 1 and 2,

s_{pooled} is the pooled estimate of the population standard deviation,

sd_{pooled} is the pooled sample standard deviation, and

s_1 is the estimate of the population standard deviation from group 1 (control group).

The effect size of studies reporting associations between two dichotomous variables will be calculated using the odds ratio, OR . The odds ratio is defined as the probability of an event occurring divided by the probability of that event not occurring (Field, 2009, pg. 270) and is calculated using

$$OR = \frac{n_{00}n_{11}}{n_{01}n_{10}}, \quad (\text{B.5})$$

where:

n_{00} is the number of participants who scored negative on X and Y ,

n_{01} is the number of participants who scored negative on X and positive on Y ,

n_{10} is the number of participants who scored positive on X and negative on Y ,
and

n_{11} is the number of participants who scored positive on X and Y .

B.4 Selection of common metric

It is common to find that primary studies report results using summaries of different inferential tests, for instance t tests or F ratios from group comparison, χ^2 from cross-tabulations, or ANOVAs with more than two groups (Card, 2012). In order to carry out a meta-analytic review of those studies, “it is necessary to convert all of these various summary statistics into a simple common metric or effect size in order to aggregate and synthesize them” (Wolf, 1986, pg. 34). In this case, the preferred metric used for aggregating and synthesizing data is r (Card, 2012; Rosenthal, 1994; Wolf, 1986). Table B.1 shows the statistical for converting the most common tests reported in studies to r .

Another common scenario encounter in meta-analytic reviews is where authors report multiple effect sizes from different measures. In this case the average effect size was computed using

$$\overline{ES} = \frac{\sum w_i ES_i}{\sum w_i}, \quad (\text{B.6})$$

where:

w_i is the weight of study i and

ES_i is the effect size estimate for study i (Card, 2012, pg. 181).

Table B.1. Formulas for converting various test statistics to r . Adapted from Wolf (1986).

Statistic to be converted	Formula for tranformation to r
t	$r = \sqrt{\frac{t^2}{t^2 + df}}$
F	$r = \sqrt{\frac{F}{F + df_{\text{error}}}}^a$
χ^2	$r = \sqrt{\frac{\chi^2}{n}}^b$
d	$r = \sqrt{\frac{d}{d^2 + 4}}$

^a Use only for comparing two group means (i.e., numerator $df = 1$)

^b n = sample size. Use only for 2×2 frequency tables ($df = 1$)

APPENDIX C
ALUMNI AND ALUMNAE SURVEY

AGEP ALUMNI & ALUMNAE SURVEY

This survey is part of an evaluation study investigating the impact of the AGEP program on the doctoral experience of students in science, technology, engineering, and mathematics (STEM).

This survey will take approximately 15 minutes to complete. You may skip any questions you do not wish to answer for any reason.

Your participation in this research will be completely confidential and data will be averaged and reported in aggregate. Possible outlets of dissemination may be journal articles, presentations in professional meetings, and reports.

This is just an online survey. There are no risks to individuals participating in this survey beyond those that exist in daily life.

Although your participation in this research may not benefit you personally, it will help us understand what factors influence student recruitment and retention in STEM and their transition into the job market.

If you have questions about this project, you may contact Valerie Ashby, Principal Investigator and NC OPT-ED Program Director, University of North Carolina at Chapel Hill, at 919-962-3663 or via email at ashby@email.unc.edu

Thank you for your participation.

By clicking "Next" below, you agree to participate in this survey.

There are 48 questions in this survey

GENERAL INFORMATION

1 [highestdegree]What is the highest degree you have achieved? *

Please choose **only one** of the following:

- ☐ Bachelor's
☐ Master's
☐ Ph.D.

2 [institution]

What institution conferred your {highestdegree.shown} degree?

Please choose **only one** of the following:

- ☐ Appalachian State University
☐ East Carolina University
☐ Elizabeth City State University
☐ Fayetteville State University
☐ North Carolina Agricultural and Technical State University
☐ North Carolina Central University
☐ North Carolina State University
☐ University of North Carolina at Asheville
☐ University of North Carolina at Chapel Hill
☐ University of North Carolina at Charlotte
☐ University of North Carolina at Greensboro
☐ University of North Carolina at Pembroke
☐ University of North Carolina at Wilmington (UNCW)
☐ University of North Carolina School of the Arts
☐ Western Carolina University
☐ Winston-Salem State University
☐ Other

3 [fieldofstudy]What is your field of specialization?

Please choose **only one** of the following:

- ☐ Astronomy
☐ Chemistry
☐ Physics
☐ Mathematics and/or Statistics
☐ Computer Sciences
☐ Earth Sciences
☐ Oceanography
☐ Aeronautical Engineering
☐ Astronautical Engineering
☐ Chemical Engineering
☐ Civil Engineering
☐ Electrical Engineering
☐ Mechanical Engineering
☐ Metallurgy & Materials Engineering
☐ Biological Sciences
☐ Environmental Biology
☐ Agricultural Sciences
☐ Medical Sciences
☐ Psychology-Biological Aspects
☐ Psychology-Social Aspects
☐ Anthropology

- ☐ Economics
☐ History
☐ Linguistics
☐ Political Science
☐ Sociology
☐ Biomedical Engineering
☐ Bioengineering
☐ Biomedical: Other
☐ Public Health
☐ Other:

4 [yearenrolled]When did you first enroll in your {highestdegree.shown} program? (Select approximate date)

Please enter a date:

5 [complete]**When did you complete your {highestdegree.shown} program? (Select approximate date)**

Please enter a date:

6 [factors]**Which of the following factors contributed to your matriculation through your {highestdegree.shown} program?**Please choose **all** that apply:

- ☐ Financial package offered by institution or program
☐ Reputation of the program
☐ Program faculty
☐ Reputation of the institution
☐ Program requirements
☐ Research opportunities consistent with my interests
☐ Faculty recommendations
☐ Motivation and determination
☐ Location
☐ Encouragement by family
☐ AGEP Program
☐ Other program for underrepresented minorities in STEM:

7 [stepout]**Did you ever consider leaving or withdrawing from your {highestdegree.shown} program?**Please choose **only one** of the following:

- ☐ Yes
☐ No

8 [whyconsider]**Why did you consider leaving or withdrawing from your {highestdegree.shown} program?**

Only answer this question if the following conditions are met:
° **stepout** == "Y"

Please choose **all** that apply:

- ☐ Difficulty securing financial support
☐ Pre-graduate job offer
☐ Academic challenges (e.g. adjusting and/or meeting program requirements)
☐ Cultural change (e.g. language, environment)
☐ Personal/Familial obligation
☐ Medical Leave
☐ Personal (Other)
☐ Spousal/Domestic partner obligation
☐ Pursue new interests
☐ Problems with faculty members
☐ Problems with advisor/mentor
☐ Feeling "burnt out" or overwhelmed
☐ Other:

9 [helpfromagep]**Did you communicate or discuss your problem with any AGEP staff or faculty member?**

Only answer this question if the following conditions are met:

* `stepout == "Y"`Please choose **only one** of the following:

- ☐ Yes
- ☐ No

10 [agep helpful] Were they helpful in resolving your problem?

Only answer this question if the following conditions are met:

* `helpfromagep == "Y"`Please choose **only one** of the following:

- ☐ Yes, to a great extent
- ☐ Yes, to some extent
- ☐ Yes, to a small extent
- ☐ Not at all

11 [transition] Which of the statement below describes your situation after graduation from your {highestdegree.shown} program?Please choose **only one** of the following:

- ☐ I am currently enrolled full-time in another program of study
- ☐ Employed full-time (including postdoc) or self-employed
- ☐ Enrolled in a program of graduate study and working part-time
- ☐ Unemployed, currently seeking employment
- ☐ Unemployed, not seeking employment

12 [studynow] What program of study are you currently enrolled in?

Only answer this question if the following conditions are met:

* `transition == "tran1"` or `transition == "tran3"`Please choose **only one** of the following:

- ☐ Bachelor's
- ☐ Master's
- ☐ Ph.D.
- ☐ Other (please specify)

13 [studyrelated]**Is your current {studynow.shown} related to your previous degree?**

Only answer this question if the following conditions are met:

* `transition == "tran1"` or `transition == "tran3"`Please choose **only one** of the following:

- ☐ Yes
- ☐ No

14 [whynotstudy] Please indicate your plans for each of the following degrees:

Only answer this question if the following conditions are met:

* `((highestdegree != "3") and (transition == "tran2" or transition == "tran4" or transition == "tran5"))`

Please choose the appropriate response for each item:

	Do not plan to pursue	Degree received	Currently enrolled or working toward	Degree you hope to attain
Second bachelor's degree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Master's degree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Doctoral degree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Professional degree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other degree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

UNDERGRAD AGEP SCHOLARS

15 [bsc_agep_activities]

During the time as an undergrad AGEP scholar, did you participate in any of the following activities?

Only answer this question if the following conditions are met:

* highestdegree == "1"

Please choose the appropriate response for each item:

	Yes	Uncertain	No
Participated in AGEP recruitment events	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Met with an AGEP faculty mentor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Served as an AGEP student scholar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attended career development workshops focusing on applying to graduate school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attended career development workshops focusing on developing teaching skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attended a career development workshop focusing on developing research skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Met with other AGEP students and disciplinary colleagues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conducted joint research activities with students/faculty from other schools	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attended AGEP sponsored conferences or professional meetings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Presented my research at AGEP sponsored conferences or professional meetings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Was invited to speak to other students about my experience in a STEM and as an AGEP scholar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attended graduate school fairs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16 [bsc_agep_impact]

Overall, to what extent did your undergraduate AGEP experience contribute to the following?

Only answer this question if the following conditions are met:

* highestdegree == "1"

Please choose the appropriate response for each item:

	Very little	Somewhat	Sufficiently	Cosiderably
Applying for graduate or professional school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improving your skills for conducting academic and research work in graduate or professional school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For sparking your interest in becoming a STEM faculty in the future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For selecting your current career	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

FINANCIAL SUPPORT

17 [financialsupport] Did you receive any kind of financial support (e.g., grants, scholarships, or stipends) other than personal savings or student loans to pay for your {highestdegree.shown} degree?

Please choose **only one** of the following:

- ☐ Yes
☐ No

18 [yearsofsupport] How many years of financial support were you guaranteed at the time of admission into your {highestdegree.shown}?

Only answer this question if the following conditions are met:

* financialsupport == "Y"

Please write your answer here:

19 [typeofsupport] What were the **THREE** primary types of non-loan financial support that you received during your {highestdegree.shown} program?

Please select at most 3 answers

Please choose **all** that apply:

- ☐ University or department fellowship or scholarship
☐ AGEP fellowship or scholarship
☐ Private or external, nationally competitive (non-university) fellowship or scholarship
☐ Private or external, locally competitive (non-university) fellowship or scholarship
☐ Teaching Assistantship (TA) stipend
☐ Research Assistantship (RA) stipend
☐ Work study
☐ Other:

20 [agesupport] Specifically, how many years of financial support did you receive from AGEP?

Only answer this question if the following conditions are met:

* typeofsupport_7 == "Y"

Please write your answer here:

21 [borrowed] How much would you estimate that you borrowed to complete your {highestdegree.shown} degree ?

Please choose **only one** of the following:

- ☐ I did not take student loans
☐ \$5,000 or less
☐ \$5,001 - \$15,000
☐ \$15,001 - \$25,000
☐ \$25,001 - \$35,000
☐ \$35,001 or more

Life after Completion of {highestdegree.shown} Program**22 [employmentarea]**

To what extent is your current employment related to your {highestdegree.shown} in {fieldofstudy.shown}?

Only answer this question if the following conditions are met:

* `transition == "tran2"` or `transition == "tran3"`

Please choose **only one** of the following:

- ☐ It is directly related to my {highestdegree.shown} in {fieldofstudy.shown}
- ☐ It is somewhat related to my {highestdegree.shown} in {fieldofstudy.shown}
- ☐ It is not related to my {highestdegree.shown} in {fieldofstudy.shown}

23 [currentposition]

Please check the box next to the statement that most accurately describes your situation

Only answer this question if the following conditions are met:

* `employmentarea == 3`

Please choose **only one** of the following:

- ☐ I found a more desirable position in another field
- ☐ I was unable to find a position related to {fieldofstudy.shown}
- ☐ I have not seriously looked for a position related to {fieldofstudy.shown}
- ☐ I am no longer interested in pursuing a career in {fieldofstudy.shown}
- ☐ Other

24 [workenvironment]

Which category best describes your current employment setting?

Only answer this question if the following conditions are met:

* `transition == "tran2"` or `transition == "tran3"`

Please choose **only one** of the following:

- ☐ Non-academic research faculty
- ☐ Academic faculty
- ☐ University/College administration
- ☐ Federal government agency
- ☐ State government agency
- ☐ Local government agency
- ☐ Industry/Corporate
- ☐ Non-Profit
- ☐ Self-employed
- ☐ Teaching K-12
- ☐ Teaching Community College
- ☐ Other

AGEP ACADEMIC DEVELOPMENT SUPPORT

25 [quality]

As an AGEP alumnus/alumna, to what extent, in your opinion, did the AGEP program offer or connect you to the following opportunities:

Please choose the appropriate response for each item:

	None	Somewhat	Unsure	Sufficiently	Considerably
Financial resources to support my studies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparation or information on how to apply to graduate school (GRE training, application procedures, etc)(te school)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparation or information on thesis or dissertation writing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparation or information on how to publish my research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Financial support to attending national conferences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Financial support to attending international conferences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparation or information for developing grant writing skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
opportunities to work in interdisciplinary teams or participate in interdepartmental reading-groups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information and advise about opportunities for funding my research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

ADVISING

Please reflect on the academic advising you received received when responding to the following questions:

26 [advisordefined]An advisor is a faculty member who has committed to supervising a student's master's research or Ph.D. dissertation

27 [MSc_advisor]Did you have an academic advisor?

Only answer this question if the following conditions are met:
* `highestdegree == 2` or `highestdegree == 3`

Please choose **only one** of the following:

- ☐ Yes
☐ No
☐ I don't know

28 [acadvisoravailable]Did you have an academic advisor during the following stages of your doctoral program? (check Yes or No for each of the statments below):

Only answer this question if the following conditions are met:
* `((highestdegree.NAOK == "3") and (MSc_advisor.NAOK == "A1"))`

Please choose the appropriate response for each item:

	Yes	No
Coursework	<input type="radio"/>	<input type="radio"/>
Preliminary exams (if applicable)	<input type="radio"/>	<input type="radio"/>
Qualifying exams (if applicable)	<input type="radio"/>	<input type="radio"/>
Dissertation writing stage	<input type="radio"/>	<input type="radio"/>
Dissertation defense	<input type="radio"/>	<input type="radio"/>

29 [meetwithadvisor]How frequently did you meet with your advisor(s) to formally discuss your academic progress?

Only answer this question if the following conditions are met:
* `((MSc_advisor.NAOK == "A1"))`

Please choose **only one** of the following:

- ☐ More than once a month
☐ Monthly
☐ Once a semester/quarter
☐ Once a year
☐ Never

30 [advisor]For each statement, please rate the extent of your agreement or disagreement

Only answer this question if the following conditions are met:
* `((meetwithadvisor.NAOK == "1" or meetwithadvisor.NAOK == "2" or meetwithadvisor.NAOK == "3" or meetwithadvisor.NAOK == "4"))`

Please choose the appropriate response for each item:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My academic advisor had the skills and subject knowledge to adequately support my research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My academic advisor made a real effort to understand any difficulties I faced and helped me to carry on	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My academic advisor adequately discussed methodological issues with me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My academic advisor adequately discussed theoretical issues with me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My academic advisor provided helpful feedback on the quality of my academic writing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My academic advisor provided helpful feedback on my progress	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My academic advisor devoted enough time to discuss aspects of my project with me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My academic advisor helped me plan my PhD program to meet all requirements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My academic advisor encouraged me to follow my own research ideas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My academic advisor had clear guidelines for their supervision such as setting deadlines or convening regular meetings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt comfortable talking to my advisor about academic related questions and concerns	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The overall quality of supervision I received was good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My advisor was readily available to me during office hours, by appointment or by email throughout the semester	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My advisor helped me to identify my educational goals and interests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

31 [interaction]What statement best describes how interactions between you and your advisor were initiated?

Only answer this question if the following conditions are met:
* `((meetwithadvisor.NAOK == "1" or meetwithadvisor.NAOK == "2" or meetwithadvisor.NAOK == "3" or meetwithadvisor.NAOK == "4"))`

Please choose the appropriate response for each item:

	(1)Disagree Strongly	(2)Disagree Moderately	(3)Disagree Slightly	(4)Agree Slightly	(5)Agree Moderately	(6)Agree Strongly
I initiated contact with my advisor via email, phone or office visits	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My advisor initiated contact via email, letter, or phone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I made appointments to see my advisor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I kept appointments I had made with my advisor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was well prepared for my appointments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

32 [improveadvice]**Please explain here why you never met with your advisor**

Only answer this question if the following conditions are met:
" ((meetwithadvisor.NAOK == "5"))

Please write your answer here:

AGEP PROFESSIONAL DEVELOPMENT SUPPORT**33 [academicsupport]**

As an AGEP alumnus/alumna, in your opinion, to what extent, did the AGEP program offer or connect you to the following opportunities?

Please choose the appropriate response for each item:

	None	Somewhat	Unsure	Adequately	Considerably
Opportunities to develop teaching skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opportunities to develop academic writing skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opportunities to develop research skills (summer research, internships, fellowships)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information on résumé and interview preparation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information on internship and job opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information on job fair & networking events	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Informal social events or retreats with faculty or students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information on professional networks in my field	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

34 [attendprogram]

Did you attend the following events sponsored by AGEP?:

Please choose the appropriate response for each item:

	Yes	No	I don't know what this is
OPT-ED Day	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cross-talks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
On-campus Open House	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AGEP Welcome	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

35 [positiveaspect]

What was the single most important factor that contributed to your success in your {highestdegree.shown} program?

Please write your answer here:

36 [negativeaspect]

What was the most significant obstacle (if any) in completing your {highestdegree.shown} program?

Please write your answer here:

37 [howimprove]

Based on your experience, how can universities attract, retain, and graduate more students from minority background?

Please write your answer here:

PROFESSIONAL ACCOMPLISHMENTS**38 [postgradachiev]****Indicate any achievements/awards you have received after graduating from your {highestdegree.shown} program: (check all that apply)**Please choose **all** that apply:

- ☐ Presentations at national conferences
- ☐ Presentations at international conferences
- ☐ Presentations at state conferences
- ☐ Trainings/Consultation
- ☐ Teaching
- ☐ Leadership in professional field or organization
- ☐ Volunteer
- ☐ Publications
- ☐ Research Grants Secured
- ☐ Licenses /Patents Pending/Secured
- ☐ Other:

ALUMNI PARTICIPATION**39 [sincegraduation]****Since graduating from my {highestdegree.shown} program I have...**Please choose **all** that apply:

- ☐ Been contacted by a former faculty member
- ☐ Stayed in contact with a former faculty member
- ☐ Been contacted by AGEP program staff
- ☐ Participated in AGEP new student screening/interviews
- ☐ Served as an alumni mentor
- ☐ Helped inform program policies, procedures, and processes
- ☐ Served as a school recruiter or program ambassador
- ☐ Volunteered within graduate program
- ☐ Served as a guest lecturer
- ☐ Participated in career preparation activities (dissertation writing, interviewing, coaching, etc)
- ☐ Other:

DEMOGRAPHICS**40 [residencework]****Where do you currently work/reside?**Please choose **only one** of the following:

- ☐ Pacific Alaska Region (WA, OR, ID)
- ☐ Pacific Region (CA, NV, AZ)
- ☐ Rocky Mountain Region (MT, ND, SD, WY, UT, CO, NM)
- ☐ Southwest Region (OK, TX, AR, LA)
- ☐ Great Lakes Region (MN, WI, IL, IN, OH, MI)
- ☐ Southeast Region (KY, TN, MS, AL, GA, FL, SC, NC)
- ☐ Mid-Atlantic Region (PA, WV, VA, DL, NJ)
- ☐ Northeast Region (NY, VT, ME, NH, MA, RI)
- ☐ Other

41 [firstgeneration]Are you the first person in your family to attend college?Please choose **only one** of the following:

- ☐ Yes
- ☐ No

42 [partner]What is your current personal status?Please choose **only one** of the following:

- ☐ Married or living with partner
- ☐ Separated or divorced
- ☐ Widowed
- ☐ Single
- ☐ Other

43 [dependents]How many dependent children do you have?Please choose **only one** of the following:

- ☐ None
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ More than 3

44 [otherdependents]Do you have any other dependents (family members, other than your children, who you support financially)?Please choose **only one** of the following:

- ☐ Yes
- ☐ No

45 [howmany]How many dependents?

Only answer this question if the following conditions are met:
* otherdependents == "Y"

Please write your answer here:

46 [gender]Are you...Please choose **only one** of the following:

- ☐ Female
- ☐ Male

47 [hispanic]Are you of Hispanic, Latino, or Spanish origin?Please choose **only one** of the following:

- ☐ Yes
- ☐ No

48 [race]What is your race? Check one or more boxesPlease choose **all** that apply:

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

APPENDIX D

POSITIVE ASPECTS OF THE AGEP PROGRAM

Survey Question 35:What was the most positive aspect of the AGEP program?

- **Networking**

- Networking with students and faculty in other disciplines.
- The Cross-Talks were a great way to meet other graduate students.
- I developed a good network while I was with AGEP for the summer research program. I was with a great mentor and a paper from that work was published.
- Financial support, networking, words of encouragement.
- Networking with other graduate students.

- **Financial Support**

- The most positive aspect of the AGEP program was the financial support and networking opportunities.
- Non-financial and financial support, resources, help with outlining your career,the staff feels like a family.
- Statistical workshop and the one time \$4000 they gave me to help with living expenses in the first year of my PhD program.

- The program allowed me to focus on my studies and not have to take on the challenge of financially supporting myself as I had done during my undergraduate career.
- The Fellowship offered to attend UNC during the first year of graduate school. Also, the statistical workshop offered in the beginning of August.
- Funding for the second semester of my first year allowed me to focus on my project and get a head start on my research.
- First-year fellowship.

- **Leveraging resources for students' success**

- The opportunity to gain the required skills to be successful in a graduate program
- I was exposed to many resources for graduate students that I did not know were available to me.
- It's ability to place a student in a nurturing research environment that catered to his or her specific scientific interests.
- Definitely the emphasis on presentation.
- They help undergraduate students prepare for the demands that research and a PhD require.
- The most positive aspect of the AGEF program is its ability to place minority students into labs that they may not normally have an opportunity to be in. Not only does this get you acquainted with different types of research but also allows you to learn a department. This is invaluable for finding future mentors, research interests, and colleagues.
- It prepared me for the whole grad school experience. Before participating on the AGEF summer internship the idea of Grad school wasn't fully clear

in my head. Actually I thought it was pretty much impossible to get to have any graduate degree.

- The AGEP provided me with an opportunity to come to UNC two 1/2 months early to complete a summer research project with my current adviser. The contacts I made in the AGEP staff helped me a great deal with becoming accustomed to the area and finding housing.
- Getting into my PhD program

- **Staff who care about social and emotional well-being of students**

- Having people for support and guidance.
- Its constant guidance and support.
- I enjoy how it brings together a group of people for you to get to know and network within a variety of different fields. The staff are a great support to the program, but also the students. They have been amazing here! Often times I don't know what I would have done without them.
- The most positive aspect of the AGEP program by far is the moral/emotional support to continue the PhD along with the financial support to do so.
- The program advisor, Kathy Wood, is always easy to get in touch with about questions. She is knowledgeable about the campus and programs.
- The staff at UNC was extremely helpful in serving as a guide for me when I first arrived to UNC. Kathy was the person on campus who I felt most comfortable talking to and asking questions.
- Kathy!
- The support I received even though I was off campus at UNC's Marine Lab (IMS) and the support after I returned to work.

- The staff served as a great resource for me when I moved to NC. It was good knowing that a program like AGEF is available to help underrepresented groups.

APPENDIX E

LEAST POSITIVE ASPECTS OF THE PROGRAM

Survey Question 36: What was the least positive aspect of the AGEF program?

- That I'm so far away from it now!
- Not the program, but the constant scare that the program may not be funded each year. it is a valuable program
- I would have liked the program to supervise the relationship between my adviser and I, during the summer more closely.
- None
- None
- Since I am in Veterinary Medical School and not Graduate School I do not get funding or have opportunities to travel to different conferences.
- I have none. This program made the difference in my life.
- Lack of communication sometimes and lack of social networking events.
- Unfortunately, the program lacks funding to support students anytime throughout their academic career.
- Note: I would not have been able to pursue my dreams without the assistance and support of the AGEF staff.

- None.
- None
- In not preparing or warning me about the nearly unbearable amount of isolation, rejection, frustration, racism, and hostility that I had the potential of facing once I got into my PhD program as its first African American PhD. candidate. After everything I have endured I definitely would not recommend that any other African Americans apply for a PhD in UNC's psychology department.
- Many of the events AGEP sponsors have been at another campus nearby, which since I lack transportation I cannot attend. It would be nice to have the event locations more evenly distributed.
- Connecting with peers in non-academic settings.
- I can not think of any aspect of the program that isn't appealing or that I don't find worthwhile.
- None.
- My graduate AGEP experience was nothing like my experience with AGEP during my undergraduate career. I would have liked to have more opportunities of getting to know the other students and socials. Perhaps even more networking within the university itself.
- I can't think of anything really so I'll say that the funding only lasts for one year.
- many departments do not know about it.
- The program seems to offer more opportunities for the "hard sciences." Aside from the Cross-Talks, I was not aware that the AGEP program offered other services.

- Very Positive, but would like to see most info for Social, Behavioral and Economic Sciences (SBE) students
- Not enough networking events.
- I would like more opportunities to get to know other AGEF fellows
- Not being able to participate in the programs offered on campus sponsored by AGEF.
- Not enough involvement from fellow students. Very few activities/workshops throughout the year for the fellows

APPENDIX F

INTERVIEW PROTOCOL FOR AGEP AFFILIATED PARTNER STAFF

Thanks so much for agreeing to speak with me. As mentioned when arranging this interview, I am an independent evaluator working with the NC OPT-ED Alliance a collaboration between 2 academic institutions: UNC-Chapel Hill, North Carolina A&T, and North Carolina State. We are working with these schools to better understand a) the value added of NC OPT-ED AGEP model compared to traditional AGEP programs, b) which of the Alliance joint programs made the most significant difference in students' persistence into the PhD and through the doctoral degree. A third question to be drawn from existing data will ascertain value/effectiveness of each program in regards to student's completion of the doctoral degree and interest in an academic career.

The information you share will help support the NC-OPT ED's efforts to effectively recruit, mentor, graduate, and aid underrepresented students interested in pursuing higher education and academic careers in STEM fields.

I anticipate the interview lasting 20-30 minutes. Everything you say will be kept confidential and findings will reported in the aggregate without identifying information. However, for our own purposes, we would like to record our conversation so we can be sure to capture all the information and your insights. Is that OK with you?

{Interviewer: Complete mic check}

Do you have any questions before we begin?

1. AGEP Involvement and Duties. What role did you play in AGEP operations and development? {Probe for actual position, involvement, responsibilities and duties}
2. Value and Impact. What was the value and impact of NC-OPT Ed and AGEP on students, at university, and for the field/discipline of STEM? {Probe for documentation that assesses value and impact}
 - (a) How effective was NC-OPT Ed in accomplishing its goals?
3. Partnership. How would you describe the extent of collaboration between AGEP and affiliates?
 - (a) Does being an affiliate in the alliance have an effect on your specific program?
 - (b) Did AGEP activities promote a feeling of community, with whom?
 - (c) Was there an increase in resources available to your students as a result of being an affiliate?
 - (d) Does being an affiliate increase your presence in the community?
4. Recommendations for AGEP. Based on your experience as an affiliated AGEP staff, what recommendations would you offer to improve the AGEP program? Additional comments?

{Thank you.}

APPENDIX G

INTERVIEW PROTOCOL FOR AGEPE ALUMNI FACULTY

Thanks so much for agreeing to speak with me. As mentioned when arranging this interview, I am an independent evaluator working with the NC OPT-ED Alliance a collaboration between 3 academic institutions: UNC-Chapel Hill, North Carolina A&T, and North Carolina State.

We are working with these schools to better understand the key facilitators that influence a successful and effective AGEPE training program. We are working with the NC OPT-ED Alliance to examine different aspects of their AGEPE program which seeks to support underrepresented students interested in pursuing education and careers in STEM fields.

The information you share will help support the NC-OPT ED's efforts to effectively recruit, mentor, graduate, and aid underrepresented students interested in pursuing higher education and academic careers in STEM fields.

I anticipate the interview lasting 20-30 minutes. Everything you say will be kept confidential and findings will reported in the aggregate without identifying information. However, for our own purposes, we would like to record our conversation so we can be sure to capture all the information and your insights. Is that OK with you?
{Interviewer: mic check}

Do you have any questions before we begin?

1. General Information Employment Information. Tell me about your current position and responsibilities?

- (a) How did you obtain your position?
 - (b) Did you use any personal/professional connections from your graduate program?
2. Most Significant AGEF Experiences. Thinking about your time at (UNC/NC-State), what were the most significant experiences you had with the AGEF Program? {Use Section E as a guide}
- (a) What were the least significant experiences? (AGEF welcome, cross talks, Alliance Day, professional development or mentoring workshops; personal coaching)
 - (b) Were these activities relevant to your personal and professional goals?
 - (c) Did AGEF activities promote a feeling of community, with whom?
3. Support, including AGEF-Specific. What type of support did you receive from the AGEF program? {Probe: Financial, academic support, professional or career advice, moral support}.
- (a) How did AGEF support impact your educational or professional experiences?
 - (b) Thinking about your matriculation and career path, can you name some essential academic supports or experiences that aided you in successfully completing a degree in a STEM program?
 - (c) Did you ever consider leaving your program? If so, please tell me about the challenges you were facing and what encouraged you to stay?
 - (d) In what way did AGEF assist you in addressing your academic and administrative challenges?

- (e) How helpful was AGEP staff in helping you obtain your degree, obtain a job, access to research opportunities, or access other resources to help aid your career?
 - (f) Would you recommend your program to others? Why or why not?
 - (g) Compared to your other colleagues do you think your program offered you the appropriate amount of support/experiences to be successful in your current career?
4. Recommendations. Based on your experience as a former student in AGEP, what recommendations would you offer to improve the AGEP program?
- (a) To transition into academia? (i.e mentor, extensive research, publications, funding, professional coaching)
 - (b) Do you participate in alumni mentoring or other activities sponsored by (UNC or NC-State)? Why or why not?
5. Additional comments. Are there any other comments that you want to share that will help AGEP during program planning?

{Interviewer: Thank you}

APPENDIX H

INTERVIEW PROTOCOL FOR AGEF FACULTY

Thanks so much for agreeing to speak with me. As mentioned when arranging this interview, I am an independent evaluator working with the NC OPT-ED Alliance a collaboration between 3 academic institutions: UNC-Chapel Hill, North Carolina A&T, and North Carolina State. We are working with these schools to better understand the key facilitators that influence a successful and effective AGEF training program. We are working with the NC OPT-ED Alliance to examine different aspects of their AGEF program which seeks to support underrepresented students interested in pursuing education and careers in STEM fields.

The information you share will help support the NC-OPT ED's efforts to effectively recruit, mentor, graduate, and aid underrepresented students interested in pursuing higher education and academic careers in STEM fields.

I anticipate the interview lasting 20-30 minutes. Everything you say will be kept confidential and findings will be reported in the aggregate without identifying information. However, for our own purposes, we would like to record our conversation so we can be sure to capture all the information and your insights. Is that OK with you? {Interviewer: mic check}

Do you have any questions before we begin?

1. General Information Employment Information. Tell me about your current position and your role with AGEF.

(a) How many AGEF students have you mentored?

- (b) How long have you been an AGEPE mentor?
- 2. Understanding of AGEPE. What is your understanding of AGEPE's goals?
 - (a) Do you participate in any other AGEPE activities other than mentoring? If so, which ones do you participate in and what can you tell us about your experiences with these activities?
- 3. Mentoring experiences. Why did you decide to mentor AGEPE students?
 - (a) Is there anything that sets your AGEPE students apart from other students?
 - (b) What can you tell us about the impact of AGEPE on the students you currently mentor or have mentored?
- 4. Recommendations. Based on your experience as a faculty mentor in AGEPE, what recommendations would you offer to improve the AGEPE program?
- 5. Additional comments. Are there any other comments that you want to share that will help AGEPE during program planning?

{Interviewer: Thank you}

APPENDIX I

INTERVIEW PROTOCOL FOR AGEF STAFF

Thanks so much for agreeing to speak with me. As mentioned when arranging this interview, I am an independent evaluator working with the NC OPT-ED Alliance a collaboration between 2 academic institutions: UNC-Chapel Hill and North Carolina State. We are working with these schools to better understand i) the value added of NC OPT-ED AGEF model compared to traditional AGEF programs, ii) which of the Alliance joint programs made the most significant difference in students' persistence into the PhD & through the doctoral degree. A third question to be drawn from existing data will ascertain value/effectiveness of each program in regards to student's completion of the doctoral degree and interest in an academic career.

The information you share will help support the NC-OPT ED's efforts to effectively recruit, mentor, graduate, and aid underrepresented students interested in pursuing higher education and academic careers in STEM fields.

I anticipate the interview lasting 20-30 minutes. Everything you say will be kept confidential and findings will reported in the aggregate without identifying information. However, for our own purposes, we would like to record our conversation so we can be sure to capture all the information and your insights. Is that OK with you?
{Interviewer: Complete mic check}

Do you have any questions before we begin?

1. AGEP Involvement and Duties. What role did you play in AGEP operations and development? {Probe for actual position, involvement, responsibilities and duties}
2. AGEP Programmatic Developments and Changes.
 - (a) What are the signature programs of NC OPT AGEP program?
 - (b) Does the alliance have a theory of action/logic theory for the program? If so, is it a printed document or known to staff?
 - (c) How was action and logic theory of program articulated in print or by staff? {Probe for LMs, TOAs, and other graphic conceptual models}
 - (d) What were the most significant AGEP programmatic changes you noticed/experienced as AGEP staff?
 - (e) What challenges existed for AGEP program development, implementation, and evaluation?

Item Value and Impact. What was the value and impact of NC-OPT Ed Alliance and AGEP on students, at university, and for the field/discipline of STEM? {Probe for documentation that assesses value and impact}

- (a) How effective was NC-OPT Ed in accomplishing its goals?
3. Partnership. How would you describe the extent of collaboration between AGEP and its affiliates?
 - (a) Has working with affiliates had an effect on your specific program?
 - (b) Was there an increase in resources available to your students as a result of collaborating with affiliates?
 - (c) Has working with affiliates increased your presence in the community?

4. Recommendations for AGEF. Based on your experience as a staff at AGEF, what recommendations would you offer to improve the AGEF program?
5. Additional comments. Are there any other comments that you want to share that will help AGEF during program planning?

{Thank you.}

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