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I, Kelly J. Obarski, hereby submit this as part of the requirements for the degree of:

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Life After a National Science Foundation Fellowship: The Implications for a Graduate Student's Professional Endeavors

Approved by:

[Signatures]
LIFE AFTER NATIONAL SCIENCE FOUNDATION FELLOWSHIPS:
THE IMPLICATIONS FOR A GRADUATE
STUDENT’S PROFESSIONAL ENDEAVORS

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by

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Acknowledgments

_The people I love the best_

_jump into work head first_

_without dallying in the shallows_

_and swim off with sure strokes almost out of sight._

- Marge Piercy

I would like to express my gratitude to my parents, Patti, Gordon, and Nancy for their tireless love, support, and encouragement to me through this arduous process and, even more importantly, in life.

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Abstract

Each year, hundreds of graduate and undergraduate students, participate as Fellows in National Science Foundation GK-12 Grants throughout the U.S. These Fellowships create opportunities for university students to improve their communication skills, teaching proficiencies, and team-building skills, in addition to expanding their interest in educational endeavors in their respective communities while pursuing their college degrees. STEP (Science and Technology Enhancement Project) is one such project. University faculty, public school teachers, and community leaders collaborated together in order to bring scientists into middle and secondary classrooms to focus on increasing student interest and proficiency in science, technology, engineering, and mathematics (STEM) skills. Seventeen Fellows, in the previous four years, designed, developed, and implemented innovative, hands-on lessons in seven local schools. The evaluation team collected a tremendous amount of research evidence focused on the effect of the program on the Fellows while they were participants in the study, but there has been very little data collected about the Fellows after leaving the program. This research study, consisting of two-hour interviews, qualitatively explores how the skills learned while participating in the STEP program affected the Fellows’ career and educational choices once leaving the project. This data was analyzed along with historical attitude surveys and yearly tracking documents to determine the effect that participation in the program had on their choices post-STEP. An extensive literature review has been conducted focusing on other GK-12 programs throughout the country, K-16 collaboration, Preparing Future Faculty Programs, as well as on teaching and learning literature. These bodies of literature provide the theoretical basis in which the research is framed in order to assess
the impact on Fellow educational and professional choices since leaving the STEP program. This research project sheds new light on how participation in a GK-12 Fellowship impacts career and educational choices after the Fellow leaves the program.
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Chapter 1: Introduction

This introduction provides the background information necessary to create a context for the proposed study. First, a description of the National Science Foundation funding is provided giving the historical context for the basis of this research. Secondly, a description of the STEP Project is provided, giving the current context for the proposed research. Finally, a brief description of the proposal study is provided, highlighting the major research questions addressed.

National Science Foundation Funding

Each year hundreds graduate and undergraduate students, participate as Fellows in GK-12 National Science Foundation Grants (graduate Fellows teaching in kindergarten through twelfth grade) throughout the nation. These grants are designed with three primary goals in mind. The first goal is to support highly qualified STEM (science, technology, engineering, and mathematics) undergraduate and graduate students pursuing bachelor’s and graduate degrees in order to provide them with an opportunity to acquire additional skills that will broadly prepare them for professional and scientific careers (Luedeman, Leonard, Horton & Wagner, 2003). The second goal is to create research opportunities for Primary Investigators (PIs, the university faculty who write the grants), academic advisors, university students, and National Science Foundation (NSF) constituents in order to study a wide variety of diverse scientific and educational research questions associated with these types of programs (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5472). The third goal of GK-12 funding focuses on the potential to make permanent changes in institutions of higher education by creating opportunities for partnerships with GK-12 schools in a manner
mutually beneficial to faculty, teachers, and students alike. This increased interaction between higher education and local schools also provides professional development opportunities for teachers, enriches scientific learning for their students, and strengthens possible lifelong partnerships between universities and schools (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5472). These partnerships also provide occasions for researchers to develop the skills necessary to explain their research to non-scientists thereby more fully comprehending their content. Through these discussions, non-scientists can offer ideas that are not blocked by educational perspectives and spark new ideas for additional research. It is the intention of this government funding to document the project outcomes and activities so that this information can be used to improve scientific research and graduate educational programs.

Through participation in a NSF Fellowship, graduate and undergraduate students are expected to improve communication skills, teaching proficiencies, and team-building skills, in addition to expanding their interests in educational efforts in their respective communities (Boyer, 1990; Hall-Wallace & Regens, 2003; Luedeman, et al., 2003). It is the responsibility of the PIs and the community of educators to determine how these skills will be developed. Typically, university students participate in college course work, seminars, and K-12 school activities that enrich Fellow knowledge of educational theory and practice, and provide them with an opportunity to practice these skills in collaborative partnerships with teachers and students.

NSF grants are cornerstones in the promotion of innovative research studies in STEM disciplines in which a multitude of higher learning is integrated. The GK-12 grant
is considered a special Congressional Budget Line Item associated with NSF. It is a unique grant that was initiated by Rita Colwell’s efforts as director of NSF from 1998-2005. Colwell wanted to promote more collaborative efforts in K-16 STEM learning. The original GK-12 grant funding began in 1999, a mere six months after Colwell accepted the directorship and has been supported by NSF ever since (Borrego & Klein, 2004; Mervis, 1998). These highly competitive grants are now found in almost every state throughout the continental United States and Puerto Rico.

With an ever-growing number of GK-12 programs nationally, there have been many variations to the primary goals of the GK-12 funding. In the beginning, this created difficulties when researchers were trying to compare the results of the various programs (Mervis, 1999). In its sixth year of implementation, GK-12 partnerships, PIs, and their associates have begun publishing articles describing their results in order to benefit the larger community of grant recipients. It is clear that, although all programs have slightly different objectives, all strive toward similar goals and have demonstrated similarities in their effects on teachers, Fellows, and K-12 students. GK-12 funding has had significant impact on teachers’ scientific knowledge, student interest and engagement in STEM skills, and an overall positive impact on the Fellows, which will be further discussed in the review of literature. Additionally, it is critical to note that there has been very little effort made by the PIs in GK-12 grants to study the long-term implications of these programs on their student participants, which is the primary focus of the research study presented here.

It is also important to note that there have been many successful university-school partnerships throughout the United States that are not directly associated with GK-12
funding. Scientists have successfully formed partnerships with schools and have implemented innovative lessons that have increased student learning and teacher understanding of STEM content. These collaborations have also had a positive impact on the scientist’s knowledge of K-12 education. These results are discussed further in the chapter 2, the review of literature.

Project STEP

Project STEP is one of over 200 similar grants within the larger GK-12 community. STEP is an innovative initiative, created under GK-12 NSF guidelines, in order to promote specific goals to enhance undergraduate and graduate students’ communication, teaching, and team-building skills. STEP was created by seven Midwestern University (UC) faculty members in a collaborative effort between two colleges, the College of Engineering (COE) and the College of Education, Criminal Justice and Human Services (CECH). These seven faculty members partnered with four community members from the Midwestern city, faculty advisors, and teachers from seven city schools to create an Oversight Committee. The schools involved in this partnership included America High School, Glendora High School, the Heffler Center, Loyola Junior School, Sumpter Academy, Wessles University High School, and Wessles Design Technology High School.

In an effort to bridge the gap between the colleges and local school districts, the partnership conducted focus groups and inquiries with the expert teachers, principals, and university faculty in order to determine the specific needs of the community, which became the grant goals for the Track I Proposal. Track I proposals are defined a initial funding opportunities for universities; whereas Track II proposals are a continuation and
expansion of the original Track I grant endowment. Project STEP received its first award for the three-year period 2002-2005 and was able to create a “successful learning community by creating interdisciplinary teams in order to cross fertilize and exchange ideas and create a shared vision” (Froman, 1999).

The two main goals of STEP are described as follows: “The primary goal is to produce scientists, engineers, and secondary science and mathematics educators who are experienced in developing and implementing authentic educational practices into current secondary science and mathematics curricula. The secondary goal is to design, develop, and implement hands-on activities and technology-driven, inquiry-based projects, which relate to the students’ community issues, as vehicles to authentically teach STEM skills” (STEP Program Proposal, 2002, ¶ 1).

STEP also designed more specific Track I objectives that relate directly to the Fellows themselves. These objectives include to:

- Engage Fellows in meaningful, productive, and innovative educational instruction and activities, so they will become excited about and motivated to teach STEM (science, technology, engineering, and math) skills.
- Help Fellows realize and understand the overlap between the facets of education, research, and professional activities, and how this overlap can translate into a more successful career; and they can be more successful in their career when they overlap these activities.
- Have university faculty and staff, as well as secondary teachers, provide guidance, instruction, and mentoring to Fellows in the practice of instructional approaches and best teaching practices.
• Provide Fellows practical and direct classroom experience in teaching middle and high school students.

• Have Fellows design, develop, and implement secondary-level, authentic, inquiry-based learning activities and projects, based on their technical expertise and knowledge.

• Train Fellows in the development and implementation of computer modules using current electronic multimedia and Web-based tools (STEP Web site, 2002, Project Summary, ¶ 1).

Additionally, project STEP recognizes that effective science and mathematics education requires authentic and inquiry-based learning. K-12 students must be able to link the relevance of education with events and issues occurring within their communities. They must be able to experience participation as effective citizens in a technology-driven society. This secondary goal is achieved through the following objectives relating to the middle and high school students, as the project sought to:

• Increase student learning and interest in math and science.

• Directly involve secondary school teachers into the teaching and mentoring of the Fellows.

• Implement hands-on, inquiry-based activities into the secondary school science and mathematics curriculum to enhance and reinforce basic concepts already taught in the secondary curriculum.

• Motivate secondary school students through real-world experiments, observations, and measurements, to study problems that affect their daily lives.
• Use these activities at various grade levels from different classes and schools, via peer teaching, collaborations, and the Internet, as they focus on common themes and learning tasks.

• Include computers, up-to-date sampling probes, and laboratory equipment in classroom activities so students gain experience with current technology.

• Incorporate computer-based, self-paced learning modules that assist with individual student learning needs, and supply background information and data that help facilitate execution of the projects.

• Motivate and educate teachers to use multimedia/Web resources for curriculum design and delivery. (STEP Web site, 2002, Project Objectives, ¶ 1 & 2).

During the first three years of project STEP’s implementation, 17 Fellows (8 undergraduate and 9 graduate students), 32 teachers, 7 PIs, Fellow faculty advisors, a technology Web designer, 2 grant coordinators, an evaluation Fellow, and an Oversight Committee collaborated to create a unique learning experience for all its constituents. From 2002-2005, Fellows participated in a wide variety of professional development activities focused on improving their teaching practices in middle and high school classrooms as well as on improving their educational technology literacy. A series of courses were also developed in order to focus on educational theory and practice and its implementation into science and math classrooms (Kukreti, Islam, Miller, Davis, Prather, Fowler, Soled, 2003; Pickering, Ryan, Conroy, Gravel, & Portsmore, 2004; Luedeman, et al., 2003; Rushton, Cyr, Gravel, Prouty, 2002; Lyons, Banich, Brader, Ebert, 2002). Each quarter consisted of in-depth, seminar-style classes that enabled the Fellows to construct knowledge focusing on teaching and learning. In the Fall Quarter, a course called
Instructional Planning engaged the Fellows in activities intended to help them understand and apply effective teaching strategies in the design, development, and implementation of authentic, hands-on, inquiry-based lessons in middle and high school classrooms. This course also focused on classroom management and urban school culture, in addition to national and state standards, and national, state and school administrative policies. These concepts were further personified by the Fellows spending an average of ten hours a week in the classroom working with middle and high school math and science teachers and their students as well as spending an average of ten hours a week researching and developing lessons. An ongoing seminar, Field Practicum, continued throughout the winter and spring quarters. It included guest speakers focusing on specific topics such as lesson assessment, application of research, and current issues raised by the Fellows in order to better address their ongoing needs.

The Fellows also participated in a technology course designed to equip them with the skills necessary to develop a personal portfolio through use of DreamWeaver® software. The course also provided them with an opportunity to master contemporary software and incorporate it into their lesson plans. The Fellows’ portfolios consisted of several key features: yearly goal statements, lesson plans developed for schools in which they were placed, pictures of students participating in the lessons, journal entries from their experience at the schools and/or meetings that they attended, their current curriculum vitae, professional conferences attended, and highlights on their current research projects. Through participation in these advanced technology courses, the
Fellows were then asked to teach these skills to middle and high school teachers in a technology workshop.

Throughout the summer, Fellows also had the opportunity to participate in two summer academies. These teaching opportunities were designed to hone their teaching skills and provide the Fellows with valuable experience participating in minority outreach programs. The students who participated in the projects had the opportunity to explore fundamentals of engineering concepts in a fun, engaging learning environment (Kukretdi et al., 2003). The Fellows acted as Teaching Assistants (TAs) in the Emerging Ethnic Engineers (E³) Family Science Academy and the E³ Bridge Program. These programs are designed to sharpen math, science, and technology skills of underrepresented minorities. The Family Science Academy works with fourth through seventh grade students and their families to explore engaging physics and chemistry fundamentals, while the Bridge Program works with pre-freshman giving them an overview of four core courses; calculus, physics, chemistry, and English. Each of these summer programs provided the Fellows with additional practice in using effective teaching strategies designed to engage and promote STEM skills.

Throughout the year, Fellows and various other constituents participated in ongoing discussions in which a wide variety of topics were discussed. Fellows and teachers met on a regular basis, both inside and outside the classroom, to ascertain ways to meet the various objectives of the grant. This provided the Fellows and teachers with the opportunity to discuss lesson planning, state and national curriculum standards, classroom management, implementation of technology in the classroom, administrative duties of the teacher, political climate of the school, district, and nation, and exchange of
scientific information about Fellows’ research, as well as any other issues that became important to the teams. Fellows and PIs also met regularly to discuss lesson development and implementation, interactions with their teacher, students and the school, and addressed successes as well as issues that arose throughout the week. These meetings provided the teams with the opportunity to discuss solutions to concerns and to celebrate successful lesson implementation as well as personal and professional growth experienced by the Fellows. And finally, it was also important for each Fellow to maintain regular meetings with their academic advisors in order to communicate their STEP activities as well as their academic advancement. Each of these three types of meetings provided additional support for the Fellows by providing opportunities for mentoring and collaboration. These types of partnerships are among the many critical support mechanisms necessary to lower program attrition rates, encourage successful completion of degrees, and for effective implementation of teaching strategies in the classroom (Pinnell & Nichols, 2004; Thompson, Collins, Metzgar, Joeston, Shepard, 2002).

*Rationale for the Current Study*

GK-12 National Science Foundation grants have successfully been implemented for the last seven years in over 114 different institutions. There have been significant numbers of publications focusing on the effects a GK-12 program has on the teacher, their students, and the Fellows while participating in the project. Research has shown that through collaborations such as these, teacher and student content knowledge increased. Participation also increases interest in STEM and critical-thinking skills, and has positively influenced middle and high school students to pursue engineering degrees.
There has also been a significant amount of data collected about the development of professional skills by the Fellows. These include increased communication abilities, honing leadership skills, development of team-building skills, and organizational abilities (Henning, Haworth, Kisenwether, Tallon, Finckh, 2002; Lyon & Fisher, 2004). However, there has been no assessment of the long-term effects these skill developments have had on the Fellows as a result of their participation in this type of outreach program. This research study is offered to add meaningful data to this gap of knowledge.

This lack of assessment is also evident in Project STEP’s grant. The evaluation team has been very successful in assessing the Fellows’ progress toward completion of the STEP objectives while participating in the program, but has not focused on long-term consideration regarding the impact STEP has had on their professional and academic career choices once leaving the project (http://www.eng.uc.edu/STEP/evaluation/). It is the hope of this researcher to uncover how working in teams affected the sharpening of professional skills such as communication, team collaboration, leadership abilities, and organizational skills and the impact these skill sets have had on the Fellows in their professional careers after Project STEP. The researcher also feels that it is important to consider how teaching in a K-12 public school affects Fellow attitudes toward education and the choices they make concerning their involvement in these arenas after completing the program.

Various GK-12 programs throughout the country have collected data to support how participation in a NSF program can improve instructional skills and how learning education pedagogy enhances Fellow teaching abilities (Lyons & Fisher, 2004; Richardson, Watts, Lyons, & Ebert, 2004). But, it is also important to consider how the
Fellows utilize these skills after their commitment to the program has ended. It is the hope of NSF that the undergraduate and graduate students will become professional educators and work to enhance and improve K-16 education (Ortega, 2006). Many STEM university professors are resistant to implement educational pedagogy into their classrooms, but faculty who have had positive experiences utilizing effective teaching strategies will be more likely to execute positive changes (Gaff, J.G., Pruitt-Logan, Weibl, R.A., & Participants in the Preparing Future Faculty Program, 2000). As long as teaching as a profession is undervalued, educators will continue to use outdated teaching strategies and the longer it will take to improve learning for all students.

This research study adds new information about the career and educational choices the Fellows have made since leaving the Fellowship by focusing on these four main research questions; How did participation in Project STEP affect the academic and professional choices Fellows made since leaving STEP? How has the skill development in the areas of learning to teach, building and maintaining partnerships, and active involvement in K-12 learning communities affected the career choices of the Fellows? How are these skills being utilized in their current professions? How did this skill development affect their abilities to successfully gain employment?
Chapter 2: Literature Review

Introduction

The goals in GK-12 NSF funding are important to consider before examining how the National Science Foundation GK-12 Fellowship program affected Fellow academic and professional choices. As stated in the introduction, NSF expects the Fellows to gain “improved communication, and teaching and team-building skills in order to broadly prepare them for professional and academic careers, while providing institutions of higher education with an opportunity to make a permanent change in their graduate programs” (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5472).

In order to adequately assess NSF goals and to properly evaluate the impact Project STEP has had on these goals, a theoretical framework must be examined. Through a thorough literature review, it is apparent that there are several key factors affecting the Fellows participating in the program. These include: (1) preparation graduate students undergo in order to be ready for future faculty positions, (2) how teaching and learning theories affected individuals in the process of learning to teach, (3) the effect K-16 collaboration has on individuals, and (4) what other GK-12 programs have learned through their participation in NSF Fellowship experiences. Each of these theoretical frameworks will be discussed as a basis for this research study.

Preparing Future Faculty

Acquiring tenured and non-tenured positions in academia has become much more complicated than previously realized. Recent studies show that not only are there fewer top graduates seeking science, technology, and engineering degrees, but there are also fewer jobs available to those looking for academic careers (Hettich, Lema-Stern, &
Rizzo, 1981; Zumeta & Raveling, 2003). This drastic change has created radically
different work environments in which graduate students can find employment (Adams,
2002). Secondly, it is important to realize that colleges and universities today are looking
for faculty who are effective teachers, competent researchers, and active participants in
academic life. This represents a shift from competent researchers to a desire for highly
qualified individuals in all three aspects of faculty life. This change combined with few
schools providing the tools to acquire these skills has created havoc, especially when
individuals are trying to find positions after graduation. This increased disconnect
between what schools are doing to prepare future faculty and the availability of positions
reached an all-time high in the 1990s, so much so that a large group of concerned
individuals wrote a grant for the Preparing Future Faculty (PFF) Program. These faculty
scholars analyzed the research data and determined that over the course of several studies
“54% of graduate students report a ‘very strong’ preference for a position in a large
research-oriented institution,” but there are only between 1-10% of Tier 1 institution
positions available (Gaff, 2002; Gaff & et al., 2000). These percentages reveal that over
half of the graduate students seeking their ideal employment would likely become
disappointed in their employment search due to their lack of teaching preparation for the
types of positions available. This lack of preparation then creates a much higher
likelihood of failure for the new faculty to acquire tenure.

One of the main sources of lack of preparation for future faculty is the lack of
training in teaching pedagogy (Adams, 2002; DeNeef, 2002; Gaff et al., 2000; Rice,
1996). Doctoral students need specific training in “writing syllabi, developing curricula,
defining learning experiences beyond the classroom, managing classroom learning, using
technology, assessing learning, and mentoring” (Gaff, et al. 2000). When graduates do find professional opportunities, very few are prepared to discuss their teaching abilities, a large part of their job responsibilities (Armstrong, Mannheimer, & Stanton, 2005).

A second source of lack of preparation for graduate students stems from a lack of knowledge concerning the types of positions available after graduation and the responsibilities required by each employer. Doctoral students typically become familiar only with the type of institutions in which they earn their degrees (typically Tier 1 universities). The problem arises when 90% of the employment opportunities for faculty positions are in the remaining institutional tiers. Many of these positions are in two-year colleges that offer a wider variety of viable positions for energetic and willing graduates.

The PFF Program has offered a solution to the ever-growing needs of future faculty by providing the participants with seminars to increase knowledge in the areas of academic job search, faculty roles and responsibilities, and teaching issues and pedagogy. Guest speakers covering a wide variety of other skills necessary to achieve success as a faculty member are also included in the seminars. (DeNeef, 2002; Gaff et al., 2000; Applegate, 2002). The participants in PFF are paired with mentors and are actively engaged in visiting various colleges and universities throughout the area. These activities combined with various others provide the necessary knowledge and experience to enable almost 100% of its members to feel more prepared and, in turn, to find the academic positions that are most suitable. Many doctoral students are guided away from “second and third tiered institutions due to the importance placed upon teaching in sharp contrast to first tiered institutions” that are mainly focused on research (Rice, 1996). Not all people who set out on a career path end up where they planned on working (Green,
Life After NSF Fellowships

1997), but the problem arises when so many graduates invest years to obtain their degrees and it becomes impossible for them to find suitable employment (Fox & Stephan, 2001). PFF is one viable option in helping individuals determine which types of positions to look for in order to gain employment in their dream job. Many people do not realize that, not only are research and teaching equally important, but also serve the public (Zumeta & Raveling, 2003). Preparing Future Faculty programs provide a deeper understanding of teaching pedagogy and various training strategies that supply valuable experience for graduates seeking various faculty positions after graduation. As a whole, PFF has been highly successful in many areas except for a shortfall in helping graduates attain the long-term experience that comes with teaching students for an extended period of time.

Collaborative Partnerships

Another viable option for graduate students seeking skills necessary for successful employment is to become involved in partnerships between universities and K-12 schools. Many communities throughout the United States are actively involved in various kinds of collaborations that are mutually beneficial to all participants including; teachers, principals, students, faculty, and graduate students. In order for these partnerships to be successful, there are several key factors. The first necessary aspect involves a sincere commitment from school districts, school principals, teachers, and university programs to form collaborative relationships (Bottomley, Parry, Brigade, Coley, Deam, Goodson, Kidwell, Linck, Robinson, 2001; Edens & Gilsinan, 2005; Ganser, 2001; Oja, 2002; Runyan, White, Hazel, & Hedges, 1998; Stevenson, Duran, Barrett & Colarulli, 2005). This collaborative team must then develop a shared vision of the project through discussions and deliberations. In addition to multiple active participants, it is imperative
to fight the culture of most schools that tend to discourage, if not block, attempts to create
a shared vision (Froman, 1999; Levey, 2005). University departments can also assist
university-school partnerships by providing the faculty with the tools necessary to
collaborate. Too often faculty work in isolation and have few opportunities to collaborate,
thereby experiencing increased loneliness. This includes encouragement to think beyond
the borders of one’s discipline and be willing to support designing learning experiences
beyond one’s expertise (Eccles, 1996 Stevenson et al., 2005). Institutions must also be
willing to look at the culture surrounding higher education and be willing to take the
necessary steps to create more collaborative partnerships (Edens & Gilsinan, 2005).

Research has shown overwhelming positive personal and professional outcomes
in response to participation in such endeavors. When scientists begin to grasp the
complexities of K-12 education, they begin to experience the joy in igniting intellectual
curiosity in students and are provided the opportunity to forge real connections with their
community (Bottomley et al., 2001; Ediger, 2000; Reese, 2001). Not only have scientists
grown through these collaborative experiences, but teachers and students have
overwhelmingly shared the positive impact that these programs have had in their
classrooms. Teachers and students alike have increased their scientific literacy and
communication skills, and have, as a result, become more interested in STEM topics
(Bowman, Arvidson, Nelson, Squyres, 2001). Teachers have experienced an increase in
the accountability of acceptable levels of content knowledge and skill development in
order to provide their students with the demands of higher quality education (Council for
Exceptional Children, 2005; Weems, 2003). Collaborations with the universities provide
these types of professional development that enable teachers to feel more confident about
their teaching effectiveness and content knowledge. Current research has also indicated that participation in learning communities can lower attrition rates, support isolated students, and create opportunities for role models or mentors to emerge (Daie, 1994).

With the student population becoming more diversified and focusing more on individual needs, these types of results can only improve the quality of education in schools.

Many research articles suggest that collaboration usually has a positive effect on all the participants and is successful, but this has not always been the case. Communication difficulties frequently arise and can significantly retard the project or even shut it down completely. Often times, members do not share a consistent commitment to the project and problems arise as a result. (Kirschenbaum & Reagan, 2001). Ongoing open and honest communication is critical to a successful partnership and enables all members to share concerns, frustrations, and successes--in real time--as they arise.

**Teaching and Learning**

It is important to note that, although teaching and learning theoretical frameworks vary through a vast spectrum of viewpoints, this literature focuses on how people learn rather than on what they learn. In this portion of the literature review, I hope to articulate why sociocultural cognition is the most viable theoretical framework on which to focus this research study (Bransford, Brown & Cocking, 2000). This will be accomplished by defining various perspectives and deciphering the elements in each as well as by pointing out their strengths and weaknesses. This section will conclude with three underlying principles associated with sociocultural cognition; the importance of culture in
communities of practice” (Lave & Wenger, 1991), the importance of context in learning, and finally using reflection to enhance learning.

Historically, teaching and learning theories began with a behaviorist’s perspective focusing on the “belief that knowledge exists outside of people and independently of them and that the major goal of good education is to instill in students an accepted body of information and skills previously established by others” (Scheurman, 1998). Behaviorists have drastically restricted the range of scientific knowledge in order to focus on what is already known. This framework focuses too heavily on theory-laden facts that historically have not had the opportunity to be explored through inductive reasoning. By moving outside the realm of the known into the unknown and through inductive reasoning techniques, researchers have been able to uncover a plethora of erudition that has enabled more students to learn and feel successful in their academic endeavors. Not only do most students not learn passively, but are turned off by environments in which they are expected to memorize difficult facts and regurgitate the information back to the instructor. In today’s technology-driven society, we do not want workers who are only capable of following directions. We desperately need innovators, with the necessary STEM skills, who can use their inductive reasoning skills to find workable and creative solutions to society’s dilemmas.

Since the 1960s, there has been a significant paradigm shift in the epistemology concerning the various dimensions of human learning. Heavily grounded in psychology and sociology, psychologists and social scientists began exploring ways in which learning takes place “within” an individual rather “to” an individual. Teaching and learning literature began focusing on “learners constructing their own learning rather than relying
on a teacher giving it to them” (Applefield, 2001). This emphasis on building and transforming knowledge within an individual rather than transmitting knowledge became the center of the constructivist movement.

In constructivist classrooms, instructors typically organize small groups of students into teams, whereby the students are then exposed to experiences in which they are required to solve authentic problems together. These real-world dilemmas enable students to understand the legitimacy of specific content standards and become engaged in their own learning. Through these shared occurrences, students are also able to build on their previously existing knowledge, thereby developing a deeper understanding of the concepts (Windschitl, 2002). The dynamic nature of this type of learning environment also allows an instructor to flex the activity toward student needs rather than dictate knowledge they may or may not understand, thereby increasing the probability of constructing meaningful understanding (Jadallah, 2000). As students discuss the problem, prior misconceptions and beliefs about content are discovered, questioned, and discussed. These types of student-centered dialogues, if done correctly, empower a student to further develop their critical thinking skills such as explaining, analyzing, synthesizing, and evaluating. As a byproduct of implementing constructivist activities, team-building skills are also honed which is another essential “working world” asset.

As with all theoretical perspectives, constructivism, as a whole, has its flaws. Within the broader framework, it is important to consider the difficulty in training instructors how to teach in a drastically different manner from which they had experienced (Lortie, 1975). This philosophy shift can cause extreme levels of frustration for both the teacher and their students if quality training is not implemented with the
teacher through professional development workshops. Teachers also do not typically understand the paradigm shift from teacher-centered instruction to student-centered instruction or how to build lessons in this manner. Often times, classrooms may feel less productive to the novice constructivist due to the noise level and the varying “stages” groups may be in throughout the activity. There is also a much higher possibility of “off-task behavior” if the teacher is not practiced in effective management techniques.

Another weak point of “constructivism acknowledges that people’s errors, prejudices, and misbegotten beliefs sometimes create a social reality” that is not appropriate for the situation (Jussim, 1991). Teachers need to be able to guide learners toward the correct understanding without “giving them the answers.” This involves developing questioning techniques and teaching strategies that may not have been previously employed. Another teacher’s frustration involves the learning curve necessary in developing the skills needed to produce lessons that generate opportunities for students to develop their critical thinking skills. Until teachers and students practice these skills for a significant amount of time, the learning curve could create problems for all involved. As important as it is to discuss these practical issues surrounding teaching and learning in a constructivist framework, it is not meant to discourage one from implementing these strategies. It is merely meant to point out obstacles which must be overcome in order to increase the probability of deeper conceptual understanding (Smith, 1995).

As constructivist research expanded, two distinct perspectives began to emerge; cognitive constructivism and social constructivism. Cognitive theorists focused on “individual construction of knowledge through internal cognitive conflicts as learners are
striving to resolve mental disequilibrium and discrepant events from their existing schema” (Applefield, 2001). The focus is primarily on individuals and their cognitive processes as they learn by creating experiences for themselves that they may not have experienced or are in direct conflict with their beliefs. Through engagement of individuals in their own primary mental constructs, the participants are able to determine whether their flawed constructs need to be improved or not. Although this research emphasis is adequate, it does not take into consideration the effect that working in a community has on one’s learning. It is focused primarily on the individual and their own cognitive processes.

Social constructivists, on the other hand, focus on the social interaction of people, specifically sharing, comparing, and debating an authentic problem in order to refine their own meaning and help others define theirs (Applefield, 2001). This perspective focuses on the collaborative nature of learning first explicated by a Soviet psychologist Vygotsky. He believed that “every function in the child's cultural development appears twice: first, on the social level and, later on, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals” (Vygotsky, 1978). Vygotsky believed that it was impossible to separate learning from a social context because individuals do not respond to external stimuli, but to the interpretation of that stimuli through dialogue with others. Social constructivists believe that the social interaction between members in a community play a critical role in the learning of an
individual because it is impossible not to “care” about being a member of a particular group.

Social constructivism as a theoretical perspective is missing three key components when considering the social interactions of individuals; the culture of the individuals in which communities of learners are participating, the context in which learning takes place and the reflection process necessary to ensure deep understanding. Within the broader field of social constructivism lies the theoretical framework that addresses these weaknesses, sociocultural cognition, or situated learning. This is the primary theoretical framework upon which this research study focuses.

Situated learning, also known as sociocultural cognition, emphasizes “the socially negotiated quality of meaning and the interested, concerned character of thought and action of persons engaged in the activity” (Perret-Clearmont, Perret, & Bell, 1991). Typically these occurrences are found in communities of practice, which Machles (2003) defines as “any social group whose members share a mutual engagement, negotiate a joint enterprise and have developed a shared repertoire.” Social constructivists “might agree that each child is engaged in a social activity, but would argue that, from the child’s perspective, it is not the same activity for all children for each child constructs their own meaning and understanding about the situation” (Smith, 1995) based on their own cultural experiences. It is this cultural experience that defines each person as an individual. Although groups of people may share common knowledge, each will sift this knowledge through their own personal sieve and process this knowledge based on their previously held beliefs and experiences. As active participants in collective knowledge building, individuals are affected by the social and cultural world in which they exist.
(Quay, 2003). The “cumulative wisdom of the culture” (Brown, Collins, & Duguid, 1989) is then used differently based upon the traditions built into a community’s way of life even though communities of practice may share only some similar characteristics.

This process of enculturation within a community starts at a very early age and continues throughout a person’s life, whether it is consciously or unconsciously adopted. Through observation and verbal communication, individuals monitor behavior in any given situation and tend to conform to the accepted practice (Brown, et al., 1989; Rogoff, 1990). Whether it is the use of tools, ways in which one solves a complex mathematical problem, or dancing with friends, there are “rules” that society deems acceptable in situ which define what a person believes and understands about a concept. School and work environments can be hybridizations of many different customs or behavioral expressions that “can be classified as routines, accounts, jargon, rituals, or symbols” (Levine & Moreland, 1989). These expressions enable the learner “to achieve in collaboration with another, something which cannot be achieved on their own” (Vygotsky, 1978). As a novice moves into unfamiliar territory, experts can work with this person in order to help them develop the skills and knowledge necessary to be successful in a given situation. This type of learning is best achieved through apprentice-like environments when “institutions have the prescriptions for skilled performance” or use specific technologies and problem-solving skills (Rogoff, 1990). These communities of practice are especially important in the appropriation of exclusive knowledge (Billett, 1996). “There are highly valued forms of knowledgeable skills in each society for which learning is structured in apprentice-like forms, primarily schooling and the workplace” (Perret-Clearmont et al., 1991). These social institutions are designed to create environments in which shared
knowledge is constructed in small group experiences. Through discourse, individuals move more effectively from the peripheral into full participatory involvement. These communities of practice can also enable an individual to develop or transform their own personal identity based on the interactions with the group (Lemke, 1997).

Another important component of situated learning is the context in which something is learned. According to Cochran-Smith and Lytle (2001), context is defined as “knowledge in practice.” The emphasis is on knowledge in action, where learners are put into situations in which they are learning as they go. Beginners are paired with one or more experts in order to help guide them through the difficulties of learning within a particular situation. In these types of environments, there is not as much focus on book learning, but the cognitive processes develop in situ. It is critically important for learners to gain knowledge, understanding, and experience in a situation as close to a “real” situation in which they will eventually be using this knowledge. It certainly does not get any more authentic than learning to teach with a skilled professional in a classroom environment. Problem-solving situations that are authentic have the highest likelihood of being transferred from one setting to another and, when learning to teach, there are certainly daily problems that need to be solved. If transference is expected to take place, then it is also essential to learn as many contexts as possible or engage in as many classrooms as possible. This practice of learning in action creates opportunities for mentors to guide the novices through difficulties without being totally left to sink or swim. Typically, learners observe and gradually ease into the teacher role in the classroom, “learning to construct and articulate their understanding of what is already ‘known’” (Cochran-Smith & Lytle, 2001). “Adult students will learn in all situations, but
sometimes what they learn is of a negative quality” (Groves, 2003), therefore, teachers need to design activities that are interactive, cooperative, collaborative, involve realistic problems and encourage a wide range of social activities from which the adults can positively learn. Workplaces can be effective venues in which to incorporate communities of practice, as long as opportunities for “learning are embedded, supported, and managed within the wider culture of the workforce” (Fuller & Unwin, 2005). Throughout varying contexts within a community of practice, one also learns how this knowledge can be applied to other situations. It is essential to understand that these contexts, as well as the learning that takes place in them, are specific to the culture, but even if it is different, one can learn how to develop the skills necessary to become an expert.

And finally in sociocultural cognition, it is also imperative for the learner to reflect on their teaching process in order to fully engage in the cognitive process. Through engaging in reflection based on their own performance, learners become wiser and more capable of making sound judgments with more difficult problems (Shulman, 2002). It is important to provide opportunities for learners to pause and take time to reflect and help others reflect on their progress as well. By sharing within an encouraging and supportive community, everyone gains deeper levels of understanding (Shulman).

Several other aspects of reflection center around gaining “knowledge about pedagogy, knowledge about content, knowledge learned from practice, and knowledge about learning how to participate in learning situations” (Cochran-Smith & Lytle, 2001). Each of these ideas should be reflected upon individually and as a group in order to share
varying perspectives for individual and collective growth in each area. Reflection is not something that happens automatically with individuals; it is something that a person or group must be trained to do. But by encouraging meta-cognitive reflection, one can “encourage higher order thinking and promote more effective learning” (Granville & Dison, 2005). Based on data and using research validated, core meta-cognition “is learning to learn, evaluate, and correct the information processing” within an individual (Granville & Dison, 2005).

In situated learning communities, it is also important to consider several areas of weaknesses. It would be negligent to ignore the relation of power within a community of learners (Lave & Wenger, 1991). Communities of practice can either empower or disempower individuals based on their relationship to the group, as an expert or a novice. Through dynamically changing roles, tensions within a group can become strained and cause anything from minor problems to full-blown crises. Experts sometimes see knowledge as power and may withhold this information from beginners in order to protect their turf-something that must be avoided.

Secondly, it is important to consider the research regarding transfer of knowledge from situation to situation. Transfer is defined as the degree to which a behavior will be repeated in a new situation” (Detterman, 1993). A plethora of data suggests that very little knowledge is transferred between various situations although “not all cognitive activities are completely specific to the episode in which they were originally learned” (Rogoff & Lave, 1984). The problem with gaining knowledge within a particular context is the necessity of knowledge transference between various circumstances. Not all knowledge can be easily traded between different situations, but through deeper learning
and reflective practice, one can significantly increase the likelihood of this occurring. Procedures and concepts that are more durable are more likely to be transferred between situations and problem-solving activities (Billett, 1996). It is essential for instructors to carefully develop these authentic problems so that the learner has the opportunity to index and organize the knowledge in such a manner that the transfer can take place. It is also important for instructors to train the novice more than once on any given task in order to provide sufficient support and time to comprehend (Machles, 2003) and encode the activity. Proper encoding mechanisms enable the learner to retrieve and transfer the information (Sternberg & Frensch, 1993) “across-situational analogies” (Greeno, Moore, & Smith, 1993).

Humans are social creatures and it is impossible for researchers to separate individual learning from its social aspects (Rogoff, 1990). Cognitive development takes place within a community of learners who must not ignore the culture and context associated with learning. It is also essential for the learner to develop a deep, long-term understanding through consistent reflection on the learning process. In conclusion, the most theoretically comprehensive teaching and learning framework for this research study is sociocultural cognition.

**GK-12 Projects**

STEP Fellows are scientists who are asked to stretch outside their area of expertise in order to learn about teaching middle or high school students. They are placed in classrooms with experts in education; but not necessarily content experts. “For many scientific laboratories and the instruments they contain are as central to science as the ‘reality’ and ‘truths’ that are created and dismantled there” (Barab & Hay, 2001). In
essence, Fellows become apprentices with experts in teaching, which can provide a useful model for learning about instruction (Brown et al., 1989; Collins, Brown & Newman, 1989). These learning communities provide apprenticeship-type experiences where Fellows can practice the teaching skills they are acquiring (Lave & Wenger, 1991). “Simulation learning” (Barab & Hay) provides learners with authentic, hands-on experience in which they can construct meaning from previous knowledge and add to their repertoire of skill sets. Although the skills sets will be slightly different when teaching college level students versus high schoolers, the pedagogy and organization will be much the same.

GK-12 communities have been able to overcome many of the challenges of creating successful learning communities by formulating interdisciplinary teams that cross fertilize and exchange ideas, and then create a shared vision (Froman, 1999). Through workshops, seminars, and consistent collaboration, university-school communities have also been able to provide many positive benefits to all members. Historically, there has been a lack of understanding about K-12 education and university environments. Both K-12 teachers and university faculty think they understand the complexities of both environments; but this is not true (Hall-Wallace & Regens, 2003). Only through long-term engagement in each setting, will both parties and university students learn how each system functions and begin to appreciate their sophistication. By exchanging ideas, both parties also have the opportunity to learn and practice effective teaching strategies that can ultimately improve student learning. The university faculty and students then carry these strategies back to the university classroom and implement teaching style changes within their respective departments and student bodies (French,
All parties experience increased communication skill development, which will allow for optimization of their individual career performance while simultaneously fostering a more nurturing environment for future collaboration.

It is clear that no matter what profession an undergraduate or graduate student aspires to, certain skills must be mastered and utilized by the potential employee. Specifically, managers of industry stated that they are looking for these specific characteristics: “cultural competencies, written, oral, and computer communication skills, the ability to demonstrate team-working abilities and knowledge of group dynamics, scientists who have data analysis skills, a passion for life and learning, good work ethics,” volunteers who want to be involved in humanitarian efforts, (Green, 1997; Kerr & Runquist, 2005; Schmidt, 2004) and those with problem-solving and leadership abilities (Greene, 1999, Jones, 2003). Employers are looking for applicants who can apply their knowledge and find solutions to problems.(Greene, 1999; Jones, 2003; Kerr & Runquist, 2005). Students are capable of acquiring these skills, but must first find programs to enhance their knowledge and ability to use these skills, or they will have a much more difficult time finding a professional situation where their skills can be maximized.

GK-12 programs have used various means to evaluate and assess Fellow skill development, attitudes, and beliefs about teaching, and their preconceptions about K-12 education. Through ongoing assessment, PIs collected data through various qualitative and quantitative methods, typically through ongoing formative assessments used to continually improve upon their projects. GK-12 programs are also required to submit
summative evaluation reports to NSF at the end of each year. These “lessons learned” are also used as evaluation tools to improve upon their programs.

Characteristic qualitative methods used by GK-12 evaluation teams include journal entries, focus groups, individual interviews, and interviews with Fellow advisors, as well as long-term tracking documents and surveys. Participants complete weekly journal entries, participant in regularly scheduled focus groups and interviews and complete years tracking documents. Emails are sent to participants in June reminding them to complete the tracking document which consists of five questions asking basic questions about their educational and professional pursuits. Although GK-12 programs throughout the country use tracking documents, only one GK-12 program has published anything about this technique. Their tracking documents focused on performance of qualifying exams, time until they finish their degree, and job placements of Fellows upon graduation (Lyon et al., 2002). Pre- and post-test surveys, on the other hand, were used by many different projects and ranged from asking the Fellows if they felt they were increasing technical knowledge to education pedagogy questions. These quantitative methods were similarly used to determine if the Fellows’ objectives were being met and to make adjustments to their individual programs in order to meet their goals.

Summary

After an extensive literature review, it is important to clarify the rationale of the proposed research based on the theoretical frameworks focused on Preparing Future Faculty literature, K-16 collaboration literature, teaching and learning literature, and the GK-12 body of literature. Whether a STEP Fellow is pursuing a bachelor’s, master’s, or doctorate degree, there are necessary skills that must be developed in order for this
individual to be marketable for any position. These skills include: collaboration and team-building skills; organizational and time management skills; written and verbal communication skills; the ability to share knowledge with others (teaching); and a heightened awareness of learning. Although industry jobs are significantly different from faculty positions, all require pedagogy knowledge that enables the individual to share their knowledge with a learner in engaging and meaningful ways. Where and how they teach the information and the culture within which someone is learning information also makes a difference in one’s learning ability. Situated learning is the mostly comprehensive theoretical framework that addresses the culture of the individuals in which communities of learners are participating, the context in which learning takes place, and the reflection process necessary to ensure deeper understanding. GK-12 projects throughout the United States are investing millions of dollars and thousands of hours into developing the Fellows, yet there is inadequate data researching the long-term impact of the Fellowship experience. This research study addresses the long-term implications of developing these types of skills and their effects on the STEP Fellows’ educational and professional choices once completing the STEP project.
Chapter 3: Methods

*Research Design*

The qualitative research design applied to this investigative study was a grounded theory approach focused on two-hour, in-depth interviews, historical attitude surveys, and yearly tracking documents (Andrews, Weaver, Hanley, Shamatha, & Melton, 2005; Gosselin, Levy & Bonnstetter, 2003; Hall-Wallace & Regans, 2003; Thompson et al., 2002). The interviews concentrated on questions pertaining to Fellow participation in the NSF Grant and how participation affected their later educational choices and professional endeavors since leaving the grant program. The purpose of the interview was to gain information pertaining to individual experiences by each Fellow during their one-to-three year engagement in Project STEP. The research study collected data to determine the way in which one understands those experiences and used this information to correlate it to their current professional endeavors (Denzin & Lincoln, 1994; Marshall & Rossman, 1999). The attitude surveys, previously collected during active Fellow participation in the grant, were also used to verify their current perceptions with their previous experiences while participating in the program (Hall-Wallace & Regans, 2003). This unobtrusive and non-reactive component enhanced the interviews and helped the researcher to more fully comprehend their experience (Denzin & Lincoln, 1994; Marshall & Rossman, 1999). It is critically important for the research to reflect credibility, transferability, and confirmation as much as possible, therefore yearly tracking documents were also assessed to corroborate Fellow education and post-grant career choices (Lincoln & Guba, 1985).
Population and Setting

Throughout the first three years of Project STEP’s implementation, there have been seventeen undergraduate and graduate Fellows who have actively participated in the project from August 1, 2002 through June 30, 2004. Of these seventeen Fellows, all but three had the possibility of being contacted to participate in the research study. Three of the previous Fellows did not complete the one-year contract due to personal or professional difficulties; consequently these participants have very different perceptions about STEP and the effect their truncated participation had on their careers than those who completed the program. These biases would bring about unreliable data, thereby skewing the results of the study (Pickering et al., 2004). Of the fourteen participants who completed at least a one-year commitment to the project, there were six individuals selected for administration of the interview. The Fellows were carefully selected through an analysis of individual characteristics in order to have a representation of graduate and undergraduate students, male and female, as well as a sampling of varying current employment status; working in industry, working in education, or further pursuit of a degree. There were six graduate males, two graduate females, three undergraduate males, and three undergraduate females who were considered for the selection process. One person from each of the six possible combinations of educational level, gender, and employment status was asked to participate during the initial phone call and email contact portion of the study. The six possibilities included; graduate males working in industry, undergraduate males working in other fields (besides industry), graduate students working in other fields, undergraduate females working in industry, undergraduate females working in other fields, and graduate females working in other fields. During the
initial contact, one undergraduate female had given birth in the three months prior and declined participation. Through deliberations with several committee members, a substitute was subsequently contacted and agreed to participate. All participants are listed in Table 2.

Other graduate students have been actively engaged in the grant but held different roles than a Fellow; these include the grant coordinator, the evaluation Fellow, and the technology/Web designer. Their distinctive and supporting roles in the grant do not lend themselves to comparisons with the Fellows, therefore they were not considered for participation in this study.

Before starting as a participant in Project STEP, all the Fellows agreed to sign an informed consent agreement along with a contract stating their commitment to engage in the requirements of the position. The consent form included a commitment to fill out a yearly tracking document for five years after the conclusion of their participation in the project. This tracking document consists of questions pertaining to their current contact information, their employment and research opportunities in relation to STEP, an update on their attainment of educational goals, a question asking them to “describe the ways you are currently involved in science and/or mathematics in your employment or volunteer/professional development, and how STEP has helped you in your professional development” (http://www.eng.uc.edu/step/evaluation/tracking/fellows.php). These questions were used to corroborate the interview findings discussed in chapter 5.

**Instruments**

The seven Fellows were initially contacted through email and a telephone call using the information obtained from their previous tracking documents. All of the
Fellows were asked to participate in a semi-structured, in-depth, two-hour interview at a time and location convenient for them. The questions for the interviews are indicated in the Appendix, Table 1. Each interview with a Fellow inside of a 100 mile radius of the medium-sized, Midwestern city was conducted in person. The Fellows who were outside this range with no plans to be in the area within the specified data collection period (one month) were asked to participate in an interview conducted by telephone (Kirschenbaum & Reagan, 2001; Thompson et al., 2002). As the Fellows were located throughout the country, now holding positions in a wide variety of engineering or educational institutions; it was impossible for the researcher to visit all locations within a reasonable time frame.

Semi-structured, in-depth interviews were the primary data collection method used in conjunction with previously completed attitude surveys and tracking documents. An in-depth interview strategy allowed the researcher to focus on the individual real-life experiences that were most influential in steering their career paths while capturing the deeper meaning of the experience in a person’s own words (Creswell, 1998; Marshall & Rossman, 1999; Seidman, 1998). “The first part of the interview solicited basic descriptive information” (Kirschenbaum & Reagan, 2001; Pickering et al., 2004), while the remainder of the interview consisted of more specific questions pertaining to teaching, collaboration, skills development, and how these skills influenced their career and/or academic choices since leaving the grant. Open-ended interview questions were developed for primary focus, but these questions were merely used as a “jumping off” place, allowing for flexibility to ask follow-up questions that the researcher may not have anticipated, or to allow for participant statement clarification (Creswell, 1998; Lyons,
Brader & Ebert, 2003; Denzin, & Lincoln, 1994; Fraenkel, & Wallen, 2000). In addition, this style allowed the researcher to discuss personal experiences and/or learning opportunities associated with their previous Fellowship experience—especially ones that may have directly affected their educational and career choices. Connelly and Clandinin (1990) describe interviewing as “a conversation with a purpose.” This offered the researcher the opportunity to explore a few general topics to help uncover the participants’ views, but otherwise respected how each framed and structured their responses (Andrews et al., 2005; Marshall & Rossman, 1999).

With perceptions changing over time, the participants’ current attitudes about schooling and teaching were then compared to their previous goals and aspirations. This allowed the researcher to trace the development of their attitudes and knowledge about teaching, learning, collaboration, and community commitment over time (Pickering, et al., 2004). Each of these interviews was audio taped and transcribed in order to make sure responses and comments were accurately recorded. These anecdotes were then analyzed in comparison to those of the other participants, and patterns were developed to draw inferences and contradictions throughout the overall experience (Marshall & Rossman, 1999) further described in chapter 5.

Procedures

Institutional Review Board (IRB) approval was attained through submission of an IRB modification letter in order to determine that the procedures, used by the researchers, are ethically sound. The participants were contacted via email and telephone to determine if they would be willing to participate in the research study. The informed letter of consent is presented in Table 8.
Data Collection

After the participant agreed to take part in the research study, a mutual time, date, and place were agreed upon by the researcher and the participant. A reminder email was sent to each participant two to three days prior to the interview. The two-hour interview was conducted in a safe environment in which there was privacy without fear of interruption. If the interview was conducted by telephone, the researcher initiated the call on a mutually agreed upon date and time.

Data Analysis

The researcher took notes in addition to recording each interview. The audio tape was subsequently transcribed verbatim by the researcher using Dragon Naturally Speaking®, and then analyzed and coded through the use of qualitative software called NVivo®. This software provided the researcher with a range of tools in order to handle rich data records and information including browsing through and enriching text, coding by category, as well as annotating and gaining accessed data records accurately and swiftly. NVivo® offers tools for recording and linking ideas in many ways. For example researchers can search and explore patterns of data and ideas by providing ways to remove rigid divisions between data and interpretations and integrating reflection and recorded data. One can also sort and manipulate data to find patterns, determining relationships and categories or they could link interviews, concept clarification, clustering concepts, seeking associations, and investigating exceptions.

Although NVivo® was utilized as a tool to manipulate data, expert qualitative data analysis relies on the researcher’s ability to search for general statements, generate categories, themes and patterns, code the data, test emergent themes, and build
interpretations based on grounded theory (Creswell, 1998; Marshall & Rossman, 1999). “The researcher’s interpretations are guided by their initial concepts while their understanding is developed and shifts are based on the data collected” (Marshall & Rossman, 1999). The researcher must also constantly search for alternative explanations through collaboration of other members in the research community.

Trustworthiness and Ethical Considerations

As the researcher was transitioning into the grant coordinator position many of the Fellows were transitioning out of their active roles in the grant. Since none of the previous Fellows had interactions with the researcher during their STEP participation, it was important that the researcher gain the trust of the participants prior to and during the interview process.

It was the hope of this researcher that none of the participants experienced negative feelings while participating in this research study. However, this research study provided Fellows with an opportunity to reflect on their previous experiences and determine if they had been able to apply this knowledge to their current employment situations and educational opportunities. The researcher was hopeful that by providing the Fellows with this reflective opportunity, they would experience positive feelings about their participation in Project STEP. There was the possibility that the participants could mask negative feelings about their experience in the program and not feel that their participation had any positive impact on their career or educational choices, although this was not expressed during the interview process.
Limitations

Before considering the limitations of the study, there are attributes of interviews that are beneficial and should be noted. These include the ability to provide the researcher with the context in which an event took place, the flexibility to formulate hypotheses, and its usefulness for describing complex interactions (Marshall & Rossman, 1999). Interviews also facilitate the discovery of nuances in culture and uncover participant perspectives in natural settings (Marshall & Rossman). The first limitation of this study is the number of participants. This study consists of only six participants although fourteen were eligible to undergo the interview process. Therefore, the results should not be generalized because each person’s experience is unique. However, there is maybe an opportunity to gather more data from the eight Fellows that completed their Fellowship experience in July 2006 as well as from hundreds of other Fellows who have participated in GK-12 Fellowships nationwide.

A second limitation of the study is the interviewing process itself. Interviewing requires the cooperation of its participants in order to gain accurate data (Marshall & Rossman, 1999). The interviewee may be uncomfortable sharing as much information as the interviewer had hoped to explore or the participant may be unaware of recurring patterns in their life. The researcher could also not be aware of other patterns in the Fellows’ lives or may not comprehend their responses due to the lack of personal contact outside the context of the interview. During the interview process, there is also the possibility of awkward moments. The researcher should take note of these occurrences in order to analyze the information collected in the proper context. The interviewer must also have excellent listening skills and questioning strategies, and be able to gently probe
the participants in order to gain exemplary elaboration of details (Marshall & Rossman, 1999). Other weaknesses of interviewing includes; the possibility that data is open to “multiple interpretations due to cultural differences, difficulty in replication, an overly articulate or literary style can obscure the research, and it is highly dependent on the researcher to be resourceful and honest” (Marshall & Rossman).

Another weakness is conducting the interview by phone. Not all communication is verbal, and the researcher will not be able to read or respond to a participant’s body language. It will be impossible to observe patterns in their body movements by phone (Marshall & Rossman, 1999). The lack of using multiple methods for verification of the data is yet another limitation in this study (Denzin & Lincoln, 1994). Many of the GK-12 research articles have very clear evaluation plans reflecting the extensive qualitative and quantitative tools each used to evaluate the Fellows and their experiences. Not one article, however, describes how they have gathered or evaluated the long-term effects on career aspirations. This is new territory and will need to be further explored in order to gain insight into the phenomena occurring with the Fellows. The researcher also considered observing the Fellows in their occupations, but with many of the Fellows living outside a 100-mile radius of the researcher, it would be impossible to observe the participants in their work environments in any reasonable time frame. While this “on the job” observation could provide invaluable information, it would also be obtrusive to their work environments. Optimally, it is important for the researcher to utilize multiple methods in order to “secure an in-depth understanding of the phenomenon in question,” but in this research study, it would be virtually impossible to execute more than has been described (Denzin & Lincoln).
Perceived Results from the Study

The researcher hoped to validate previous research results and shed new light on the long-term effects of participation in a GK-12 project. The researcher expected to find consistent themes based on the research of others. These include Fellows expressing:

- their increased communication, interpersonal skills, confidence, and leadership skills (Audette & Vieth, 2004; Parry & Bottomley, 2002; Pickering et al., 2004; Powers, 2003; Vickers, Foster & Salamo, 2004; Williams, 2002).
- an increased content knowledge base and increased confidence in sharing their research with individuals at different development levels (Centeno, Clayton, Otero, & Zekri, 2004; Dunfrey, Gravel, Rushton & Salisbury, 2003; Pickering et al., 2004; Richardson et al., 2004).
- the increased ability to connect life experiences to subject studied in engineering as well as the ability to increase social relevance of the curriculum to these life experiences. This, in turn, would decrease attrition rates of undergraduate and graduate students (Pickering et al., 2004; Pinnell & Nichols, 2004; Rochefort, Levien, Ford, & Momsen, 2004).

Other recurring themes include:

- “STEP Fellows gaining a greater appreciation of the effort needed to construct high school curriculum or implement a new projects” (Robertson, Vaughan, Singhose, Pastirik, Usselman, & Llewellyn, 2005).
• The Fellows gaining an increased understanding of K-12 education and the culture of the public school system (Martin-Vega, Ganesan, Das, Edwards, Okogbaa, Centeno, Kumar, Hunnicutt, & Project Fellows, 2005; Powers, 2003; Robertson, et al., 2005; Vickers et al., 2004).

Previously completed attitude surveys revealed several important factors that should be considered as they relate to this research. These include;

• confidence in teaching due to course participated; development of creating effective lessons
• acknowledging weaknesses in teaching skills-thought they were better than they were; * the same problems experienced in years 1 and 2 of the grant were clarifying roles, communication of expectations were the same things they remembered two to three years out of the grant, inconsistency in school experiences
• begin relating teaching to possible career goals
• increased knowledge of standards, lesson plan developing, pedagogy, and connections between learning and practice
• Ability to positively impact student learning by helping students relate to the material
• Not conclusive evidence that attitudes about teaching math and science changed from surveys or interviews-need further research

Fellows tended to rate the importance of the skills they were teaching higher than their confidence in being able to use these skills (Koehl, Soled, Kukreti, and Fowler, 2005).
Chapter 4: Narrative of Findings

Introduction

Individuals throughout the world have their own motivations, goals, interests, and aspirations. Keeping this in mind, chapter 4 presents an overview of each person’s individual findings within seven larger thematic schemes found through analysis of the data. The themes include descriptions of past, present, and future professional and educational goals; collaboration experience with Fellows, teachers and PIs; individual school experiences as they relate to their perspectives on teacher preparation, teaching and learning; the impact STEP Fellowship experiences had on their skill set in terms of usefulness for future employment; the impact of non-scientists on their research; contributions to the betterment of society through volunteer experiences; and suggestions for improvement.

Initial analysis of the data was completed in the form of data reduction, including quotes from the semi-structured interviews conducted. Each theme concluded with a brief discussion of collective group findings. A final summary closes each chapter by corroborating interview results with historical tracking documents and a brief description of previously collected attitude surveys. Similarities and differences of each individual perspective are suggested and are further explained throughout the analysis in chapter 5. This narrative of findings is different from the analysis of findings presented in chapter 5. Chapter 4 focuses on individual Fellow perspectives while chapter 5 integrates these perspectives in the form of themes supported by the literature and discusses implications of the research.
Fellow Educational and Professional Experiences

Each Fellow joined STEP with different professional and educational goals. These prior goals are explained in the context of choices made while in STEP, after STEP and in relation to future aspirations as they apply to each individual. Each Fellow’s experiences are explained in individual sections with a short summary of the trends at the end of this section. A summary of educational and professional experiences can be found in Table 4.

George

George participated in STEP during his senior year while pursuing a computer engineering bachelor’s. As an undergraduate student, George was interested in computer engineering, but as he began considering graduate school, he realized he really enjoyed teaching and decided that graduate school would provide him with the necessary knowledge to teach in a university. George also believed that he “had a pretty good relationship with students” and that his “composure in front of people is okay.” As he applied for graduate schools and explored other types of engineering degrees, he discovered that pursuing a biomedical engineering degree interested him more than continuing with his computer engineering interests. Ultimately, George was accepted into one of the top ten graduate schools in the country. This fast-paced, competitive environment gave him an opportunity to expand his experiences and challenge himself at a much higher level than ever before. George is currently focusing his research on microfluidics, “tiny fluid networks” used in DNA chips and micro-propulsion in addition to micro-thermal and lab-on-a-chip technologies. George feels as though he is just beginning to come into his own in the biomedical engineering field. Although he is not
yet certain exactly where he would like to work after graduation in 2008, he does know that he prefers a fast-paced environment.

Many of George’s undergraduate friends have chosen to pursue careers in computer engineering and are highly successful. Even though he realizes that biomedical engineering will not be as lucrative for him, he has chosen to follow his interests rather than pursue employment purely for financial reasons. George said “I don’t want to get stuck in a job that I don’t care about. I don’t want to get stuck in a job where I wake up 50 years later, and ask “What are all my efforts for? It would be a shame.”

During his graduate school experience, George also had an eye-awakening experience. He perceived other students in his graduate school to be “like factories, they don’t sleep.” George became so wrapped up in the fast-paced environment that he realized he was getting “burned out” and may even “need to take a break and find a job for awhile” before he pursuing his ultimate goal of getting his Ph.D. and teaching in a college or university.

Michael

As an undergraduate student, Michael majored in zoology and minored in anthropology and Italian. After graduation, he joined Teach for America and was placed as a science teacher in an under-resourced, rural high school in Louisiana. After his year-long teaching experience, Michael decided to pursue a structural engineering graduate degree instead of a degree in education. Michael took an extra year of night classes to acquire the necessary engineering background while working for a civil and environmental engineering research group in order to qualify for a graduate program. After gaining the necessary skills to officially begin a master’s in structural engineering,
Michael joined the STEP team and participated for two years. His thesis work involves using computer models to assess the health of steel girder highway bridge systems. Michael accepted a position in New York City, but has yet to complete his thesis at the time of the interview. He hoped to have the rewrites approved and complete final graduation requirements by March 2007.

As a structural engineer, he “works mostly on bridges, but also tunnels.” When he first went to New York City, he “was hired to work on a security project but, since then, has mostly developed a lot of models that would support structures.” Michael enjoys his current position and is continuing to grow as a professional. At present, he has no intention of leaving his current employment or continuing his education past the expected completion of his master’s.

Brad

While completing his senior year in Electrical Engineering and participating in STEP, Brad decided to pursue a graduate degree in physics in order to teach at the college level. “Teaching appealed to me more, from the point of view of physics.” He believes that he “can teach physics at a lot of different types of schools, at larger universities, or at smaller schools, or community colleges,” but doesn’t think he “could always teach engineering at a smaller school.” Usually, “engineering is going to require a larger school where there would be a definite emphasis on research. If I want to do that with physics, I can, but I don't have to… this appealed to me more. Plus, truthfully, I loved physics from the beginning, but professional reasons were what really made me think I’d better switch.”
Since making this decision, Brad has been on course to graduate in June 2009 from a university in St. Louis, Missouri. His research focus is on epilepsy and seizures using “non-linear dynamics and measures from medical imaging equipment EEGs (electroencephalography) and MEGs (magnetoencephalography).” Brad is doing some programming to “try and take this data and make something useful out of it. His perception of imaging technologies is that they are understood, but not completely utilized yet. They are not as well known as MRIs.” He is hoping that by collecting and analyzing this data, he will arrive at an interesting thesis topic.

Patrick participated in STEP for the first two of the three years he was in the Electrical Engineering master’s program. His research focused on the fabrication and testing of Organic Light Emitting Diodes (OLED), using rare earth sulfides. When he finished school he was looking to “get into the semiconductor industry/government defense or medical/industry devices.” After interviewing for a position in OLED, Patrick decided that the topic “didn’t seem that exciting” after spending three years on his research. He felt that he’d learned as much as he wanted to, but when he interviewed with another nationally recognized organization, the work seemed so much more fascinating. He has had the opportunity to work on a wide variety of surgical products. His current focus is on medical implants.

Since joining the team, Patrick has had the opportunity to travel to Switzerland every three to four months to work on various aspects of the implants. He has also completed a Black-Belt Processing Certification, paid for by his employer. This is the highest processing level one can obtain in the manufacturing field. Patrick is currently
researching Master of Business Administration programs in the Boston area and plans to start classes part-time in Fall 2007. He hopes to graduate in three years.

Michelle

Michelle entered the STEP program as an undergraduate senior in Computer Engineering and took the opportunity to focus her senior capstone project on her STEP experiences. This project provided her with an opportunity to “analyze data” entrenched in math and science without having to be too technical about things she was not as interested in. She was able to “do something a lot more interesting and that she enjoyed a lot more.”

Michelle realized at the end of her bachelor’s degree that she was not interested in working as a computer engineer and hoped that her STEP experience would provide her with different experiences that could lead to a career outside her area of expertise-- which it did. She landed a job with a nationally recognized research and marketing firm focusing on a personal cleansing product account. Michelle spends her time at work analyzing marketing data, researching historical trends of products, and making recommendations for product launchings.

Michelle also hoped that her personal STEP experience would provide her with “an opportunity to try out teaching as something she might want to do as a career or somehow be involved in.” For the time being Michelle expressed satisfaction with her current position and is relatively happy in her professional life, but is not at all certain how long she will continue to pursue this career path. She indicated that eventually she could potentially see herself wanting to teach or be involved in education in some capacity.
Brian

Brian started with STEP as a senior in Electrical Engineering and continued in the program for two additional years as an Electrical Engineering graduate student. Brian’s educational and professional pathway has been riddled with difficult dilemmas and challenges. Prior to entering college, Brian had no idea what Electrical Engineering was or what type of a career completing this degree would lead to. As an undergraduate student looking toward his senior year, he began brainstorming ideas about other careers to pursue if he was not content with Electrical Engineering. By the time of his final co-op experience, he began wondering if this was a career he could sustain “past ten or fifteen years without getting burned out.” As an upcoming senior, he was exposed to the possibility of joining STEP and focusing his senior capstone project on his experience. He was thrilled with the opportunity to find out more about teaching at the high school level without having to commit to further education.

As Brian was completing his senior year in Electrical Engineering, he was once again struggling with decisions about what he would do next year. When he learned that he could “go to graduate school for free, work for Project STEP again, and have more time to figure out what he wanted to do,” he jumped at the opportunity to pursue an Electrical Engineering master’s degree. Brian was confused as to what type of job he was precisely looking for, but he did know that if he wanted to go further in engineering, he needed a master’s degree to distinguish himself from others in a rather competitive market. Brian also admitted he “forgot to look for a job” during his senior year. STEP provided him with the ideal opportunity to explore the teaching profession for another two years without totally committing to teaching or Electrical Engineering.
After completing his master’s degree coursework, Brian once again faced several difficult dilemmas. The Electrical Engineering employment opportunities he was most interested in were located out of town and, in the meantime, he was experiencing mounting family pressures. Brian felt conflicting emotions and eventually decided to seek employment in town. Since he had been interested in teaching and was having a difficult time finding fulfilling Electrical Engineering employment, Brian decided to pursue an Alternative Educators License (AEL). This required him to take classes at a local university while teaching high school math full time. In the midst of finding professional employment and fulfilling AEL requirements, Brian also had aspirations of completing his master’s thesis. As of January 2007, Brian was still juggling full-time teaching, AEL classes, and has yet to finish collecting his research data for his thesis. He hoped to get back into the lab during the 2006 winter break, but realized that personal and professional obligations may keep him from doing so. He hopes to graduate soon but doesn’t have a clear plan for accomplishing this. To further complicate finishing his thesis, Brian is required to continue to improve his teaching skills and complete the required AEL coursework in order to maintain his teaching position. Brian admits that this combination of difficult tasks is draining his energy.

Brian is currently in his second year of teaching high school students. During his first year, he taught in an under-resourced, suburban school teaching six different math preps. He had an opportunity to change schools for the 2006-2007 academic year to a well-respected, urban high school where he was only asked to teach two preps. It was an easy decision for him to make the switch. At the previous school, Brian received almost no mentoring, feedback, or help from other more experienced teachers. He was basically
left on his own to sink or swim. At the new school, however, Brian is now receiving weekly mentoring from an experienced teacher, who observes his teaching, provides written comments, and shares helpful suggestions. He especially appreciates the feedback he receives from his mentor, but also enjoys receiving feedback from others. He believes himself to be “open minded and willing to listen to negative as well as positive suggestions” from anyone who is willing to share them—and that includes his students.

**Summary of Career and Educational Findings.**

Although all six Fellows participated in STEP from 2002 through 2004, each participated for a different length of time and had different goals. Several had changing goals during their STEP experience, although none of them can fully attribute this to the STEP experience. Each Fellow’s experience in STEP affected their career and educational choices in some manner. The most dramatic affect of the STEP experience was Brian’s aspirations to pursue a full-time, high school teaching career. Michelle, Patrick, and Michael chose not to teach due to other professional interests. But, Michelle is clearly interested in future teaching possibilities, whereas Patrick clearly is not planning to teach anytime in the near future. Michael enjoys volunteering but is also committed to continue working in structural engineering. George and Brad are enjoying their studies and want to pursue college teaching positions, although George may need a little more time in the workforce before pursuing a Ph.D. due to a burnout factor.

**Collaboration Experiences**

This section describes the different kinds of collaborative experiences in which each Fellow had the opportunity to participate. These included collaborations among members of the research team, academic advisors, Fellows, teachers, and PIs. Whether
the Fellow was an undergraduate or graduate student while in STEP affected whether or not they were paired with another student, which was explained in the findings. A summary of each Fellow’s collaboration experiences can be found in Table 5.

George

As a graduate student, George has had the opportunity to work in two different types of laboratories. The first lab was pure biochemistry, “where the team focused on DNA.” His faculty advisor had somewhat of a laissez-faire attitude. Other than his advisor providing basic supplies and scheduling a monthly check-in meeting, George was basically left on his own. In the second lab, George’s faculty advisor was a “micromanager.” George was required to write weekly reports and attend meetings twice a week with his advisor. On one hand, George didn’t feel comfortable being left “on his own” and felt he needed more direction but, on the other hand, he didn’t believe that micromanagement was the best situation for him either. George appreciated finding a balance between the two types of management styles; he wanted direction, but without sacrificing the freedom to learn on his own.

These types of collaborative experiences influence how George interacts with others in his research lab. George has had the opportunity to oversee several undergraduate students as he completes his graduate degree. He spends time training them on various laboratory techniques; in return, they assist him with his research. As each student outgrows a particular technique, George is able to train them in more advanced ones. He believes in talking to people the way he would like to be spoken to. George speaks “to them as if they are very intelligent, like they would pick things up the first time, but he does expect them to ask him to repeat things.” Ideally, they feel
“respected and capable.” The second thing he did was to “appreciate everything they do, even if it is just cleaning dishes.” Not only did George make a conscious effort to blend his previous two laboratory advisors’ managerial styles, but he also tried to find a balance in his collaborations outside of the lab.

While in the STEP program, George had the opportunity to collaborate with Fellows, teachers, and PIs. As an undergraduate Fellow, George was assigned to work with Patrick, a graduate student (also interviewed). They shared the same urban classroom and the same teacher. George felt that he got along really well with Patrick because he was a “good detail person,” while George was the “creative guy.” George’s role was to come up with the overall idea and Patrick would figure out what needed to be done in order develop and implement each lesson. George felt that this type of collaboration was critical to their success in the classroom. George appreciated having a good “backup” person instead of feeling like he was entering a “foreign country” where nothing was familiar. Since George and Patrick were busy with their academic classes, they would usually meet at the high school during “recess hours,” when they weren’t interacting with students. But, if their schedules conflicted, they would meet outside of school.

George’s interactions with the high school teacher, Ron, were much different than his experiences with Patrick. George felt that Ron “wasn’t really helpful,” and that he was basically hands-off when it came to working with the STEP Fellows. George felt that Ron trusted him, but wasn’t going to help him because he “had enough on his plate” already. George felt that Ron basically did the same thing day after day and was just passing time until he could retire--because the benefits were good. In some ways, George
found this a positive experience because he could experiment with lessons and not feel pressure to have each lesson be perfect. Overall, George felt that there were both worse teachers and better teachers out there than Ron, and it was just the “luck of the draw” to have been paired with Ron.

As far as collaboration with PIs went, George felt that he interacted with them only minimally. He described Fellows and PIs gathering in “weird pseudo meetings” where they would “share ideas and discuss current projects. It was like a ‘have you earned your stipend?’ kind of meeting.” He felt that there were very few guidelines other than “that was great or you could do that better.” He felt like he was pretty much on his own with regard to his interactions with the PIs. George stressed that his experience happened in the early stages of the grant, and characterized it as feeling more like “growing pains” than neglect. He felt that the STEP team was “still figuring things out.”

These types of collaborative experiences not only provided George and his partners with unique opportunities to share their collective expertise and grow professionally, but also to learn what type of future professional employment they might like to pursue. For George, the ideal type of collaboration involves having the opportunity to work on problems by himself, but having someone to turn to when he feels “stuck.” Ideally, he would prefer a mentor or collaborator to check on him periodically and offer assistance only when needed. He prefers to be personally responsible for the work expected from him, yet he would also like to have access to the knowledge and expertise of others if needed. With an “on demand” bank of knowledge to draw on beyond his own expertise, George feels that he would be able to turn out the highest quality work possible.
Michael

As an undergraduate student in zoology, Michael did not have opportunities to collaborate with others like he did in his first year of graduate school. While pursuing course work in engineering, Michael worked closely with a professional engineering team. This team not only provided him with valuable work experience, but also with experts in their field who were willing to share their expertise. As a structural engineer, Michael constantly works in teams of individuals with a wide variety of expertise. They don’t “usually sit around together, they usually meet and figure things-which direction to go-and then everyone does their part.” Although Michael has not had a lot of experience with collaborative teams, he finds that people are “very supportive and very professional.” He tends to think things over and ask questions about how they thought things went and they give him “a very clear and honest answer.” Often times, he solicits answers from people on the same level, and sometimes even from people on different levels, in order to learn more about his job performance. He finds their answers a “good thing” because it is “always better to hear what you could do to improve.”

As a STEP Fellow, Michael had opportunities to collaborate with other Fellows, teachers, and PIs. In his first year in STEP, he was assigned to work with an undergraduate Fellow, Brian (also interviewed). Michael felt that they both “fully collaborated; they didn’t just bounce ideas off each other.” He felt that he and Brian came up with some “kick-ass lessons.” Michael also had the opportunity in his first year to collaborate with other Fellows. “It was the kind of situation where, if you needed something, there were a bunch of different people who would help you.” Fellows would set aside time to meet and talk about lessons, something Michael found very helpful.
In Michael’s second year in the fellowship, he was placed in a high school more or less by himself. Michael said it was a “weird” experience for him, and he was much more “on his own.” The teacher he was placed with during this year was teaching a subject area outside of her expertise. She was “out of her element” and in a “hard situation.” Michael felt that her feedback wasn’t really helpful and wished that the first-year teacher could provide him with tips on how to make his lessons better. He felt the first-year teacher “really knew what she was doing and her feedback would have been valuable.” The first-year teacher would give Michael and Brian an objective or standard that she wanted them to teach and provide time for the three of them to talk through the planning process. Michael felt that the teacher also gave them freedom to choose how to present the concepts, something Brian and Michael enjoyed working on together. After the lesson, the teacher would provide a constructive review, more “like a movie review,” saying “that went well” or “that’s the way I usually teach that.” Michael would have preferred even more constructive criticism than he received, although it was much more beneficial to him than the prior feedback from the second-year teacher.

In answering the question about his interactions and collaborations with PIs, Michael initially expressed the feeling that he didn’t have any sort of guidance or direction from the PIs. Ultimately, however, he did come to appreciate his PI’s direction after attending a GK-12 national conference where he had the chance to compare his experiences to that of other Fellows in the program. In retrospect, he felt that his PIs were a lot more accommodating than other GK-12 PIs. Overall, Michael very much enjoys working as a member of a team. He feels it is “always better when we collaborate; you can get different perspectives and it is a good way to go about doing things.”
As a graduate student in a shared research laboratory, Brad commented that although everyone focused on different things, “everything is related.” One graduate student focused strictly on experimental things while another worked on creating a model of epilepsy; one student focused strictly on synchronization models while others work on different kinds of models. This type of dynamic team provides Brad with discussion opportunities that give him “new ideas” he can apply to his research. He is able to “pick up little things along the way,” enabling him to move his research forward productively. Sometimes Brad has to filter this information and make difficult choices so that he is not bogged down by “trying to do everything.” In addition to his research team, Brad works intimately with a faculty advisor. He finds discussions with his advisor rewarding, and he looks forward to sharing various happenings with him.

As an undergraduate STEP Fellow, Brad was assigned to work with a graduate Fellow, who was assigned to a different classroom teacher and with a different subject area, which made collaboration difficult. He felt “it didn’t coincide well.” Brad thought that if he had the opportunity to work with another undergraduate, his experience “might have been different.” As it was, he didn’t have the opportunity to sit down with anyone else to develop a lesson; everything was done on his own. During his STEP experience, Brad was placed in a ninth grade classroom and found it challenging to determine what would grab the students’ attention. He wished he would have had more Fellow and PI collaboration, especially in the beginning of developing lessons, so that he could understand ninth grader capabilities better in terms of “what they could handle and what
they couldn’t.” Brad didn’t recall interacting with the PIs much; he remembers being “individual about it” (the process).

When Brad was in the classroom, he found himself trying to figure out the curriculum, thinking about an idea, and then bringing the idea to the teacher and bouncing ideas off of him or her in order to “make sure his idea was OK.” He never had the opportunity to sit down and develop a lesson with the teacher. The conversations about lesson development were short, typically a “quick two-sentence conversation.”

Brad did, however, have an opportunity to observe the teachers interacting with their students and overhear conversations in the teachers’ lounge. He realized that they “don’t just talk about teaching, they talk about their cars, husbands,” etc. He felt it “was great to get a picture of what was going on inside” (teaching). Brad’s younger brother is studying to be a teacher, and Brad hopes that he will have the opportunity to share “something I learned there” with him.

Patrick

Since joining a Boston company one and a half years ago, Patrick has had the opportunity to work as a member of a variety of teams. Patrick regularly collaborates with “patients and surgeons and gets to see how his products are used and how they impact people,” something he finds rewarding. Since he works for a medical device company, everything must be documented and he receives input from several different departments including; “Research and Development, Marketing, Regulatory Quality, and Documents and Labeling.” Patrick describes his work experience as a “team effort to design a product. Everyone’s ideas are welcomed and considered.” Patrick enjoys the collaboration in the various teams he is a member of because it gives him an “opportunity
to be productive away from his desk while promoting relationships and gaining support. Patrick prefers collaborating “with people rather than working by himself.”

As a graduate student, Patrick worked in a lab with several other students. Although the students would “help each other run experiments or recover certain tasks when they weren’t around,” he felt “they weren’t necessarily working together.” Patrick felt he was “working mostly by himself and with his advisor” toward his own specific goals.

As a STEP Fellow, Patrick worked with other students on almost every lesson he developed. He believes that the collaborative effort was definitely better because “you could get a lot more done and make it a more comprehensive activity.” He felt that they had “more resources working toward the same goal rather than four people trying to create their own.” Patrick also found it helpful to “delegate responsibilities” so that one person wasn’t responsible for all of the work. Often times, they would “work together to produce one activity for multiple schools.” Although they didn’t necessarily share the results of student learning in every classroom, each Fellow reflected on how the lesson worked in his or her assigned classroom.

In his first year, Patrick did not work closely with the teachers when he was developing a lesson. “They (the teachers) would suggest a topic or a subject and then I could just do it.” By the second year, “the teachers were much more involved; they gave me feedback about what they thought would work and what wouldn’t.” He felt that these teachers were “much more experienced” and that their input was “valuable,” particularly when the teams were developing lessons. Although teacher input increased somewhat the
second year, Patrick still felt as though he interacted more with the Fellows, especially when developing ideas for lessons. He would brainstorm with other Fellows and then run these ideas by the teachers to get feedback, accept any suggestions, and then plan further with the Fellows. Having regular teacher input helped “make it a lot better for the students.”

As far as Patrick’s interactions with the PIs, he remembered only a few and couldn’t remember which PI he was assigned to either year. Patrick did remember one conversation about his research with Dr. Tony when they discussed the possibility of incorporating some of his research project into a lesson. Ultimately, there were too many lesson plan ideas and Patrick never developed one based on his research.

Michelle

In Michelle’s current occupation, she has the opportunity to be part of several collaborative teams. She collaborates in a larger group of about thirty people, and in smaller groups, like her client services team, comprised of six people. Some of her project teams constantly change in size as different individuals are pulled in from various departments based on changing tasks. Along with team responsibilities, she also has individual project responsibilities that she must find time to handle. Michelle juggles her various assignments by using her planner and “only using the time allotted on my calendar for certain tasks,” fitting everything together in an organized fashion. Most of her team members share a similar frame of mind and she finds herself working with people who are able to work together in a business-like manner.

As an undergraduate student, Michelle did not work as part of a research team, but did meet with her academic advisor, Dr. Kathy, who was also her STEP PI advisor.
Michelle met with Dr. Kathy on a “very regular basis” because she was also assigned to the same school in which Michelle was placed. Dr. Kathy visited the school regularly to observe Michelle and “offered a lot of perspective about things.” Michelle felt that Dr. Kathy was “always extremely helpful.” Although Michelle met with Dr. Kathy most regularly, she met occasionally with two of the other four PIs as well. These occasional conversations were focused on high-level questions. For example “How is it going? Is there anything you need to make it work better?”

As an undergraduate student, Michelle was paired with a graduate student. In Michelle’s case, she was paired with Brian (also interviewed) as he moved into his second year in the project. Dr. Kathy met regularly with Michelle and Brian together as well as meeting with Michelle separately. In individual meetings, Dr. Kathy focused their conversations on suggestions or guidance as to how she could better document things or “collect her data” for her capstone project. Michelle was extremely grateful for the guidance she received from her advisor.

Brian and Michelle also worked together on “almost every project,” however; there were times when sometimes they would split up the tasks. In addition, there were some projects that they worked on totally independently of one another. But, for the most part Michelle worked collaboratively with Brian. At times, this proved to be a difficult experience for Michelle due to very different working styles. Michelle is “schedule oriented;” her planner is “her best friend.” Brian’s style was “more spontaneous, more go-with-the-flow attitude.” At times, Brian’s relaxed style was very difficult for Michelle to deal with, but she tried to get along as best she could under the circumstances. Michelle does feel that she “should have more flexibility in her life,” but during this time,
it was a challenge when she was trying to finish her course work, work on her capstone project, look for employment, and participate in STEP.

Michelle really enjoyed her interactions with the teachers. She felt it was “easier and fun” because they had specific goals they needed to accomplish. She also found the teachers to be “very open to doing different things in the class and letting them try different things.” Michelle even opted to spend extra hours observing in the classroom extra hours to observe so that she “wasn’t an unfamiliar face” when it came time for her to teach a lesson. In retrospect, Michelle would have preferred more feedback from the teachers she worked with. She felt they were hesitant to share their expertise and “didn’t want to criticize.” Michelle knew the teachers “wanted to be involved,” but she never understood what they were feeling about the whole process. She would have preferred to “have been offered more constructive criticism” so that she could do a better job. Overall, Michelle prefers to work in collaborative teams where people are sharing their knowledge with one another and offering helpful feedback.

Brian

For Brian, collaboration is a critical part of learning to teach or working on research. As an undergraduate Fellow, Brian was paired with a graduate Fellow, Michael (see above), and enjoyed collaborating with him on various lessons. Both Fellows remember one of their most successful lessons, Viva Las Vegas, with fond memories. Brian, in particular, felt that he learned a lot about lesson development and teaching from Michael. This particular partnership with Michael, along with spending time in the STEP office where other Fellows would drop by, provided Brian with opportunities to bounce
ideas off others in similar positions. Brian believes that collaborating is much better than undertaking a project on his own.

As an undergraduate student, Brian had the opportunity to co-op in different parts of the country and work on various types of teams. He also had the opportunity to collaborate with Dr. Kathy (a STEP PI who also worked with Michelle) and was able to focus his capstone project on his STEP experience. Dr. Kathy provided Brian with much-needed guidance on his project and in the classroom. Although Brian continued to collaborate with other Fellows, he learned the most from Dr. Kathy.

As a graduate student, his research advisor required him to participate in a research lab with several other graduate students. Although their research projects were not the same, he still had opportunities to discuss his research and exchange ideas with other students. Since putting his thesis on hold, Brian has not had the opportunity to discuss his research with other students other than his girlfriend, who completed her bachelor’s in Electrical Engineering last year.

In Brian’s first year as a graduate Fellow, he was partnered with Michelle. As described earlier, Michelle and Brian had very different working styles. Now that Brian has his own classroom, he realizes the importance of “organization and planning.” He strives to “become better at this” on a daily basis. In Brian’s third year of STEP and second year of graduate school, he was not specifically partnered with anyone, but did find it beneficial to collaborate with other Fellows on lessons. He enjoyed the opportunity to teach a lesson in different classrooms with other Fellows.

In each of the three years that Brian participated in STEP, he was partnered with different teachers. In retrospect, he wished he had been able to “go into the classrooms
the first couple of weeks of class in order to learn how to organize their classroom and focus on classroom management skills.” Brian also wished he had paid better attention to these particular skills so that he would be better prepared to teach now. Although he is grateful for the mentor he has now, he wished he had learned more while he was in STEP from the teachers he interacted with.

Brian also had opportunities to collaborate with PIs other than Dr. Kathy, who assisted him in his capstone project. Dr. Tony’s knowledge of the educational system was able to guide him into the AEL program, help him make connections that were beneficial for securing a high school teaching position, and provide answers when he had questions. Other PIs were also able to direct him when he had questions.

*Summary of Collaboration Experiences.*

Overall, all Fellows interviewed enjoyed working with others in a collaborative manner. Some Fellows (Michael, Patrick, and Michelle) do this regularly in their current employment and enjoy sharing ideas in order to create a better product. Brian collaborates with his team teachers on student progress but not on lesson planning, which is something he is struggling with. As graduate students often do, Brad and George share labs with others. Although everyone in the labs works on different projects, there are discussions that can spark new ideas about their research. All Fellows enjoy sharing their research with others in the same position and find the exchanges rewarding, especially if they spark new ideas. Along with each Fellow’s research, they all had a research advisor. This person directed them toward the final product and was influential in their research endeavors. Most Fellows found this rewarding and engaging although different individuals liked different things from their advisors.
As a whole, all Fellows really appreciated collaborating with other Fellows on projects. They enjoyed bouncing ideas off of one another and felt that sharing the workload was beneficial to all involved. Other than Brad, all Fellows had the opportunity to work together with Fellows in the STEP program. In the case of interactions with STEP advisors, only Michelle and Brian, who shared Dr. Kathy as their academic and STEP advisor, were satisfied with their interactions. Otherwise, each of the Fellows felt that they were pretty much on their own and could have used more guidance. In the case of Fellow interactions with teachers, all Fellows would have liked more collaboration with their teachers, especially in terms of feedback about their lessons. Patrick noticed that the second year teacher was much more comfortable giving feedback and collaborating with him. Conversely, Michael felt his teacher was struggling too much with her own teaching to give him any useful information.

School Experiences

This section describes individual school experiences including previous high school experiences prior to joining STEP, lessons learned while in the classroom including interactions with students, and the effect all of the above had on their career and educational choices. Each Fellow’s school experiences are different based on several factors, the most critical factor is the time spent in the classroom. Undergraduates were expected to spend about sixty hours over the course of a university quarter (eleven weeks) working on STEP requirements, with at least half the time spent in the classroom. Graduate students, on the other hand, were expected to spend an average of ten hours per week in the classroom and another ten hours a week researching, developing lessons, and participating in STEP seminars. A summary of this information can be found in Table 6.
George

George’s previous high school experience in a “small, suburban town, where diversity was zero” was much different than the west side neighborhood STEP school in which diversity was abundant. He describes the feeling of going into the school as “going into a foreign country.” George previously suspected that these students faced “hard realities such as fourth generation welfare and teenage pregnancies,” but to “experience it was much different” than he realized.

George described his classroom experience as a “prison education system” where the “kids wanted something that was stable.” Trying something different in class created a “rowdy” situation, to which the students weren’t really accustomed. He noted that this “stable” system seemed to work better for the teachers and students, even though he found it to be somewhat “cookie cutter.” George observed that most of the time the students would read a chapter from the book, answer five to six multiple choice questions, and switch papers while the teacher guided them through the correct answers. George felt that this type of structure allowed everyone their “own level of creativity” within certain boundaries.

Another one of the realities George faced was the pessimism of the teachers. He observed that the best teachers were drawn to the worst classrooms and, over time, these teachers became jaded and worn out. He thinks that it would take a very “strong person to be optimistic all the time.” Although he admits he didn’t think he could do a better job, he felt the teachers needed some type of refresher on optimism to revive them. He saw the teachers as being so busy and pressured all the time trying to comply with the No
Child Left Behind Act (NCLB), that he hoped that his lessons would take some of the pressure off the teachers and give them a break for a little while.

As George was developing lessons, his goal was to challenge the students without over stimulating them. He was careful not to come up with something that “would be over the kids heads” and make them “feel dumb.” George also expressed discouragement when he developed a lesson that required the students to go on the Internet for a search. He was amazed that the students didn’t understand the difference between doing a search and typing in the Uniform Resource Locator (URL).

Although George was somewhat discouraged by the students’ knowledge levels, he did feel that he had a positive impact on the students. He was able to bring “toys” and other fun stuff into the lesson with the intent of engaging the students in learning. He also felt that the students respected him more than the teacher. He felt that because he was younger, the students could relate to him more. Although the age difference was minimal, between George and his students, George believed that the students thought he was “Albert Einstein” because of his research interests. George was almost apologetic when he described talking about his research and college experiences to the high school students. He was mindful of the lack of opportunities these students faced and didn’t want any of the students to be discouraged and feel as if they couldn’t earn a college diploma.

Overall, George felt that he got much more out of the experience than the teachers or the students. He also wished he could have helped the teachers and the students more, but with such a limited amount of time in the classroom, he could only accomplish so much.
Michael

Michael came to Project STEP with a full year of urban teaching experience from the Teach for America Project, hence some of his perspective was put into context by relating his STEP experiences to his Louisiana experiences. Michael also felt that his previous teaching experience “motivated him to apply for the Fellowship,” as it met a need for him. One thing Michael has noticed while working in New York City is that people his age don’t really think about schools or education. He thinks that maybe it is because “they don’t have kids yet,” but it is something that is really important to Michael.

In Michael’s first year with Project STEP, he was placed in a highly successful urban high school, Heffler Center, and he really enjoyed this opportunity. But in his second year at Wessles University High School, the school resembled the chaos that he experienced in Louisiana. Wessles University High School was an under-resourced school with many challenges, one being that the “students didn’t want to be there.” This, coupled with the fact that he was in a classroom where the teacher was teaching outside her area of expertise and he had no Fellows to collaborate with, created special challenges for Michael.

Throughout his two years in the STEP public schools, most of his previous views about public education were confirmed. For example, Michael noticed that “parents are more critical than teachers when it comes to education.” Michael observed that “parents who are motivated have students who will be successful” whether the student’s teacher is “good or only mediocre.” He also observed the difference a good principal can make at a high school. Michael was impressed with the principal at Heffler Center, who knew all the students’ names—even the ones who hadn’t been “suspended.” He had the opportunity
to observe a school with a strong administration; one that supported its teachers. The end result was that the school provided a better learning environment for the students. At Heffler, Michael was also exposed to student seminars (the Paideia Philosophy). While watching students participate in seminars, he saw ninth graders acting and thinking like eleventh graders. He was “totally blown away by the experience.” He acknowledged that when he has children, he will “definitely look around for places like this” (Heffler Center).

Michael also thoroughly enjoyed interactions with students. He felt like he was a “guest teacher” that didn’t have to discipline the students, and therefore felt freed up to have fun with them while learning. He saw his lessons as an opportunity to “bring something fresh to the classroom.” One lesson, Viva Las Vegas, was a week-long lesson that he described as “the most fun I had” teaching a lesson. He felt that both “he and the kids were really into the module” and that “it was easy, exciting, and fun. Everyone was having a good time.” He notes that he reflected during and after teaching this lesson and felt that he learned a lot about teaching. He also indicated that he would probably go back and change some things about the lesson, but overall felt it was really a “fun one.”

In general, Michael enjoyed his two years teaching in the Project STEP, and his experience with STEP was “very, very positive.” He was originally attracted to the STEP program because of his interest in teaching and, although his views about teaching didn’t change as a result of his STEP participation, they were reinforced and enhanced by a positive school experience with Heffler Center High School. Michael stated the “highs that you get teaching are definitely higher than here (his current job), but the lows are
much lower.” Michael feels that his current job is satisfying in a different way, and he hopes to continue volunteering for various educational opportunities in the future.

**Brad**

As Brad reflected back on his parochial high school experiences as compared to his STEP school experiences, he commented that he remembered more about the “work, homework, and tests he took.” He didn’t remember the importance of “what a person was wearing, emotional relationships, or what happened after school between this guy and that guy.” He felt that the teacher he was paired with was better “attuned to this and did a good job of sorting it all out.” Brad recalls being “intrigued” with personal issues that the students were dealing with and commented that he “guesses he just forgot.”

During one of Brad’s first lessons, he learned the importance of being prepared. He believes that a teacher has to have one thing after another prepared or students “will take advantage and you will lose a little control.” During his first lesson he gave a lot of directions and thought that his directions were clear. But, after answering a multitude of questions from the students, he realized the importance over preparing a lesson and had underestimated the amount of energy required to teach a lesson. In this particular lesson, he had about twenty-two to twenty-three students broken into smaller groups. As he circulated from group to group answering questions, the forty-minute class flew by so quickly that he didn’t feel as though he had done enough to ensure learning. He was also astounded at the amount of energy it took to keep students on task and interested in the subject matter. He believes in the importance of having the activity “relate to the students’ lives” so that they are more interested and are “more likely to learn from it” (the
lesson). Brad’s goal in developing a lesson was to “bring something interesting to an otherwise boring subject.” Lesson design is critical to students learning the concepts.

Patrick

As Patrick reflected on his own suburban high school experience, he felt it was significantly different from the rural, middle school and urban high schools in which he was placed during STEP. Patrick was surprised by the “behavior of the students” in the two schools he taught in during his participation in STEP. In fact, he had to re-learn how students behave at different ages, which was definitely different “than the way he had behaved in school.” Patrick appreciated that the high school he attended provided him with exposure to a diverse student body, enabling him to adapt more easily to the various STEP classrooms.

Patrick joined Project STEP with no previous teaching experience, although he said he really enjoyed “helping people out.” As a STEP Fellow, he was required to participate in various STEP seminars and classes and felt that the courses were more beneficial to him because of his lack of experience. Patrick believed that the course work helped to better prepare him for designing, developing, and implementing lessons. He felt that the courses helped to train him to construct activities, plan lessons using standards and objectives, and utilize teaching strategies that most teachers “don’t really think about.” He continued to hone these skills throughout his two-year engagement in STEP as he gained more experience using the tools he acquired in the seminars.

During Patrick’s first lesson and throughout his first year, Patrick had several eye-opening experiences. Patrick’s first lesson consisted of a forty-five minute lecture without engaging any of the students in activities. He quickly realized that a high school student’s
attention span is about “ten minutes” and that they need “a change of pace, something to do, or hands-on activities.” He realized that hands-on were the kinds of activities students liked best and were also the ones that would help them “learn a lot better.” This shift from lecturing to hands-on activities was something that Patrick admitted “took him a long time to do.” The only teaching he had personally experienced in the past five years as a college student was lectures; he “forgot how middle and high school students learn.” It took Patrick awhile to successfully make the shift from developing teacher-centered lessons to student-centered lessons. By the second year, he felt he had developed lessons that were “much more interesting to the students,” and he thought the students “also learned a lot more as well.”

One of the most rewarding experiences for Patrick was when he presented material to students who were considered “the bad kids in class” and he could see “them actually learning.” He received comments from the teacher like “Wow, so-and-so never pays attention” but was engaged in this activity. He surmised that the teachers “never realized that this student was capable of understanding the material.” He said he found it “very satisfying to teach someone something new and to see them learn it and understand it.” Patrick pointed to some of his greatest experiences being when students asked him about “what it is like to be an engineer” or about “life in general.” He felt free to be honest with the students and privileged to be able to “provide guidance” and be a “role model.” Any time he had an opportunity to share something, beyond the subject matter in “textbooks” and get the students “excited about their actions and work in the classroom, he felt that he was helping them down the road,” which was personally “very satisfying.”
One of the realizations about teaching and learning for Patrick centered on presenting material to a group of students. As a student, Patrick believed that “the material was very straightforward.” When he moved into the classroom, he realized that he had to “present the information in a very different manner.” Patrick didn’t realize the extent of off-task behavior required. He also came to grips with the work a teacher needs to do in order to keep the students engaged enough to bridge the gap between teachers and learners. In creating lessons, Patrick also made some assumptions about student knowledge. By “covering the basics before jumping into the material,” he was better able to make sure everyone was “keeping up and understanding what was going on.”

Another part of the teaching and learning process for Patrick was learning how to explain things in a simpler manner by using other examples. Explaining concepts in different ways gave him an opportunity to reach different learners because “not all students learn the same way.” Recognizing that explaining it “two or three different ways targets a larger percentage of students who can understand it,” Patrick was able to increase student knowledge in a more meaningful manner. As Patrick became more comfortable designing lessons, he also began realizing the importance of consulting the teacher’s expertise in the classroom. He felt that teacher experience helped to provide him with guidance, particularly when he was developing an activity. This appreciation for the art of teaching and the effort teachers put forth to create engaging lessons continued to grow as Patrick developed professionally.

Overall, the tools and skills that Patrick developed and polished over the two years that he was involved in STEP, provided him with the ability to engage students in fun activities while learning. Even though teachers don’t always “know which tools to
use, they at least know which options are available to choose from and are prepared to use the different options.” Patrick also understood that the longer one works with students, the more “a teacher learned their tendencies,” and the easier it was to engage them, especially if a teacher uses examples focused on the students’ interests.

Michelle

When Michelle joined STEP, she was interested in branching outside of her Computer Engineering co-op experience. Knowing that she enjoyed working with students, STEP provided her with an opportunity to take some education classes and find out more about urban classrooms. Although Michelle ultimately did not pursue an education degree after her bachelor’s because she felt like she would “miss being in the corporate environment,” she did feel that, in the future, she would continue to seek out volunteering opportunities in education, such as tutoring, in order to continue working with students—something she very much enjoyed. She also believes that teaching is something she “could go back to” if she was still interested.

Michelle’s favorite part of participating in STEP was working with students, particularly the seventh grade class. She found these students “easier to work with than the tenth graders” because they seem to have “more fun” with the projects. The tenth graders didn’t view the activity as “anything special or fun.” Although she “generally likes working with students,” Michelle thought it was “cool” if she could help the students understand what they were learning through real-world application.” When the activity had an “impact outside of their class, something that actually happened, something that people were actually using in real life,” she found the experience even more rewarding.
Michelle’s favorite lesson she taught was in a seventh grade class where they were talking about plate tectonics. Michelle and Brian created a lesson around natural frequencies that included the students constructing buildings and then placing them on a shake table to determine their susceptibility to earthquakes. This engineering-related simulation was very “applicable to what a civil engineer is really trying to do.” Michelle felt that they “all came away with learning something new, but had a really fun time doing it, too.” Real-life simulations are something that Michelle applies to her job today. She takes data and applies it to a scaled-down version of a new product launch to test her methods prior to the full launch.

During another lesson, Michelle learned something else very valuable. In a chemistry unit where they were “talking about the ways molecules are arranged,” she introduced an example using her hair. She described her hair when she went out in the rain and when she used a curling iron. When constructing the example, she failed to consider the differences between her hair and her students’ hair; all of her students were African American (Michelle is Caucasian). Michelle quickly realized that “you can’t assume everyone has the same experiences that you do” and recognized the importance of structuring a lesson “around different peoples’ backgrounds.”

This chemistry lesson triggered other teaching and learning understandings for Michelle like the importance of structuring a lesson to suit different students’ learning styles. She discovered that some students “think about things or approach problems completely different” than she would. This provided a much different experience for her than tutoring had, where she only worked with one or two students at a time. The challenge of acknowledging the various learning styles within a large group versus being
able to get inside a single person’s head intrigued and interested her. Sometimes Michelle had to concoct as many as six different examples while trying to find the one that would best fit the majority of the class. Through trial and error, she would usually find the right example. It was especially rewarding for Michelle when the teacher asked if they could spend the rest of the class on one type of problem because the students were really catching on. The “best days” for her were “when things were clicking and going well.”

Throughout the year, Michelle also had opportunities to share her college studies with her students. In the beginning, she shared her feelings about what it was like to be in college and what she was studying. Later on in the year, during Career Day, Michelle had the opportunity to describe, in more detail, her “background, co-op experiences, her research, where she was coming from, and other stuff about herself.” Michelle also enjoyed “getting their perspective on things.” Overall, Michelle really enjoyed her experiences in the classroom and felt that they positively affected her in so many different ways. The most rewarding part of her experience was “seeing how things all work together as a whole and how she could go beyond what she was studying” to accomplish so much more. STEP gave her the “confidence to try other things.”

Brian

Brian’s participation in STEP lasted three years, longer than any other of the interviewed Fellows. This unique experience, along with Brian’s changed career goal toward becoming high school mathematics teacher rather than working as an Electrical Engineer, provided him with a somewhat different perspective than the other Fellows. As an engineer, Brian felt that he could not make as big of an impact on lives as he would teaching. As an engineer, he realized that he could be earning twice the money and would
probably not be as stressed out as he is teaching. But Brian believed that teaching will be worth it in the long run and that “something good will come of this.” He also believes that as he continues to develop effective teaching strategies, teaching will become easier. Brian has always enjoyed helping students engage in the lesson and make connections. Seeing and experiencing this process through STEP provided him with the added incentive to pursue a career in teaching rather than in engineering.

Since having his own classroom, Brian realized the importance of the first couple weeks of classes. While Brian was in STEP, he wished he had been able to observe how teachers organize and structure their classrooms, particularly in those initial weeks. Having never observed this process, he thought that it would be so much easier that it actually was. There was one teacher, in particular, that Brian felt he could have learned so much from, if only the school had allowed him in the classroom during the first week. Unfortunately, all of the Fellows were asked not to attend this particular high school those first few critical weeks when the teachers put procedures and classroom rules in place. Although Brian admits that observing is not the same as having your own classroom, he feels he would have benefited from the experience. Brian understands that he needs to be “out there learning, messing up, fixing it, and doing it all over again” in his own classroom--in other words developing his own, unique teaching style.

Brian believes that he is a “pro at winging it,” but also understands that he needs to learn more discipline--something he is working on with his public school mentor. Part of discipline for Brian is the organizational component necessary for truly effective teaching. Brian typically does not plan further ahead than the next day’s class. When students are sent to In School Suspension (ISS) or are absent from the classroom for
several days, he does not have the material ready ahead of time, which prevents him from effectively helping students not in class every day. He does hope that as he becomes better prepared, he will develop at least some of the materials in advance and can better accommodate all students—even the absentees. Teaching for him is a constant juggling act to find the time to prepare, get enough rest, and have a personal life. When push comes to shove, he feels that he is better off getting some sleep and than determining what he needs to do for his afternoon classes because he has the advantage of having a two-hour break between his preps to use for that purpose. Brian enjoyed the time he spent in STEP classrooms, but quickly came to believe that “it wasn’t really teaching.” Since having his own classroom over the past year and a half, he has learned that “teaching is a lot broader than what he thought it was and it takes a lot more time.”

The STEP experience also provided Brian with the opportunity to work with “kids rather than adults.” Brian was interested in the “possibilities” of working with younger people. Brian had a student who was “one month away from graduating” (a senior) but decided to drop out. The student was a writer and wrote Brian a letter. Brian was unsure about what to do with the student, but decided to share the student’s writing with the class. Although Brian wasn’t sure if this was the “best” thing to do, he felt as though everyone learned from the experience. The student matured and eventually went on to graduate and attend college, periodically keeping in touch with Brian. Brian realized that not everything he does in the classroom can be this causal, but fully understands that he can “make a positive impact on a student’s life.”

Brian believed that one of his strengths is having a good rapport with his students. He felt that “the kids can open up” to him and they can tell him “something that may hurt
someone else or tell him something they may not tell another teacher.” Brian replied “I love taking feedback.” His goal is to stay open-minded and appreciate the feedback from students, teachers, and his mentor alike. Brian hoped to grow as a professional and feels that if he works long enough, he will have so many procedures and management techniques developed that his classroom will run much smoother.

Brian developed activities based on concepts that had already been taught. As beneficial an experience as this was for Brian, he spends most of the time in his current position teaching new material. He wished he knew how to present these concepts to students and had the tools necessary to predict their questions. Brian struggled with “how a teenager’s mind works.”

Overall, Brian has always enjoyed helping students make the connection and watching them “really get into the lesson.” Seeing this and experiencing this process through STEP gave him the feeling that he was really able to make an impact on a student’s life. The observations Brian made while in STEP provided him with real examples of how to “write on the board, how teachers organized their classroom, how groups work together, and what kinds of rules and procedures were in place.” But while he was in STEP, these “didn’t hit home” for him until he had his own classroom. It is taken awhile, be he thought he is “getting there.”

Summary of School Experiences.

Throughout each Fellow’s school experiences, individual experiences varied but some common themes emerged. These themes include previous high school experiences were much different than their STEP school placement; creating engaging and fun lessons were the goal; creating lessons that related to student backgrounds and learning
styles was key in effective lessons; all Fellows felt that they learned valuable insights into high school education; the interactions with the students were an enjoyable part of the experience; and the most rewarding experiences were watching the students have fun while learning. It is also apparent that Patrick, with the least amount of teaching experience, learned more than Michael, who had already taught a full academic year before entering the project. The remainder of the Fellows fell somewhere in between. But, most importantly, each Fellow walked away from the school experience believing that the STEP experience was very valuable to their professional growth and felt they had a much better understanding of education than they had pre-STEP.

*Individual Skill Development through Involvement with STEP*

Through each Fellow’s STEP participation, individuals were able to hone and develop skills that enabled them to succeed in their current professional and educational endeavors, regardless of the path each chose to pursue. Each Fellow’s skills are described below and are also found in Table 7.

*George*

Over the course of George’s one-year participation in STEP, he gained an altered perspective on teaching and learning, in addition to developing skills to use after leaving the project. One of George’s first realizations was when he developed and taught his first lesson. He thought he “could wing it” (the lesson), but as soon as the students started asking questions he “became stumped” and realized that he needed to practice the lesson prior to teaching it. He also clearly understood the importance of thinking through the different perspectives the students might have that could alter the direction of the lesson.
He understood the need to conceptualize different scenarios and be ready to handle student difficulties.

George also experimented with the use of humor in the classroom. The teacher he worked with was more of a “drill sergeant” than he was. Although he didn’t want to step on the teacher’s toes, he needed to find a teaching personality that suited him best. While in the classroom, George used humor to keep the kids’ attention and to create a “cordial” environment where the students would want to do the work. He learned that “making fun of myself is always a good tool.”

During his STEP experience, George took the opportunity to take extra classes that were not required by STEP. Although he didn’t feel that the teaching strategies were awe-inspiring, he did realize that the “little things that make a difference.” He utilized these strategies to make his lessons better by using wait time, calling on students by name, calling on different students, and using fun tools to teach a lesson. He found that these small things engaged students in the lesson and created a learning environment that suited the students as well as him.

Part of the learning experience for George was utilizing more communication skills. He realized the importance of “knowing your audience” in order to help them achieve the lesson’s objectives. He understood that by making small adjustments to a lesson, he could keep the same core concepts and teach it to a lower or higher grade. After finishing a lesson, George also took the opportunity to reflect back on the project and think about ways he could have done it “better or more efficient.” He also thought about what strategies he could use to make the “kids feel STEP and important because
they need to believe that they can do it.” He believes that the more “confidence you can build (in a student), the more material you can cover.”

During the STEP experience, George also came to a personal realization: He realized that he did not have to be the best in his field. He began “mellowing out” about his career choices. And although he wanted to excel, he could be happy without striving to be the best. He is not sure if his “happy where I am” attitude was a direct result of being in STEP, or just a part of his personal journey and evolution.

By the end of his STEP experience, George appreciated how much more work teaching involves—much more than he had ever realized. He came to respect teachers that “deviated from the norm and built relationships with students.” George never “admired teachers before participating in STEP; he just didn’t care.” During his undergraduate experience, he was more astounded by the material, not the way in which it was taught. Once he started to get a grasp on the material, he then began focusing more on how the teacher was teaching. He realized college professors were using the same formula to teach, but that high school teachers did so much more. This revelation made him want to be a better college professor. He wants to “give projects to students that they will actually enjoy.”

Michael

As Fellow who had previous teaching experience, Michael understood the importance of developing sound lesson plans. In the course of his STEP involvement, he found STEP’s requirements for writing lesson plans to be much more demanding. He adjusted by writing more details in his lessons than he previously had done, creating lessons that other teachers could read and use. He also found it important to “anticipate
how groups of people might react to what you are telling them.” In his current engineering job, Michael writes project proposals that are presented to a number of different people, some of which are “not technical.” This requires him to bring them up to the level where they need to be to understand his proposal and then present the information in a manner that can be easily understood by the layman. Michael likens this to “lesson planning and working with a bunch of IEP students” (Individual Education Plans for special needs). One must “know their personalities” and then find a way to communicate the information in the best way possible.

Michael also claims that his public speaking experience, gained through STEP, is a “gigantic career advantage” in his current employment. Often times, engineers don’t want to get up and talk in front of a room full of adults, but if “you say I’ll do it, you will get noticed for sure.” Michael also had the opportunity to present his STEP lessons at three different conferences and to write short conference proceedings papers, which provided valuable public speaking experience and the opportunity to communicate with different audiences.

Brad

After the STEP experience, Brad said he “definitely felt more prepared to teach at a community college.” As described previously, Brad learned the “importance of good preparation for a lesson plan” whether it is for a high school or college course. Even though he only taught five or six lessons, he felt that this experience was much better preparation than a teaching assistantship. He felt he had the knowledge and experience of what it was really like to teach and it gave him a “good feeling of being able to evaluate students correctly.”
Brad often times reflects on his teaching and his communication with his students. Although he likes to joke with his students, Brad also learned that there are “boundaries you don’t want to cross.” While in the high school classroom, Brad’s teacher was able to joke effectively with his students. Balancing professionalism with humor is something that Brad hopes to improve in the future. By reflecting on conversations and emails between himself and his students, Brad keeps a constant eye on his tone while communicating with his students.

Another skill Brad mentioned as being important to him during his STEP experience was the development of his portfolio and contributing to the STEP one. He had only minimal experience with Web development, but quickly learned how to decipher different guidelines for Web sites and has since offered to update Web sites for his colleagues. It is definitely something “good you can put on your resume.”

Brad’s overall high school classroom experience taught him many valuable skills that he hopes to continue using in the college courses he teaches. Although he did enjoy working with high school students, Brad also realized that he prefers to teach in a Tier II or III college, where teaching is valued more than research. He “enjoys teaching and interacting with students.”

Patrick

Patrick’s plethora of experiences over a two-year period provided him with valuable skills to utilize in his new position along with increased teaching and learning expertise. As a graduate student, Patrick toyed with the idea of teaching; but, after participating in the STEP program he was “less eager to teach high school.” He thought that “it was a lot more difficult than what he expected it to be.” He explained that it
wasn’t that he had a “bad experience,” but that he wanted to accomplish something in a different way. He thinks that down the road “teaching might be an option.”

As Patrick’s confidence and teaching ability improved he focused more on “what students were understanding and what they were not getting.” He used this information to “build on for future activities.” These factors, along with learning more about the students and more about himself as a teacher, provided Patrick with the feeling that “the jump between the first and second year was enormous.” He believed his activities in the second year “got even better.”

Teaching also provided him with the opportunity to “present in front of large groups of people, something he never really felt comfortable doing.” As Patrick gains more responsibility in his current position, opportunities for presenting to his team, larger groups, and for training purposes increase. He is expected to take on “more leadership roles,” which includes leading audiences and presenting in front of larger groups. As a result of his STEP experiences, he feels more confident moving into this type of role. He feels that it is “more intimidating to talk to a group of fifteen-year olds” than to talk to a room full of adults.

Another skill Patrick felt that he learned while he was in the project was Web development. Through a STEP course, he learned how to create a Web page, connect links, and post his own lessons. He felt his Web site was a “great resource for the teachers so that the team could download lesson plans and attachments.” These were skills that could be “applied anywhere--personally or professionally” and could also be an asset on a resume, regardless of its direct influence on particular employment
opportunities. He deemed these as skills he, more than likely, would not have developed without his participation in STEP.

As a relatively new employee, Patrick began working in his current position by asking questions of others. But now, colleagues come to him with questions, which he is expected to answer. He says it is “nice to offer advice and help other people out when he can.” Although he may or may not gravitate toward teaching in the future, he still enjoys helping people whenever possible.

**Michelle**

Throughout Michelle’s one-year participation in STEP, she felt that she developed several useful skills which she continues to use in her current avocation. As a senior in computer engineering, Michelle had an opportunity to focus her capstone project on her STEP experiences. She used this opportunity to reflect on each module by writing general summaries of each. These general summaries consisted of various pieces, including; the “process of putting together the project, how the lesson went, how the students reacted to the lesson, and how the students scored on tests, etc.” Reflection is also a skill that Michelle uses daily in her job. With each client, she feels that she has the opportunity to learn something new. Part of this process for her is determining what she would and would not do again and writing it in a project summary. This is very similar to her reflection in STEP, in that she would complete a monthly summary of her work. She documented her work “in case anyone would have to come back and repeat” what she had already done.

One of the “more interesting things” Michelle learned in STEP was “taking something that may be a concept of some kind and deciding how to fully explain it on a
level a seventh grader or ninth grader could understand.” This is a large part of her current job where she takes a “large amount of data, analyzes it, and finds a way to explain it on a usable level to her client.” Much of her time is spent processing the information to the point where she understands it and then the remainder of the job is finding user-friendly ways to present it to her clients. She believes there is a “creativity aspect to it” because she is continually searching for ways to communicate the information effectively--so that it is actionable and her client can “take the information and use it.”

Communicating is also a skill that Michelle finds herself spending a lot of time doing in her job. Part of communication is presenting material. This is something that she is starting to do more of, although it admittedly makes her “very nervous.” STEP “got her in front of groups of people talking about things and explaining things, which has been very helpful to her and something she wanted to gain from the experience.” As she grows in her current profession, she feels that all of these skills acquired through STEP will better enable her to succeed in her chosen profession.

Brian

STEP provided Brian with an understanding of the complexities of teaching high school. In his three-year participation with STEP, Brian designed, developed, and implemented over ten lessons. He spent countless hours researching, planning, and collaborating with others in order to create engaging lessons. Although Brian realizes that he doesn’t have the time necessary to create these kinds of complex modules today, he does appreciate how much he learned about standards, Bloom’s Taxonomy, benchmarking, and the process of planning an activity--tools he now uses in his
classroom every day. Teaching modules also gave him extensive occasions to work with large and small groups of students. The more lessons he taught, the more his confidence level increased. As he continues to teach full time, he expects this to increase considerably more.

STEP also afforded Brian the opportunity to hone his communication skills while in front of students and teachers. He learned how to think more quickly on his feet and process answers to student questions on a dime. Another skill Brian further developed was collaboratively working with teams. Although the teachers in his team do not develop lessons together, he hopes that this will be possible in the future, once he feels more comfortable teaching.

The main benefit Brian derived from STEP was being put “in contact with the right people.” Without STEP, he wouldn’t have gone into teaching or pursued it nearly as far as he has. Mainly, it is because of “all the contacts, knowledge, and experience he had” during STEP that encouraged him to pursue his current profession.

Summary of Fellows’ Skill Development.

Overall, the Fellows expressed appreciation for their experiences in STEP as they relate to skill development. There were specific examples that each of the Fellows shared, but there were also collective themes around which skills were developed. One core area was related to communication. Whether the Fellow specifically discussed speaking in front of an audience or not, each of them said that STEP gave them an opportunity to practice their communication and presentation skills. All agreed that, even if they were not currently making presentations to others, this was something they would be expected to do in the future as each gained in leadership capacity in their respective fields. Four of
the six interviewed specifically stated that this experience gave them more confidence speaking in front of others.

The other core theme that arose from the data was the increased knowledge of effective teaching and learning strategies. Michael was the only Fellow with prior extensive teaching experience, and even he admitted to learning more about teaching high school students and about how they learn as result of his STEP participation. Patrick, with no previous teaching experience, shared that he learned a tremendous amount about the process. Each Fellow also expressed a greater appreciation for teachers in these settings and the amount of work involved in creating a quality lesson. The rigor expected by the Fellows increased their knowledge and expertise in the classroom.

Impact from Non-Scientist on Individual Research

One of the National Science Foundations goals for the GK-12 program is to engage non-scientists in conversations with graduate students about their research, hoping that new ideas will be generated. While asking each of the Fellows about their participation in these types of conversations, all of them stated that, if they did talk about their research to a non-scientist, it was usually in very general terms. The Fellows didn’t go into great detail about their research because they felt it was, more than likely, over the person’s head. Therefore, no new ideas were generated as NSF had hoped, nor was there any change in each Fellows thought process as it relates to their research.

All Fellows stated that the most influential factor in guiding their research was interactions with their advisors. Brad, George, and Michael did receive some input from other graduate students, although their advisors were still most influential in guiding their research. Brian and Michelle both focused their undergraduate research on their STEP
experience, and Dr. Kathy, who was both their academic advisor and their STEP advisor, was able to provide them both with valuable insights through their interactions. All Fellows stated that conversations with their advisors were most valuable to them in directing their research. Additionally, conversations with other scientists in each Fellow’s field provided some insight into the research process. Brian recalled one specific conversation at a professional conference that sparked new ideas about what he could create with his research after finishing his thesis. Brian is keeping these ideas in mind as the basis for a summer project that could potentially generate some extra funds outside of his teaching employment.

*Contributions to the Betterment of Society - Volunteering*

Another of the National Science Foundations’ goals for the GK-12 project focuses on the hope that, once Fellows leave their respective programs, they would become interested in writing collaborative grants, building bridges between industry and education, and engaging in other educational endeavors. In order for the Fellows to have opportunities to engage in these types of activities, they must first have established themselves in their respective professions. At the point where all the Fellows were interviewed, they had been out of the program two and one-half to three and one-half years. While this is sufficient time for those working in industry or teaching to start becoming established, that is not necessarily true for those pursuing higher education. At this juncture, all but one Fellow, Brian, had engaged in some type of volunteer activity. George spent six months mentoring a twenty-one-year-old male coming out of prison, assisting him to get back on his feet.” Currently, George’s graduate program is
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consuming all of his time. Once he finishes his degree, he plans on finding other
volunteer opportunities because he finds these kinds of experiences rewarding.

Michael has several friends who are teachers in New York City schools and he
worked to convince his department head that he and his colleagues should have the
opportunity to go into the classroom and assist the teachers with engineering/educational
projects. Michael was excited to have the opportunity to visit a school once a week for a
semester. He was able to provide technical support to the teacher and ask the students
provocative questions to help them critically think through their design projects. Michael
found this activity both “fun and enjoyable,” although it wasn’t quite as deep of a
learning experience for him as STEP, which he still terms as “useful.”

Through Brad’s research department, he had the opportunity to mentor a junior
high school student when a group of them spent six weeks in his lab, working on
problems and using some of the equipment. Brad enjoyed “helping the students out with
their problems and talking to them about stuff.” Brad also invited a high school junior to
a college lab he was conducting. The student participated in the activities and “had a
good time.”

Michelle has always been interested in volunteering her time, especially with
grade school students. As an undergraduate, her sorority volunteered for many different
mentoring and tutoring projects. Participating in STEP was a natural position for her as
she would have even more opportunities to teach and mentor students. Since leaving the
STEP program, Michelle has volunteered for the Big Brothers Big Sisters program as
well as tutoring a couple of girls every week. She enjoyed volunteering so much that she
has actively “sought it out” since graduating from college.
Patrick, on the other hand, has not had any opportunities to work directly with high school or middle school students, although he gives to the United Way, helped to renovate a building by doing construction work, and is involved in various fundraising events. All of these philanthropic activities came about through his employer and Patrick is unsure as to where to obtain information about other types educational volunteer opportunities. He would be open to considering education volunteer work if the opportunity arose.

Brian is the only one of the six Fellows who was not involved in any educational volunteer activities. While pursuing an engineering degree, Brian decided to become a full-time high school teacher and is actively involved with secondary school education on a much deeper level than any of the other five Fellows. However his schedule does not allow time for any volunteer activities.

Fellow Suggestions

Overall, all of the Fellows thought the STEP experience was beneficial on many different levels and were grateful for the experience. But there were a few general “wish list items” that several Fellows would have wanted to experience if they had the opportunity to re-live the experience. It is important to note that five of the Fellows interviewed took part in the project in the first two years of the program; one of the Fellows participated for the first three years. Each of the Fellows who offered suggestions for improvement believed that many of the problems were directly attributable to the newness of the program. The Fellows understood that the PIs were still trying to establish the mechanics of the program, which explained the relative sense of disorganization at times.
Another Fellow expressed frustration with changing expectations. “I would have asked for clearer expectations from the beginning.” He felt that the expectations for the Fellows, as well as for the teachers, could have been made clearer. As stated before, most of the Fellows had little or no formal educational training prior to going into the classroom. For the most part, they did not understand lesson development or teaching. They were looking to teachers, advisors, or PIs to explain the teaching and learning processes to them more clearly. Although the Fellows were involved in a seminar in which the grant coordinator imparted the fundamentals of teaching and learning, they were looking for their classroom teachers to help fill in the gaps–something the middle or high school teachers may not have realized. Fellows who stayed in the program for two years indicated that, by the second year in the program, they were feeling much more comfortable with the entire process. Each Fellows comfort level increased as a result of more seminar experiences, clearer expectations, and greater organization.

_Historical Attitude Surveys and Tracking Documents_

When reviewing the historical tracking documents from each of the six Fellows, it is apparent that, although four of the six Fellows completed the online form, details about their experiences were not included due to the brevity of the document. Only basic information was provided in these documents in order to corroborate Fellow interview answers. Fellows provided current contact information; degree status, program and graduation date; in addition to short responses to the following questions:

- How has Project STEP helped you in your professional development?
- List employment and/or research opportunities are you currently pursuing that are related to your work in Project STEP?
• In what ways are you currently involved in science and/or mathematics education (as employment or volunteer/professional development)?
• What advice do you have for secondary school students interested in a STEM career? (Table 9).

This research study provided valuable insight into the ongoing application of lessons learned as described previously in chapter 4.

Previously completed pre- and post-test attitude surveys revealed several important factors that corroborate the findings of this research. These include the Fellows developing: (1) increased confidence in teaching math and science due to course participation and experience in classrooms; (2) increased confidence in creating effective lessons; (3) increased knowledge of standards, pedagogy, and connections between learning and practice; (4) increased confidence in one’s abilities to impact student learning by helping students relate to content; and (5) the ability to positively impact student learning by helping students grasp the connection between learning and practice. There was no evidence to indicate that the Fellows’ attitudes about math or science changed over time.

Attitude survey data also provided evidence of Fellows acknowledging their “weaknesses” in teaching. Prior to entering the classroom, the Fellows believed they had the skills necessary to teach effectively in a middle or high school classroom. Once in the classroom, however, each realized the importance of learning teaching and pedagogy. During the course of their STEP experience, Fellows also expressed increased appreciation for teachers. Many believed they could teach simply because they had attended school. This myth was challenged by the Fellows and their appreciation for the
profession grew. Fellows also tended to rate the importance of the skills they were teaching higher than their confidence in being able to use these skills (Koehl, Soled, Kukreti, and Fowler, 2005) indicating that rate confidence is higher and skills are even more important than originally thought.

Chapter Summary

This chapter recapped the personal experiences of the six Fellows based on their educational and professional aspirations before and after entering STEP, their collaboration experiences, their school experiences as they relate to teaching and learning, and their overall skill development acquired as a result of the STEP experience. What emerged are collective themes in each of these areas. These themes are described at the end of each section and will be expounded upon further in chapter 5.
Chapter 5: Analysis of Findings and Implications

Introduction

Chapter 4 focused on individual findings as well as collective themes, while chapter 5 correlates these findings to the questions this research set out to answer and the literature that was expounded upon in chapter 2. The themes are interwoven within the research questions, but it is not sufficient to merely answer the questions; one must answer why these findings are similar or different from the predicted findings. It is important to remember that the themes were driven, in part, by the questions posed, as well as by the data collected. The themes include descriptions of past, present, and future professional and educational goals; collaboration experiences with Fellows, teachers and PIs; individual school experiences as they relate to their perspective on teacher preparation, teaching and learning; the impact STEP Fellowship experiences had on their skill set as useful for future employment; the impact of non-scientists on their research; contributions to the betterment of society through volunteer experiences; as well as suggestions for improvement. The four research questions asked include: How did participation in Project STEP affect the academic and professional choices Fellows made since leaving the project? How has the skill development in the areas of learning to teach, build, and maintain partnerships and active involvement in K-12 learning communities affected the career choices of the Fellows? How are these skills being utilized in their current professions? How did this skill development affect each Fellow’s ability to successfully gain employment? Each of these questions was answered in relation to the findings and literature. Each of these questions was discussed separately in this chapter as they relate to the findings, followed by implications and a final summary.
Research Questions

Research Question I: How did participation in Project STEP affect the academic and professional choices Fellows made since leaving the Project?

As stated in chapter 4, each of the Fellows entered the program with different experiences as well as with different academic and professional goals. One Fellow continued his career path exactly as he had planned, two took completely different career paths, and three made slight adjustments to their goals. This is consistent with Green’s (1997) research where he states that “in every field of study, at least some people who prepare for a specific occupation end up working in another.” Each Fellow felt that they were able to “transfer their specialized knowledge” (Green, 1997) to a career about which they felt more passionate. Up to this point, none of the Fellows has changed careers since beginning to work in their current profession, which is atypical (Green, 1997).

Two of the three people who chose to make adjustments to their careers and educational goals, opted to “maximize their career options” (Bruce, 1997) by going into teaching. This shift from engineering to education was due to spending time in the classroom and realizing that teaching was something they wanted to pursue full time. One Fellow chose the high school setting while the other opted for shifting their interest to a Tier II or III institution where teaching is more highly valued. In making this decision, both Fellows needed to adjust their educational aspirations. One Fellow chose to obtain a teaching license while the other opted to pursue a different academic interest, physics. He decided that physics would provide him with more opportunities to teach at various types of colleges, not just Tier I institutions where research has a higher priority than teaching. Understanding the difficulty in successfully gaining employment in a Tier I institution
and realizing how much he enjoyed teaching helped him decide to switch majors, so that he would have a higher likelihood of finding suitable employment. Knowing one’s interests and pursing them is a clear path toward a successful career (Green, 1997). It is expected that all six Fellows will feel successful in their educational and professional endeavors, regardless of the avocation they choose.

Determining the “long-range employment demand” (Bruce, 1997) is also crucial to being gainfully employed. Although all six Fellows have considered this, two acknowledged that they purposely took this into account through strategic positioning. Currently, high schools are in dire need of qualified math teachers. By participating in the AEL program, Brian positioned himself in a guaranteed teaching position for three years and has the opportunity to have his student loans paid off by the district. Brian was also provided with a mentor for this time period, which ensures successful professional development and increased skill. One Fellow, George, took an enormous leap of faith and switched majors to biomedical engineering, a field not as clearly defined. Even though his choice meant taking a pay cut and dealing with a lesser demand for biomedical engineers, George is willing to compromise his original goals for his passion. Being “versatile and unafraid to step into unfamiliar territory” (Bruce, 1997) allowed Michelle to change career focus. The STEP experience provided her with the necessary confidence to branch into a different career--a level of confidence that her computer engineering background failed to provide.

Research Question II: How has the skill development in the areas of learning to teach, building and maintaining partnerships, and active involvement in K-12 learning communities affected the career choices of the Fellows?
The STEP experience provided all but one Fellow with a newfound opportunity to gain a firsthand cultural experience of under-resourced education in America. Five of the six Fellows had never had an opportunity to intimately work with middle and high schools students in this capacity. All of the Fellows, including Michael, gained a deeper understanding of the pedagogy and training necessary to implement effective teaching strategies in a classroom, something most college students never have the opportunity to explore.

Working with urban teachers, faculty, research advisors, and other Fellows provided the participants with a unique opportunity to collaborate on many different levels of K-16 education. Learning how to work as a team member, ask questions, communicate clearly, and fulfill grant obligations provided each Fellow with a plethora of new experiences. Collaboration, at times, proved challenging; but, it was also an aspect each Fellow appreciated and even wished they had the opportunity to experience more. All Fellows understand and look forward to more opportunities partnering with others in their careers and through volunteer opportunities. It is not clear whether or not their participation in STEP influenced their careers based on educational partnerships, although each Fellow looked for opportunities to collaborate with others in his or her current profession.

Research Question III: How are these skills being utilized in their current profession?

All Fellows felt that organization, data analysis, and communication are key skills used in their current professions. Not only must they have the ability to analyze and interpret data, but they must also be able to communicate their findings effectively to others who may not have the technical background to understand it. For example,
Michelle’s use of data analysis “allows her to think creatively and apply knowledge to achieve a goal. Problem solvers are investigators. They ask questions, analyze information, draw conclusions, and take action toward remedies or improvements” (Jones, 2003). The STEP project encouraged all Fellows to practice these skills.

STEP provided the Fellows with firsthand teaching experience. When most graduate students are asked if they feel prepared, especially to teach, most feel that they are not (Rice, 1996). On one hand, Brian felt under prepared to teach, while Brad felt as though he was thoroughly integrated into teaching and had mastered many required skill sets, even some he had not anticipated acquiring through the STEP experience. Brian felt that he needed to learn many more skills in order to be prepared to teach full time in a high school. This could be attributed, in part, to Brian’s self-proclaimed “lack of organization,” or it could be a result of his STEP experience. Brian did admit, however, that STEP provided him with the basic information, but that he needed to work much harder to fully acclimate himself to his new profession. It is important to note that most teachers feel inadequately prepared, even when they participate in a formal education program (Keiffer-Barone, Hedricks-Lee, and Soled, 1999).

Many professions require employees to solve many different management problems such as strong interpersonal skills, written and oral communication skills, leadership ability, creativity, and flexibility (Jones, 2003). Many of these skills were necessary in the day-to-day functions of the fellowship. There is not a single aspect of the STEP experience that can be attributed to the development and implementation of these skills, but rather an accumulation of the year-long fellowship experience that supplied the
intuitiveness to utilize these skills—all of which are used currently in their respective occupations or will be in the near future.

Active participation in volunteer activities, especially with students, is also one of the ways in which Fellows are using their skills. Thoughtfully utilizing pedagogical knowledge and practice takes a concerted effort. Five of the six Fellows have had the opportunity to spend time with students. Patrick, the sixth Fellow, doesn’t volunteer with students in any capacity. This extra effort demonstrates the Fellows willingness to contribute to the betterment of society, particularly in the area of education. Not only have the Fellows demonstrated “leadership skills, focus, drive, and skill development” (Bruce, 1997), they have also served as role models to under-resourced, urban students.

Research Question IV: How did this skill development affect their ability to successfully gain employment?

One critical aspect of gaining successful employment is the ability to distinguish oneself from others in the field (Bruce, 1997). The STEP experience provides this experience for Fellows through training above and beyond what normal students experience. Seminars, practical experience, Web designing, presenting lessons at conferences, and teaching are just a few of the opportunities that distinguish STEP Fellows from their colleagues in their perspective fields. Fellows are also encouraged to lead, organize, further develop communication abilities, and make meaningful connections with students and teachers. Brian found the credentials he had earned and contacts made during his STEP experience to be “invaluable” (Green, 1997) for successfully finding employment. In fact, these connections were able to help him secure a position in a field in which he had limited experience.
Another quality that helped all Fellows successfully gain employment is their abilities in “putting oneself up front and not fearing rejection” (Greene, 1999). Several Fellows specifically stated that they developed the necessary confidence to make changes to their career aspirations. Confidence is also critical in presenting oneself to a potential employer. Through further development of these skills, the Fellows have been able to find satisfying employment, something most of America has yet to find.

Development of communication skills such as “selling yourself” (Greene, 1999) was also necessary for distinguishing oneself from “the pack.” Although not often compared, teaching and selling are more similar than one might think. In order to successfully engage students in a lesson and manage learning, the teacher must delve into the students’ backgrounds and determine their interests in order to successfully tailor the lesson to diverse learners. Similarly, if a person is interested in securing a career in the corporate world, they must also find out about the company, accurately determine what kind of person they are looking for, develop the skills needed for the position, and finally convince the employer that they are the best candidate for the job. Kerr and Runquist (2005) found the following to be true;

We need scientists who have cultural competencies, excellent communication skills, … scientists who have the ability to work with others within interdisciplinary, problem-solving teams, data analysis skills, a passion for life and learning, good work ethics, maturity, and a broad background with the ability to move effortlessly from science to business to humanitarian issues. (p. 231)
Employers are looking for skilled workers and “engaged citizens” (Schmidt, 2004). Fellowship experiences provide evidence that the students are not merely concerned with their own educations, but are also willing to take the extra step to help others in their educational endeavors. What better proof of “engagement” is there than college students who spend hours every week designing, developing, implementing, and assessing lessons for under-resourced students?

Project STEP provided the Fellows with the opportunity to take classes not ordinarily offered in engineering programs (Green, 1997) and learn teaching skills by working inside of a classroom. Many of these skills cannot be taught, but must be experienced by working inside of a classroom. Providing the students with a well-rounded education could be one of the reasons all six Fellows became gainfully employed or were accepted into graduate programs immediately after or during their participation in the program.

Academic faculty, corporate recruiters, and other professionals have a “keen eye for spotting the most talented and ambitious” (Bruce, 1997). By providing college students with additional training associated with pedagogy, theoretical frameworks for teaching and learning, and opportunities for mentoring in these areas, there isn’t an organization in the country that would not find these skills valuable. Whether one is a salesman, engineer, or analyst, budding leaders need to have effective communication abilities, team-building skills, and organizational and planning expertise, as well as teaching abilities; all of which are beneficial in any profession.
Predicted Findings

Qualitative research lends itself to unpredictability at times. The researcher cannot always know what one will find, although some predictions can be made. At the beginning of this study, six predictions were formulated based on previous research. Although none of the predictions relates directly to career and educational choices since no previous GK-12 research exists, the predictions were based on themes which could arise and affect Fellow choices based on their experiences. Each of these will be discussed individually as they relate to the findings.

The first prediction, that Fellows will express their increased communication, interpersonal skills, confidence and leadership abilities (Audette & Vieth, 2004; Parry & Bottomley, 2002; Pickering et al., 2004; Powers, 2003; Vickers, Foster & Salamo, 2004; Williams, 2002) came true for all six Fellows. There was a preponderance of evidence to suggest that communication was critical to each Fellow’s success in the program. In fact, all Fellows interviewed clearly stated that each improved his or her communication skills as a direct result of developing lessons and communicating information to the students. Fellows had to examine a student’s previous knowledge and experience in order to determine how to present the information in the most meaningful manner.

Communication, as a skill in and of itself, is not only critical to each person professionally speaking, but also personally.

Although none of the Fellows specifically stated that his or her interpersonal skills improved, it could be assumed that these skills did not decrease over time, and were similarly developed. During participation in STEP, Fellows were faced with challenges outside their previous experience. One must either move forward or backward; since each
Fellow’s experience proved successful, it can be assumed that interpersonal growth did, in fact, occur. For example, Michelle was forced to deal with Brian’s lack of organization and planning. In order to develop a successful lesson, she had to learn how to cope with the Brian-related stress to make the collaboration work. Michael, on the other hand, had to cope with a teacher who didn’t understand the content she was expected to teach. He had to learn the content himself and then find a way to teach this to students who were basically unmotivated. One can assume that each Fellow faced similar challenges and found ways to grow interpersonally as a result.

Four of the six Fellows interviewed specifically mentioned confidence as something that increased due to their participation in STEP. Confidence itself can be a powerful tool that enables an individual to expand beyond their current frame of reference. Five of the six Fellows decided to pursue careers different from than what they originally intended. This increased self-confidence enabled these five Fellows to move in a different direction to pursue their dreams. This does not mean, however, that the sixth Fellow did not increase his confidence; only that it was not specifically documented in the data or evident in the Fellow’s career decisions after leaving the program.

Leadership development was not something that emerged from the findings, aside from five out of the six Fellows interviewed hoping to gain increased responsibility at work. These five Fellows believed that, as they proved themselves on the job, increasing their responsibility and leadership would be expected. This is an area that could be specifically explored in a future study.

The second prediction focused on Fellows expressing an increased content knowledge base and increased confidence in sharing their research with individuals at
different developmental levels (Centeno et al., 2004; Dunfrey et al., 2003; Pickering et al., 2004; Richardson et al., 2004). When referring to conversations with non-scientists or others not associated with their particular research fields, all six Fellows rarely mentioned their research to others or even thought about doing so. When a Fellow did think about sharing his or her research, each felt that it was too complicated to explain to “outsiders,” so they tended to explain it only in the broadest sense. Each Fellow believed that briefing an “outsider” with the background information necessary to explain their research required too much effort, and, consequently, tended not to assist them in their quest for answers. In most cases, conversations about their research were short presentations to students or brief conversations focused around developing a lesson for their respective schools. Since there was very little discussion of their research with outsiders before or after STEP, it is difficult to determine if their confidence or content knowledge increased.

The third prediction includes Fellows expressing their increased abilities to connect life experiences to subject material in engineering, as well as their abilities to increase social relevance of the curriculum as it relates to these life experiences. This, in turn, will decrease attrition rates of undergraduate and graduate students (Pickering et al., 2004; Pinnell & Nichols, 2004; Rochefort et al., 2004). As Fellows gained experience developing and implementing lessons, each found the importance of designing lessons that related to the students’ individual life experiences. By focusing lessons on engineering principles, Fellows were required to consider how engineering relates to personal understandings. Fellows found that only those lessons that considered these combined factors were successful. Therefore, this created the need for Fellows to place more emphasis on the relationship of social relevance to engineering. Whether attrition
can be associated with this factor cannot be determined, since all six Fellows remained in the program for the full contract period. This is something that should be investigated further with a larger population, especially with Fellows that dropped out before completing a full year in the program.

It is abundantly clear that all but one of the STEP Fellows “gained a greater appreciation for the effort needed to construct high school curriculum or to implement new projects” (Robertson et al., 2005). Michael, having taught for a full academic year in Louisiana, had a clearer perception of the amount of effort required to create and implement meaningful curriculum, since he had a larger field of experience to reference. But, each of the other five Fellows gained a new appreciation for the “energy and effort” necessary for teachers to teach effectively. Many middle to high achievers in the teaching profession do not fully comprehend the differing learning styles, pedagogy, or theory behind effective teaching, since it comes more naturally to them. By learning theory and putting it into practice, Fellows had the opportunity to learn firsthand the complexities of quality education and were duly changed by the experience.

In order to design, develop, implement, and effectively assess lessons, all six Fellows had to “exhibit strength in organization, anticipatory set and questioning skills” (Powers, 2003). Each Fellow, from different levels of teaching experience, became more adept at these skills over time. Knowing what they know, working with others, and developing effective teaching strategies enabled each Fellow to take his or her own skill set and progress. It must be considered that all Fellows, coming from backgrounds outside of education, needed to be taught these skills. Patrick, having no experience teaching, was at a much different beginning place than Michael, who already had one
year of teaching experience under his belt before joining STEP. Each Fellow was able to further develop their organization and questioning skills, which ultimately helped their students to engage in lessons and learn content. If this wasn’t the case, their lessons would have proved to be ineffective.

The final prediction that Fellows will gain an increased understanding of K-12 education and the culture of the public school system (Martin-Vega, et al. 2005; Powers, 2003; Robertson, et al., 2005; Vickers et al., 2004) has produced the most astounding findings. The extraordinary depth in which five of the six Fellows learned and experienced urban education opened their eyes to the realities of education outside the realm of his or her own experience. Each of the Fellows came from a different high school experience as a result of the differences between the schools in which they were placed. Feeling like the school was a “foreign country” and not remembering “what was important to students,” the Fellows faced the enormous challenge of understanding the culture of urban schools. Many people feel like they understand education because they have been through the system, but this is, often times, a misnomer. Participating in an experience versus organizing and preparing one for others provides a completely different understanding of what education entails. Even Michael, who had experienced an under-resourced school, had his eyes opened to the possibilities of quality urban education. By experiencing seminars (the Paideia Philosophy), he came to understand how learning can be elevated to a much higher level. As a result of participation in the STEP program, these Fellows will never again view public education in the same light. Michael said it spectacularly when he mentioned “people my age don’t think about
education because they don’t have kids, but when I look for schools for my children I will keep these things in mind.”

_Broader NSF Goals_

And finally, it is important to address whether the long-term NSF goals are being met on a broader basis than just within the STEP project. The first goal is to support highly qualified STEM undergraduate and graduate students pursuing bachelor’s and graduate degrees, providing them with an opportunity to acquire additional skills that will broadly prepare them for professional and scientific careers (Luedeman et al., 2003).

Clearly, the first goal is being met by STEP’s participants, but one can also assume that if GK-12 projects are also held accountable to similar guidelines, Fellows throughout the country are gaining valuable skills necessary to prepare them for successful academic and professional careers.

The second goal is to create research opportunities for PIs, academic advisors, university students, and NSF constituents in order to study a wide variety of diverse scientific and educational research questions associated with these types of programs (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5472). Research articles from STEP, as well as the hundreds of other GK-12 programs, clearly indicate the wide field of research being generated by these types of studies. The wide variety of topics being described and written about in respected journals indicates an abundance of discoveries being made, with numerous others yet to investigate. Clearly, GK-12 projects have found a niche in the academic community.

The third goal of NSF is to make permanent changes in institutions of higher education by creating opportunities for partnerships with GK-12 schools in a manner
mutually beneficial to faculty, teachers, and students alike. Engineers, scientists, mathematicians, and educators have joined forces to create systemic changes in the K-16 environment as we know it. More and more people are bridging the gap between theory and practice and moving toward a more holistic approach to educating America’s youth. There are obvious hurdles to climb over, but as more and more collaborative initiatives are formed, these challenges will be overcome to create a more effective educational system for every child.

Implications

It is important to consider the implications of this research. This section considers two types of recommendations: those intended for future research and ones meant for practical application. Due to the nature of this type of study, it is important to convey information that, not only can be used later, but is also critical to the success of the current STEP program, offering insight for today’s applications.

Recommendations for Future Research

The most significant limitation of this research study was the limited number of Fellows interviewed. Within this project, I would recommend interviewing all of the previous Fellows including ones that did not successfully complete the program. This information could help psychographically profile the types of Fellows that fellowship projects should look for in addition to exposing some of the pitfalls of the process.

At this point in time, this is the only research study addressing these issues associated with GK-12 programs. Of the hundreds of participants, other programs should develop quality, long-term follow-up agendas. Since GK-12 project funding has been in existence for eight years, there are hundreds of Fellows who could be interviewed, or at
the very least, be asked to complete more extensive online surveys. It is the recommendation of this researcher to require, not only a yearly check-in by the Fellows, but mandate more extensive data collection at regular intervals-- at 2-year, 5-year, and 10-year intervals--after completing the program. It is not practical for all GK-12 programs to conduct the type of extensive research described in this study; however, through thoughtful planning and implementation, each GK-12 project could collect and analyze data similar to that which has been presented by this researcher. Development of a collective NSF database is the first step to systematically analyzing and sharing these findings with NSF and other GK-12 projects.

**Recommendations for Practice**

After reviewing the findings of this research study, there are several practical recommendations that could be applied to the STEP program immediately--first and foremost being the importance of revisiting existing tracking documents. Thoughtful contemplation must be undertaken by the administrators of the grant to determine how the tracking survey can be improved to more adequately assess the long-term career and educational choices of the Fellows. Adding questions to explore the long-term impact of their participation in ongoing increments of two years, four years, and ten years is one suggestion offered by this researcher. This data should be documented through journals and presentations within the research community in order to share more meaningful information with NSF and other GK-12 programs.

In completing this study, there were also several technical difficulties to overcome. First and foremost was obtaining the correct contact information for many of the Fellows. Secondly, two of the Fellows had not completed the yearly tracking
document or their records could not be located. To further complicate matters, tracking documents were overwritten each year and it was not clear to the researcher which parts of the document were newer or which sections had been changed year to year, since the original submission of the document. The only tracking information available was from 2003 and 2005. In the case of the 2005 tracking data, information for all but one of the Fellows interviewed for this study was missing and two final tracking documents for 2003 were missing. Since all Fellows were required to fill out the tracking document, it seems odd that this information was absent. All Fellows were willing participants in this study, but I am not sure they understood the importance of the yearly tracking document or updating their contact information to reflect changes in address, email, or phone number. And finally, post-attitude surveys were not readily available to the researcher. Future care should be taken to ensure evaluation data collected is adequately archived, readily available, and easily accessible.

The second recommendation is “getting the right people on the bus” (Collins, 2001). Fellow teaching experience during the first three years of the program ranged from no teaching experience whatsoever to having a full year of practice. Determining the types of Fellows the program wants to attract is critical to determining the results of the project. Does a project want the same types of Fellows on the project, or are Fellows with a wider range of experiences and goals preferable? Strategic planning of Fellow participation is critical to the outcome of the grant. It is completely understandable that, during the first three years of the grant implementation, goals may not have been clear. At this juncture, however, every effort should be taken to ensure recruitment of the best possible Fellows based on clearly defined program goals.
The third recommendation is to clearly communicate expectations to all participants. Although this is not directly related to the questions of this study, several Fellows suggested that they would have felt more successful during the project if they more clearly understood what was expected of them from the outset. Building collaborative partnerships takes purposeful measures in order to create the best possible partnerships (Edens & Gilsinan, 2005). Ongoing discussions and planning should be regular occurrences in order to make sure the needs of all STEP participants are being met.

Teachers also need to understand the importance of providing feedback to Fellows. Sharing expertise can benefit both the novice and the more experienced. By the same token, Fellows have a great amount of valuable expertise in their particular research area. Specific discussion times should be scheduled so that the Fellow, first of all, knows of this expectation and makes time for it. Through these types of discussions, Fellows could gain the much-needed experience of explaining their research to non-scientists, while providing others with the opportunity to learn more about another field. Conscious effort must be taken in order to address this GK-12 goal.

Final Remarks

It is impossible to consider this a complete study in and of itself. As described above, one must consider the limitations of this research as well as the findings. Although this research was able to uncover education and career choices of six Fellows after they participated in a GK-12 project, it is merely a beginning. Millions of dollars are being spent on hundreds of GK-12 projects throughout the country. It is important for ongoing research considerations that each of these programs spends a few extra hours designing
more efficient tracking systems and follow-up procedures. The lack of reasonable, long-term follow-up for all but one of the over one-hundred programs creates a huge chasm in the GK-12 research. If NSF would like to continue to receive funding for these programs, efforts must be made to improve the programs and utilize the funding more effectively. Project STEP, as well as other GK-12 projects, are able to prove their validity during the process, but discovering the long-term effects on Fellows participating in these programs, would make these programs all that more meaningful. This is especially true for student discussions with non-scientists, the likelihood of Fellows working toward building connections between industry and education, as well as effective K-16 collaborative partners. Our country’s workforce and competitive marketability depend on these efforts.
References


*Occupational Outlook Quarterly, 41*(1), 12-20.


Lyons, J., Banich, M., Brader, J., & Ebert, C. (2002, June). *Formative Assessment of the University of South Carolina’s graduate teaching fellows in K-12 education program*. Paper presented at the American Society for Engineering Education Annual Conference and Exposition, Montréal, Quebec, Canada.


http://www.eng.uc.edu/STEP/overview/objectives.html.


Appendix

Table 1

*Interview Questions*

<table>
<thead>
<tr>
<th><strong>General Background Information</strong></th>
<th>Please explain what you have been doing educationally and professionally since leaving Project STEP.</th>
</tr>
</thead>
</table>
| **Discovery**                     | How have discussions with teachers, students, or other “non-scientists” impacted your knowledge, understanding, and interpretation of your research?  
|                                   | Has this impact changed any of your thought processes pertaining to your research questions? Sparked any new ideas for your research? |
| **Integration of Research and Career** | How has your experience of interdisciplinary collaboration (educational theory/practice and your research) affected your view of K-16 education, your career, societal issues, and your willingness to contribute to the betterment of society?  
|                                   | Are you interested in taking any further action in any of these areas? |
| **Application of Educational Theory to Research** | How has your understanding of pedagogy influenced your career decisions and educational choices?  
|                                   | What types of skills did you develop or learn as a result of participation in Project STEP that prepared you for your professional and/or scientific career? |
| **Teaching and Learning** | What kinds of experiences did you encounter during your participation in STEP that shaped the way you view teaching and learning? Could you have learned this another way?  
|                                   | How do you apply these skills to your current occupation? |
| **Closing Question** | Do you have any other thoughts or feelings about the effect that STEP or the communities of practice you participated in had on your professional career or educational choices? |
### Table 2

*All Possible Fellows to Interview*

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>WORKING IN INDUSTRY</th>
<th>WORKING IN OTHER FIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Undergraduate Fellows</strong></td>
<td>George</td>
<td>Brad (pursuing Ph.D.)</td>
</tr>
<tr>
<td></td>
<td>Michelle</td>
<td>John (pursuing Ph.D.)</td>
</tr>
<tr>
<td></td>
<td>Julie</td>
<td>Delvina (graduate student)</td>
</tr>
<tr>
<td><strong>Graduate Fellows</strong></td>
<td>Michael</td>
<td>Brian (AEL program)</td>
</tr>
<tr>
<td></td>
<td>Gorge</td>
<td>Fong (looking for faculty position)</td>
</tr>
<tr>
<td></td>
<td>Patrick</td>
<td>Tella (looking for faculty position)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tracey (teaching HS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vini (completing Ph.D. at Tufts)</td>
</tr>
<tr>
<td><strong>Fellows Who Resigned</strong></td>
<td>Ross: Resigned to pursue a Master of Divinity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Patricia: Resigned to focus on doctorate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Andrew: Quit MS degree program and cannot be contacted</td>
<td></td>
</tr>
</tbody>
</table>
### Table 3

**Fellow Current Employment**

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>WORKING IN INDUSTRY</th>
<th>WORKING IN OTHER FIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Undergraduate Fellows</strong></td>
<td>Michelle</td>
<td>Brad (pursuing Ph.D.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>George (pursuing master’s)</td>
</tr>
<tr>
<td><strong>Graduate Fellows</strong></td>
<td>Michael Patrick</td>
<td>Brian (AEL program and teaching HS)</td>
</tr>
</tbody>
</table>
### Table 4

**Fellow Educational and Career Summary**

<table>
<thead>
<tr>
<th>FELLOW</th>
<th>EDUCATIONAL PURSUITS WHILE IN STEP</th>
<th>EDUCATIONAL ENDEAVORS SINCE LEAVING STEP</th>
<th>PROFESSIONAL ENDEAVORS SINCE LEAVING STEP</th>
<th>FUTURE CAREER PLANS</th>
<th>FUTURE EDUCATIONAL PLANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRIAN</td>
<td>Electrical Engineering Bachelor’s and Master’s</td>
<td>Pursuing an Alternative Educator’s Licensure</td>
<td>Taught two years at two different high schools</td>
<td>Teach at least three years at an urban school</td>
<td>Complete his master’s, not sure when. Complete AEL program</td>
</tr>
<tr>
<td>Undergrad Student 2002-2003 Graduate 2003-2005</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRAD</td>
<td>Electrical Engineering Bachelor’s</td>
<td>Master’s in Physics completed, working on Ph.D.</td>
<td>Working as a research assistant, teaching physics classes</td>
<td>Graduate and teach at a 2&lt;sup&gt;nd&lt;/sup&gt; or 3&lt;sup&gt;rd&lt;/sup&gt; tier institutions</td>
<td>Finish Ph.D. in 2008</td>
</tr>
<tr>
<td>Undergrad Student 2002-2003</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MICHAEL</td>
<td>Master’s in Structural Engineering</td>
<td>Completing Master’s-hopes to graduate March 2006</td>
<td>Structural engineer working on bridges and tunnels in NYC</td>
<td>Not sure</td>
<td>None</td>
</tr>
<tr>
<td>Graduate Student 2002-2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PATRICK</td>
<td>Master’s in Electrical Engineering</td>
<td>Black Belt Processing Certification</td>
<td>Working for a national organization making sure medical devices are meeting FDA standards</td>
<td>Stay with company for awhile and continue to grow professionally</td>
<td>Plans to start MBA fall of 2007</td>
</tr>
<tr>
<td>Graduate Student 2002-2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MICHELLE</td>
<td>Computer Engineering</td>
<td>None</td>
<td>Works at nationally recognized research and marketing firm</td>
<td>Not clear</td>
<td>Maybe go back and teach in future</td>
</tr>
<tr>
<td>Undergrad Student 2003-2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEORGE</td>
<td>Computer Engineering</td>
<td>Biomedical Engineering Master’s and Ph.D.</td>
<td>Research Assistant</td>
<td>Wants to get a job for awhile and then make a decision about whether to go back and get a Ph.D.</td>
<td>Complete master’s in 2009</td>
</tr>
<tr>
<td>Undergrad Student 2003-2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5

*Fellow Collaboration Experiences*

<table>
<thead>
<tr>
<th>FELLOW</th>
<th>INDUSTRY/TEACHING EMPLOYMENT</th>
<th>RESEARCH LAB</th>
<th>RESEARCH ADVISOR</th>
<th>OTHER FELLOWS</th>
<th>STEP ADVISOR</th>
<th>STEP TEACHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRIAN</td>
<td>Negative</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>BRAD</td>
<td>N/A</td>
<td>Moderately</td>
<td>Positive</td>
<td>Negative</td>
<td>No comment</td>
<td>Negative</td>
</tr>
<tr>
<td>MICHAEL</td>
<td>Positive</td>
<td>No Comment</td>
<td>No Comment</td>
<td>Positive</td>
<td>Negative</td>
<td>Somewhat</td>
</tr>
<tr>
<td>PATRICK</td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
<td>Somewhat</td>
<td></td>
</tr>
<tr>
<td>MICHELLE</td>
<td>Positive</td>
<td>N/A</td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>GEORGE</td>
<td>N/A</td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>
Table 6

_Fellow School Experiences_

<table>
<thead>
<tr>
<th>FELLOW</th>
<th>EXPERIENCE SUMMARY</th>
</tr>
</thead>
</table>
| GEORGE | • Attended a small suburban HS  
• The STEP classroom was like a “foreign country” and like a “prison education system”  
• Experienced different realities than he had; pregnancies, 4th generation welfare  
• Observed the teacher pessimism and the pressure of NCLB  
• He felt the challenge of creating lessons that would not over stimulate the students or not make feel dumb  
• Felt he was a positive influence on students and brought fun to the classroom  
• Felt students could relate to him more so than teacher  
• Felt students looked up to him  
• Felt like he got much more out of the experience than teachers or students |
| MICHAEL | • Taught for one year in Louisiana  
• Education has always been important to Matt  
• One school he taught in was under-resourced and challenging. The students didn’t want to be there nor was the teacher prepared to teach the curriculum  
• One school was a great school where administrator knew students names and it was a positive learning environment  
• Most of his prior educational beliefs were confirmed rather than eye opening. He observed the importance of parental involvement, the importance of a good principal, and was impressed with student participation in seminars  
• He enjoyed his interactions with the students, felt he was a guest teacher who didn’t have to discipline  
• Overall the STEP experience was very positive |
| BRAD | • Attended parochial high school  
• He didn’t remember the importance of clothes, who was doing what or relationships when he was in school  
• He observed his teacher being in touch with student’s lives and the importance of certain things to them  
• He learned importance of being prepared  
• He was astounded by the amount of energy it took to teach  
• He realized importance of relating to students’ lives  
• He realized the importance of lesson design for student learning |
Table 6 (continued)

<table>
<thead>
<tr>
<th>FELLOW</th>
<th>EXPERIENCE SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATRICK</td>
<td>• Attended a suburban high school</td>
</tr>
<tr>
<td></td>
<td>• He was surprised by the behavior of the students</td>
</tr>
<tr>
<td></td>
<td>• He had no previous teaching experience</td>
</tr>
<tr>
<td></td>
<td>• He valued the STEP course work and seminars where he learned about teaching and learning</td>
</tr>
<tr>
<td></td>
<td>• The courses trained him to construct and plan lessons using standards and objectives, utilize teaching strategies</td>
</tr>
<tr>
<td></td>
<td>• He learned the importance of student-centered activities, hands-on activities, and the short attention span of the students</td>
</tr>
<tr>
<td></td>
<td>• He found it rewarding to see “bad students” engage in a lesson and the teacher learn how much more these students could accomplish</td>
</tr>
<tr>
<td></td>
<td>• He enjoyed answering questions about himself and being a role model to students</td>
</tr>
<tr>
<td></td>
<td>• He realized the work necessary for a teacher to keep students engaged and not off task</td>
</tr>
<tr>
<td></td>
<td>• He realized the importance of covering the basics and not making assumptions about student knowledge</td>
</tr>
<tr>
<td></td>
<td>• He learned how to explain things in a simple manner</td>
</tr>
<tr>
<td></td>
<td>• He understood the importance of consulting the high school teacher and using his expertise to design lessons</td>
</tr>
<tr>
<td></td>
<td>• His appreciation for the art of teaching increased</td>
</tr>
<tr>
<td></td>
<td>• He developed a set of tools to use when teaching</td>
</tr>
<tr>
<td>MICHELLE</td>
<td>• Her favorite part was interacting with the students, especially 7th graders who would have more fun with the projects</td>
</tr>
<tr>
<td></td>
<td>• She thought it was “cool” to help students learn through using real-world problems</td>
</tr>
<tr>
<td></td>
<td>• She was excited to see students learning and having fun, particularly the earthquake lesson</td>
</tr>
<tr>
<td></td>
<td>• She uses real-life simulations in her job today just as she did in the classroom</td>
</tr>
<tr>
<td></td>
<td>• She analyzes data to use in real life just as she did in the classroom</td>
</tr>
<tr>
<td></td>
<td>• She learned the importance of using examples which recognized student backgrounds and experiences</td>
</tr>
<tr>
<td></td>
<td>• She realized the importance of structuring lessons to meet different students’ learning styles</td>
</tr>
<tr>
<td></td>
<td>• She realized how creating different examples increased her chances of helping all students learn</td>
</tr>
<tr>
<td></td>
<td>• She enjoyed sharing her background with the students as well as understanding their perspectives</td>
</tr>
<tr>
<td></td>
<td>• The most rewarding experience for her was seeing how all things work together and going beyond what she was studying</td>
</tr>
</tbody>
</table>
Table 6 (continued)

<table>
<thead>
<tr>
<th>FELLOW</th>
<th>EXPERIENCE SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MICHELLE</strong></td>
<td>- She gained confidence to look for employment outside of her studies</td>
</tr>
</tbody>
</table>
| **BRIAN** | - He wanted to make a bigger impact on people and thought he could do this better in education rather than in engineering  
- He hopes that as he develops more teaching strategies, teaching will be come easier  
- He hopes it will be “worth it” in the long run  
- He enjoys engaging students and helping them to make connections  
- He realized the importance of the first couple of weeks of classes  
- He feels he needs more organization and structure particularly with lesson planning  
- He experiences a constant juggling act between planning, sleep, and having a life  
- Teaching is a lot broader than what he thought  
- He feels he is able to make a positive impact on students’ lives  
- He believes his strength is having a good rapport with students  
- He is able to take feedback from others including students, teachers, and his mentor  
- He is learning how to present new ideas to students |
Table 7

Fellow Skill Development

<table>
<thead>
<tr>
<th>FELLOW</th>
<th>COMMUNICATION</th>
<th>REFLECTION</th>
<th>CONFIDENCE</th>
<th>INCREASED KNOWLEDGE IN T &amp; L</th>
<th>PRESENTING</th>
<th>WEB DEVELOPMENT</th>
<th>CONNECTIONS TO OTHERS IN EDUCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRIAN</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>BRAD</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>MICHAEL</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHILLIP</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEGAN</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GABE</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 8

Informed Consent Letter

INSTITUTIONAL REVIEW BOARD – SOCIAL AND BEHAVIORAL SCIENCES
INFORMED CONSENT STATEMENT
Fellows

University of Cincinnati

Consent to Participate in a Research Study

College of Education

Dr. Suzanne Soled
513-558-3823
suzanne.soled@uc.edu

Title of Study: Project STEP – Science and Technology Enhancement Program for K-12.
(NSF Grant: 0139312)

Introductory Statement
Before agreeing to participate in this study it is important that the following explanation of the proposed procedures be read and understood. The description includes the purpose of the study, its procedures and any associated risks and/or benefits. It also describes the right to withdraw from the study at any time. It is important to understand that no guarantee or assurance can be made as to the results.

Purpose
The purpose of this study is to evaluate the effectiveness of Project STEP in meeting the stated goals and objectives of the grant.

The goals of the grant are to:

- Increase the number of students who choose to pursue engineering and technology degree
- Produce scientists, engineers, and secondary science and mathematics educators who are experienced in developing and implementing authentic educational practices into current secondary science and mathematics curricula.
- Design, develop, and implement hands-on activities and technology-driven inquiry-based projects, which relate to the students' community issues, as vehicles to authentically teach science, math, engineering and technology (SMET) skills.

The objectives of the grant are indicated below.

Relevant to the Fellows, the objectives are to:

- Engage Fellows in meaningful, productive, and innovative educational instruction and activities so they will become excited about, and motivated to teach SMET skills.
- Help Fellows realize and understand that the facets of education, research, and professional activities overlap, and they can be more successful in their career when they overlap these activities.
- Have university faculty and staff, as well as secondary teachers, provide guidance, instruction, and mentoring to Fellows in the practice of instructional approaches, and best teaching practices.
- Provide Fellows practical and direct experience in teaching middle and high school students.
- Have Fellows design, develop, and implement secondary-level, authentic, inquiry-based learning activities and projects that are based on their technical expertise and knowledge.
- Train Fellows in the development and implementation of computer modules using current electronic multimedia and web-based tools.

Program funded by National Science Foundation Grant # 0139312
and matching funds by University of Cincinnati

8/29/2005
The project involves the collaborative work of graduate fellows, university faculty members, and middle and high school teachers to design and implement teaching modules for middle and high school science. Students in seven schools will participate as members of classes in which the modules are taught. Including all these constituencies, it is estimated that the study will involve approximately 1050 participants.

Duration
My participation in this study will last for 1 to 3 years depending on how long I stay in the program. As a fellow I have the right to decide if I will return in a subsequent year and the faculty reserves the right to decide on the renewal of my fellowship.

Procedures
As a participant in this evaluation of the grant I will be asked to submit demographic information, respond to survey questions about my attitudes and beliefs towards science education, document my activities, evaluate course information for courses I take, evaluate team dynamics, complete a skills checklist and participate in assessments of my learning. These learning assessments may include learning portfolios, course grades, and journal entries. I will be asked to respond to these instruments upon entry into the project and upon completion depending on the instrument. Some evaluations will be on an ongoing basis, such as documenting my activities.

Exclusion: N/A

Risks/Discomforts
I understand there are no anticipated risks or discomforts associated with this evaluation study. I also understand that I may discuss any discomfort or problems with the researchers (Dr. Suzanne Soled, 513-586-3625, or Patricia McKinney 937-620-7792) or the Chair of the Institutional Review Board for the Social and Behavioral Sciences at 513-589-5784.

Marketable Material
One outcome of this NSF grant is the creation of a website that will provide information about authentic learning activities for science education. These may include modules that I have participated in developing and implementing. These will be available as a public service to science educators. No financial remuneration will be involved.

Benefits
As a participant in this research, I may receive the benefit of an increased understanding of science education. This will include access to inquiry-based science activities, projects and modules for science education. Additionally, web resources will be developed that will be available to me as a science educator.

I may receive no direct benefit from my participation in this study, but my participation may help teachers, scientists, school administrators, and students better understand science education.

Alternatives
There are no alternative procedures in which I may participate.

New Findings
I will be told if there is any new information that becomes available during this study that may affect my willingness to continue participation in it.

Program funded by National Science Foundation Grant # 0129319 and matching funds by University of Cincinnati
**Confidentiality**

Every effort will be made to maintain the confidentiality of my study records. Agents of the University of Cincinnati and the sponsoring agency, National Science Foundation, will be allowed to inspect sections of the research records related to this study. The data from the study may be published; however, I will not be identified by name. My identity will remain confidential unless disclosure is required by law, such as mandatory reporting of child abuse, elder abuse, or immediate danger to self or others.

**Certificate of Confidentiality**

N/A

**Financial costs to the participant:** none

**Compensation in case of injury:** N/A

**Payments to participants**

Graduate fellows receive an annual stipend of $30,000. Payment will be PRORATED if the participant withdraws or if the study is terminated by the investigator. Stipends are paid on a monthly basis.

**Right to refuse or withdraw**

My participation is voluntary and I may refuse to participate, or may discontinue participation AT ANY TIME, without penalty or loss of benefits to which I am otherwise entitled. The investigator has the right to withdraw me from the study AT ANY TIME. My withdrawal from the study may be for reasons related solely to me (for example, not following study-related directions from the investigator, etc.) or because the entire study has been terminated.

**Offer to answer questions**

If I have any other questions about this study, I may call Dr. Anant Kukreti at 513-556-3648 or Dr. Suzanne Seled at 513-556-3623. If I have any questions about my rights as a research participant, I may call the Chair of the Institutional Review Board for the Social and Behavioral Sciences, at 513-558-5784.

**Legal Rights**

Nothing in this consent form waives any legal right I may have nor does it release the investigator, the sponsor, the institution, or its agents from liability for negligence.

I HAVE READ THE INFORMATION PROVIDED ABOVE. I VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY. I WILL RECEIVE A COPY OF THIS CONSENT FORM FOR MY INFORMATION.

---

<table>
<thead>
<tr>
<th>Participant Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Print Name of Participant ____________________________

Program funded by National Science Foundation, Grant # 613931.

and matching funds by University of Cincinnati

8/20/2005

Page 3 of 4
Table 8 (continued)

| If verbal assent/consent was obtained, check this box and have a witness sign and date below. |
| Witness Signature (required only for verbal assent) | Date |
| Signature and Title of Person Obtaining Consent | Date |
| Identification of Role in the Study |

---

Program funded by National Science Foundation [Grant # 013931](#) and matching funds by University of Cincinnati.
Table 9

_Fellow Tracking Documents_

<table>
<thead>
<tr>
<th><strong>George</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Describe how Project STEP has helped you in your professional development.</strong></td>
</tr>
<tr>
<td>The classes and teaching experience provided the knowledge and confidence to teach undergraduate courses as a teaching assistant.</td>
</tr>
<tr>
<td><strong>List employment and/or research opportunities you are currently pursuing that are related to your work on Project STEP.</strong></td>
</tr>
<tr>
<td>None that I can think of. I do plan on teaching in the future if it becomes a possibility.</td>
</tr>
<tr>
<td><strong>In what ways are you currently involved in science and/or mathematics education (as employment or volunteer/professional development).</strong></td>
</tr>
<tr>
<td>Teacher’s assistant at University of Texas at Austin.</td>
</tr>
<tr>
<td><strong>What advice do you have for secondary school students interested in a STEM career?</strong></td>
</tr>
<tr>
<td>If you go to an okay undergraduate program, but go to an excellent graduate program, you will save a lot of tuition cost. Also, volunteer to do research as an undergraduate and put most of your effort into becoming well rounded as opposed to narrow minded in your academic pursuits. A well-rounded scientist/engineer can always find jobs and learn, however a super-specialist has only one job--being a super-specialized scientist.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Michael</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Describe how Project STEP has helped you in your professional development.</strong></td>
</tr>
<tr>
<td>Good practice in public speaking.</td>
</tr>
<tr>
<td><strong>List employment and/or research opportunities you are currently pursuing that are related to your work on Project STEP.</strong></td>
</tr>
<tr>
<td>None.</td>
</tr>
<tr>
<td><strong>In what ways are you currently involved in science and/or mathematics education (as employment or volunteer/professional development).</strong></td>
</tr>
<tr>
<td>Volunteer to read to kids at a public school.</td>
</tr>
<tr>
<td><strong>What advice do you have for secondary school students interested in a STEM career?</strong></td>
</tr>
<tr>
<td>Pay attention in math class. Math is the basic language of science and technology.</td>
</tr>
</tbody>
</table>
Table 9 (continued)

<table>
<thead>
<tr>
<th>Michelle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Describe how Project STEP has helped you in your professional development.</strong></td>
</tr>
<tr>
<td>It helped me to learn some self-confidence when I speak in front of others. I found that I was much more effective with students when I was confident in what I was showing them. Teaching something to someone else really does make you learn it even better yourself.</td>
</tr>
<tr>
<td><strong>In what ways are you currently involved in science and/or mathematics education (as employment or volunteer/professional development).</strong></td>
</tr>
<tr>
<td>I tutor in the Covington Kentucky Public School system.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brian</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Describe how Project STEP has helped you in your professional development.</strong></td>
</tr>
<tr>
<td>In every way possible. Work experience, paying for school, traveling for professional development, affecting my current life objectives and job of desire.</td>
</tr>
<tr>
<td><strong>List employment and/or research opportunities you are currently pursuing that are related to your work on Project STEP.</strong></td>
</tr>
<tr>
<td>I am planning on working as a full-time high school math teacher for two years to get certified through the AEL route.</td>
</tr>
<tr>
<td><strong>In what ways are you currently involved in science and/or mathematics education (as employment or volunteer/professional development).</strong></td>
</tr>
<tr>
<td>Project STEP as a graduate fellow, conferences, class work, and future work over the next two years.</td>
</tr>
<tr>
<td><strong>What advice do you have for secondary school students interested in a STEM career?</strong></td>
</tr>
<tr>
<td>Consider it because it can be more rewarding than anything else I have done, and be fun, as well, if treated in the right manner.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brad</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Describe how Project STEP has helped you in your professional development.</strong></td>
</tr>
<tr>
<td>No tracking document submitted.</td>
</tr>
<tr>
<td><strong>List employment and/or research opportunities you are currently pursuing that are related to your work on Project STEP.</strong></td>
</tr>
<tr>
<td>No tracking document submitted.</td>
</tr>
<tr>
<td><strong>In what ways are you currently involved in science and/or mathematics education (as employment or volunteer/professional development).</strong></td>
</tr>
<tr>
<td>No tracking document submitted.</td>
</tr>
<tr>
<td><strong>What advice do you have for secondary school students interested in a STEM career?</strong></td>
</tr>
<tr>
<td>No tracking document submitted.</td>
</tr>
<tr>
<td>Patrick</td>
</tr>
<tr>
<td>----------------</td>
</tr>
</tbody>
</table>
| **Describe how Project STEP has helped you in your professional development.**  
No tracking document submitted. |
| **List employment and/or research opportunities you are currently pursuing that are related to your work on Project STEP.**  
No tracking document submitted. |
| **In what ways are you currently involved in science and/or mathematics education (as employment or volunteer/professional development).**  
No tracking document submitted. |
| **What advice do you have for secondary school students interested in a STEM career?**  
No tracking document submitted. |
Table 10

*Fellow Attitude Surveys*

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>Pre-test AGREE</th>
<th>Pre-test DISAGREE</th>
<th>Post-test AGREE</th>
<th>Post-test DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am looking forward to taking more mathematics courses.</td>
<td>63.6%</td>
<td>18.2%</td>
<td>33.3%</td>
<td>33.3%</td>
</tr>
<tr>
<td>2. I enjoy learning how to use technologies (e.g., calculators, computers, etc.) in mathematics classrooms.</td>
<td>100.0%</td>
<td>0.0%</td>
<td>100.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>3. I like mathematics.</td>
<td>91.7%</td>
<td>0.0%</td>
<td>100.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>4. Calculators should always be available for students in mathematics classes.</td>
<td>50.0%</td>
<td>33.3%</td>
<td>55.6%</td>
<td>22.2%</td>
</tr>
<tr>
<td>5. In grades K-9, truly understanding mathematics in schools requires special abilities that only some people possess.</td>
<td>16.7%</td>
<td>66.7%</td>
<td>22.2%</td>
<td>77.8%</td>
</tr>
<tr>
<td>6. The use of technologies (e.g., calculators, computers, etc.) in mathematics is an aid primarily for slow learners.</td>
<td>0.0%</td>
<td>100.0%</td>
<td>11.1%</td>
<td>88.9%</td>
</tr>
<tr>
<td>7. Mathematics consists of unrelated topics (e.g., algebra, arithmetic, calculus and geometry).</td>
<td>0.0%</td>
<td>100.0%</td>
<td>22.2%</td>
<td>77.8%</td>
</tr>
<tr>
<td>8. To understand mathematics, students must solve many problems following examples provided.</td>
<td>75.0%</td>
<td>16.7%</td>
<td>55.6%</td>
<td>33.3%</td>
</tr>
<tr>
<td>9. Students should have opportunities to experience manipulating materials in the mathematics classroom before teachers introduce mathematics vocabulary.</td>
<td>50.0%</td>
<td>16.7%</td>
<td>55.6%</td>
<td>11.1%</td>
</tr>
<tr>
<td>10. Getting the correct answer to a problem in the mathematics classroom is more important than investigating the problem in a mathematical manner.</td>
<td>8.3%</td>
<td>83.3%</td>
<td>11.1%</td>
<td>77.8%</td>
</tr>
<tr>
<td>11. Students should be given regular opportunities to think about what they have learned in the mathematics classroom.</td>
<td>91.7%</td>
<td>8.3%</td>
<td>77.8%</td>
<td>11.1%</td>
</tr>
<tr>
<td>12. Using technologies (e.g., calculators, computers, etc.) in mathematics lessons will improve students' understanding of mathematics.</td>
<td>75.0%</td>
<td>8.3%</td>
<td>55.6%</td>
<td>22.2%</td>
</tr>
</tbody>
</table>
Table 10 (continued)

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>Pre-test AGREE</th>
<th>Pre-test DISAGREE</th>
<th>Post-test AGREE</th>
<th>Post-test DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. The primary reason for learning mathematics is to learn skills for doing science.</td>
<td>25.0%</td>
<td>66.7%</td>
<td>55.6%</td>
<td>44.4%</td>
</tr>
<tr>
<td>14. Small group activity should be a regular part of the mathematics classroom.</td>
<td>58.3%</td>
<td>8.3%</td>
<td>55.6%</td>
<td>22.2%</td>
</tr>
<tr>
<td>15. I am looking forward to taking more science courses.</td>
<td>75.0%</td>
<td>16.7%</td>
<td>44.4%</td>
<td>55.6%</td>
</tr>
<tr>
<td>16. Using technologies (e.g., calculators, computers, etc.) in science lessons will improve students' understanding of science.</td>
<td>83.3%</td>
<td>8.3%</td>
<td>66.7%</td>
<td>33.3%</td>
</tr>
<tr>
<td>17. Getting the correct answer to a problem in the science classroom is more important than investigating the problem in a scientific manner.</td>
<td>8.3%</td>
<td>91.7%</td>
<td>33.3%</td>
<td>66.7%</td>
</tr>
<tr>
<td>18. In grades K-9, truly understanding science in the science classroom requires special abilities that only some people possess.</td>
<td>16.7%</td>
<td>83.3%</td>
<td>33.3%</td>
<td>66.7%</td>
</tr>
<tr>
<td>19. Students should be given regular opportunities to think about what they have learned in the science classroom.</td>
<td>91.7%</td>
<td>8.3%</td>
<td>88.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>20. Science is a constantly expanding field.</td>
<td>100.0%</td>
<td>0.0%</td>
<td>88.9%</td>
<td>11.1%</td>
</tr>
<tr>
<td>21. Theories in science are rarely replaced by other theories.</td>
<td>16.7%</td>
<td>58.3%</td>
<td>33.3%</td>
<td>55.6%</td>
</tr>
<tr>
<td>22. To understand science, students must solve many problems following examples provided.</td>
<td>66.7%</td>
<td>33.3%</td>
<td>55.6%</td>
<td>44.4%</td>
</tr>
<tr>
<td>23. I like science.</td>
<td>100.0%</td>
<td>0.0%</td>
<td>100.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>24. I enjoy learning how to use technologies (e.g., calculators, computers, etc.) in science.</td>
<td>91.7%</td>
<td>8.3%</td>
<td>100.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>25. The use of technologies (e.g., calculators, computers, etc.) in science is an aid primarily for slow learners.</td>
<td>8.3%</td>
<td>91.7%</td>
<td>22.2%</td>
<td>77.8%</td>
</tr>
</tbody>
</table>
Table 10 (continued)

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>Pre-test AGREE</th>
<th>Pre-test DISAGREE</th>
<th>Post-test AGREE</th>
<th>Post-test DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. Students should have opportunities to experience manipulating materials in the science classroom before teachers introduce scientific vocabulary.</td>
<td>66.7%</td>
<td>25.0%</td>
<td>55.6%</td>
<td>11.1%</td>
</tr>
<tr>
<td>27. Science consists of unrelated topics like biology, chemistry, geology, and physics.</td>
<td>16.7%</td>
<td>75.0%</td>
<td>22.2%</td>
<td>77.8%</td>
</tr>
<tr>
<td>28. Calculators should always be available for students in science classes.</td>
<td>41.7%</td>
<td>33.3%</td>
<td>44.4%</td>
<td>33.3%</td>
</tr>
<tr>
<td>29. The primary reason for learning science is to provide real-life examples for learning mathematics.</td>
<td>8.3%</td>
<td>75.0%</td>
<td>33.3%</td>
<td>66.7%</td>
</tr>
<tr>
<td>30. Small group activity should be a regular part of the science classroom.</td>
<td>66.7%</td>
<td>16.7%</td>
<td>88.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>31. I expect that the college mathematics courses I take will be helpful to me in teaching mathematics in elementary or middle school.</td>
<td>58.3%</td>
<td>25.0%</td>
<td>55.6%</td>
<td>11.1%</td>
</tr>
<tr>
<td>32. I want to learn how to use technologies (e.g., calculators, computers, etc.) to teach mathematics.</td>
<td>100.0%</td>
<td>0.0%</td>
<td>88.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>33. The idea of teaching science scares me.</td>
<td>25.0%</td>
<td>66.7%</td>
<td>11.1%</td>
<td>88.9%</td>
</tr>
<tr>
<td>34. I expect that the college science courses I take will be helpful to me in teaching science in elementary or middle school.</td>
<td>75.0%</td>
<td>0.0%</td>
<td>66.7%</td>
<td>11.1%</td>
</tr>
<tr>
<td>35. I prefer to teach mathematics and science emphasizing connections between the two disciplines.</td>
<td>91.7%</td>
<td>8.3%</td>
<td>77.8%</td>
<td>11.1%</td>
</tr>
<tr>
<td>36. The idea of teaching mathematics scares me.</td>
<td>33.3%</td>
<td>58.3%</td>
<td>0.0%</td>
<td>77.8%</td>
</tr>
<tr>
<td>37. I want to learn how to use technologies (e.g., calculators, computers, etc.) to teach science.</td>
<td>91.7%</td>
<td>0.0%</td>
<td>77.8%</td>
<td>0.0%</td>
</tr>
<tr>
<td>38. I feel prepared to teach mathematics and science emphasizing connections between the two disciplines.</td>
<td>75.0%</td>
<td>8.3%</td>
<td>77.8%</td>
<td>11.1%</td>
</tr>
</tbody>
</table>