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National Science Foundation Grant Implementation:
Perceptions of Teachers and Graduate Fellows in One School Regarding the Barriers and
Successes

A dissertation
presented to
the faculty of the Department of Educational Leadership and Policy Analysis
East Tennessee State University
in partial fulfillment
of the requirements for the degree
Doctor of Education in Educational Leadership

by
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May 2013

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Keywords: collaboration, graduate fellow, partner teachers, National Science Foundation grant,
STEM integration, content specialist

ABSTRACT

National Science Foundation Grant Implementation:
Perceptions of Teachers and Graduate Fellows in One School Regarding the Barriers and
Successes

by

Sharon Durham Pickering

The purpose of this qualitative case study was to examine the perceptions of partner teachers and graduate fellows in 1 school regarding the barriers and successes made during their participation in a National Science Foundation Grant. This study included 9 partner teachers and 7 graduate fellows who participated in the *Science First!* NSF GK-12 Grant. There were 16 participants in this study. This study was conducted at North Side Elementary and East Tennessee State University.

Partner teachers and graduate fellows were interviewed to gain perceptions of the barriers and successes of their participation in the implementation of the *Science First!* grant at North Side and East Tennessee State University from 2008-2013. A list of possible participants in the study was provided from the grant leadership team. The 16 participants in the study were chosen through purposeful sampling.

During data analysis, 4 themes arose as successes and 4 themes arose as barriers. The success themes were (a) relationships, (b) mutual appreciation, (c) increased academic depth, and (d) professional growth. The barriers were (a) communication, (b) time, (c) expectations, and (d) preparation.

Based on the research, the following conclusions were presented. The coordination of a major NSF-GK12 grant can provide STEM support and academic rigor for a high poverty school with leadership. Positive relationships between the graduate fellows and partner teachers as well as the 2 participating institutions are critical in fostering successful grant implementation. Professional growth through the grant partnerships was obtained. The participants gained a mutual appreciation for the roles and responsibilities of each other.

There are ups and downs in implementing a large grant at 1 elementary school with a university, but the rewards of the potential to influence teacher practices in STEM and student learning are great. Recommendations from the study findings may assist future grant award winners or partnerships of any kind in building productive relationships between schools and other institutions.

DEDICATION

This work is dedicated to my husband James Pickering and sons Eric and Nate. They have given their unwavering support with their time, patience, computers, and kindness. My precious husband has gently guided me through the tough moments and encouraged me through my transitions. Thank you.

It is also dedicated to my parents Carl and Faye Durham. My dad and mom have modeled the kind of work ethic, passion, and nurturing of others I hope I possess. It is through their loving support this study was achieved.

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CHAPTER 1

INTRODUCTION

“Today, Ms. J is coming to class and bringing her spiders!” says an enthusiastic second grader. “She’s going to show us how they live in a community like us!”

The teacher smiles and relates to the academic coach that the graduate fellow will be there in the afternoon and had prepared them for today’s lesson during her previous visit. The teacher and graduate fellow planned together for the activity and were combining science and social studies. *Science First!* fellow Jennifer Price (MS Biology) is studying the neurochemical underpinnings of social and aggressive behavior in the polyphenic spider, *Anelosimus studiosus*. By bringing live spiders into the second grade classroom, she instantly gains the children’s interest, which gives her the opportunity to talk to them about many key biological and ecological concepts, including how and why organisms change over time, how all members of an ecological community play a vital role in maintaining a natural balance, and how chemicals, specifically biochemicals, affect living things. Some of the spiders are social, living together and cooperating in colonies, whereas others within this species are solitary and more aggressive. This allows Jennifer to ask the students questions such as, “What are the pros and cons of sociality? What are the pros and cons of solitude and aggression? What can we learn from these spiders?” The introduction to chemicals and the effects they have on spiders’ behaviors provides a platform for her to discuss the effects of drugs and medications on humans. This leads to a discussion about how our behavior affects the biochemicals in our bodies and provides an excellent way to discuss exercise, health, and wellness. This is only one example of the type of excitement and learning that comes from the collaboration and planning in the *Science First!* GK-12 Grant provided from the National Science Foundation between a graduate fellow and elementary teacher. The *Science First!* Grant allows graduate students in biology, chemistry,

and mathematics to enhance their communication and collaborative skills while bringing their research into the classrooms of one high poverty elementary school.

The National Science Foundation (NSF) established the Graduate Teaching fellow Program in K-12 Education in 1999. The purpose of the grants received through the GK-12 branch of NSF is to provide graduate fellows at the university the skills they need to apply what they are learning at a deeper level in order to reach students in at-risk populations to succeed in the STEM disciplines. The GK-12 program was created to bring together the content expertise of mathematics and science graduate students and teachers, the communication skills of graduate students, and the science teaching abilities of both groups (Hook, Huziak-Clark, Nurnberger-Clark, & Ballone-Duran, 2009).

The elementary school and university wrote and applied for the grant with NSF in 2007 and received news in 2008 that they were the recipients of a 5-year, three million dollar STEM GK-12 grant. The university is a state supported regional university with over 15,000 undergraduate, graduate, and professional students. Master level students were the highest level of degree participant of graduate fellow in the *Science First!* Grant. The leadership committee for the grant consisted of the principal investigator for the grant, the Dean of Arts and Sciences, the chair of the math department, associate professor of the curriculum and instruction department, principal of the elementary school, science teacher of elementary school, and academic coach for elementary school. The elementary school has a 90% low socioeconomic group and 50% minority population with 370 students. The first year of the grant was 2008-2009 with the first set of nine graduate fellows selected and matched with seventeen participating teachers. When a collaborative is conceived, a new institution is being constructed, and reformers must look inside and outside of the new construct at the forces that shape it: issues of

status (e.g., instructional level, differing expertise) and the political context (K-12 schools, the university, NSF) (Davis, Feldman, & Irwin, 2003). Teachers were asked to participate through a contract system. The grant provided graduate fellows with tuition, a stipend, and professional development funds. The grant provided teachers with a stipend, instructional supply money, and professional development money. The grant goals also required teachers to attend one graduate level content course in a STEM course each year of the grant. Teachers had an opportunity each year to reevaluate and modify the level of their involvement on the grant.

Statement of the Problem

Graduate fellows and teachers collaborated to develop integrated science, technology, engineering, and math (STEM) lessons and worked with students. The barriers and successes of implementing a multiyear NSF-GK12 grant with a high poverty elementary school and university graduate students was the focus of this study. Together collaborative partnership teams of teachers and graduate fellows worked to build integrated STEM curriculum modules to present in the classroom. Enhanced focus on high quality, long-term professional development, in collaboration with faculty from arts and sciences may be one method to improve both the content knowledge of teachers and the teaching ability of future scientists and mathematicians (Huziak-Clark, Van Hook, Nurnberger-Hagg, & Ballone-Duran, 2007). The graduate fellows worked in the classroom with the teachers presenting the lesson and with the students as well as outside the classroom planning the lesson and preparing the resources. The work with the fellows provided teachers with content experts to build on their content knowledge. The teacher and graduate fellow were able to identify areas in which they could improve and then work together to effect change (Hook et al., 2009). The perceptions of the teachers and the graduate fellows of their collaborations and any barriers or successes were explored during this case

study. Communication can provide an avenue for these partnerships to be successful or not in the educational setting.

Research Questions

This study was guided by the following research questions.

1. What were the successes for teachers and graduate fellows of the 5-year *Science First!* NSF-GK-12 Grant?
2. What were the barriers for teachers and graduate fellows of the 5-year *Science First!* NSF-GK-12 Grant?

Significance of the Study

While working on this NSF funded grant graduate fellows and teachers were required to work together 10 hours per week. Though this time was to be focused on curriculum materials STEM activities and strategies in teaching relationships were built through this work. The quality of the materials and the amount of time spent in the classroom with students could be affected by these relationships. NSF typically funds GK-12 grants for 5 years to give schools ample time to implement programs. Graduate students were obtaining their master's degrees in a science or math discipline and only have 2 years to build that relationship. Gaining the confidence of each party in the partnership was essential in building effective collaboration early on. The study was an examination of the teacher and graduate fellow's perspectives through interviews of the barriers and success of the grant from year 1 through mid- year 5 of the grant implementation.

Scope of the Study

This study addressed the research questions referenced above by using qualitative methodology. Interviews were conducted with seven graduate fellows and nine teachers. The purpose of these interviews was to gather perceptions of the teachers and graduate fellows participating in the *Science First!* Grant regarding the barriers and successes. An outside person not related to the grant was brought in to conduct the interviews to focus the questioning and maintain objectivity throughout the study.

A qualitative case study approach was appropriate because of the small sample size. A single case study was the research design for this project. Interviews took place during the final semester of the grant.

The in-depth interviews took place after school hours at a convenient time for the participants. These interviews provided the study with information using open-ended questions that the interviewees answered openly about their participation in the grant and with their partner. Because the grant concluded this year, these data will be used for future planning and as an evaluation tool.

Statement of Research Bias and Limitations

As a participant observer of the *Science First!* Grant, the researcher was in on the ground work of the grant. The researcher has her perceptions of expectations and outcomes of the grant. Case study research bias can be the degree to which one is open to contrary findings (Yin, 2003). Yin cautioned that while participant-observer provides certain unusual opportunities for collecting case study data it also involves major problems. The researcher had an outside person not connected to the grant conduct the interviews. As the principal at the

elementary school, I had preconceived ideas of what I wanted to happen to impact the curriculum and the students. A separate research assistant to conduct interviews removes any obstacles participants may have in answering questions openly and any subjectivity I may place in questioning.

The graduate fellows involved in the grant were attending the university and working at the elementary school as well. They were challenged with learning the hidden language of both environments. This hidden language of the elementary school includes the “teaching” of science and math concepts and the nature of the professional teaching day that comes with the training of an educator. The graduate fellows were science or math content specialist trained in the field of research methods in higher education. The challenge of bringing content area subjects down to the level of elementary students as well as sometimes teaching a totally different subject takes the fellow out of his or her comfort zone. Graduate fellows were role models for scientists in education. The important point was that they shattered the stereotypes of nerdy scientists and geeky engineers (Levey, 2005). Latterell (2009) found four reasons for graduate fellows’ frustrations with education: (1) fellows wanted to work with higher level math and science; (2) fellows thought students were not behaved and were unmotivated; (3) fellows did not view being a teacher as being a career; (4) fellows believed school systems required teachers to do too many things that fellows did not want to do. Juggling schedules of the work at the elementary school, the classes at the university, and their research required the fellow to prioritize. This time management and scheduling issues meant different things to the teachers and the graduate fellows.

The teachers in this GK-12 grant experience had conflicted interests. The teachers have a commitment to the standards and structure of the school environment. They were so focused on

the needs of the students in other curriculum areas and priorities of the school that the grant and STEM activities were sometimes not met. Teachers do not see the significance in learning information about higher level STEM content they cannot implement it the classroom. Teachers tend to work on a utilitarian level and address practical classroom puzzles that must be solved while teaching and researching in their classrooms (Gilbert & Smith 2003).

Action research is intentional and systematically conducted; it does not rely on common trial- and- error strategies generally employed by teachers (Gilbert & Smith 2003). Some teachers are departmentalized and do not understand how STEM concepts can be integrated into their academic areas. The time that this grant placed on an already packed schedule for an elementary teacher created additional pressure to grant success.

The research was conducted within the same elementary school and local university. Participation in the grant and research was voluntary. Participants varied over the term of the grant. The tiered contract offered options of participation for partner teachers.

Definition of Terms

Collaboration- the act of teachers working together in order to achieve something (Seed, 2006).

Graduate fellow- a university student in math, science, or technology pursuing a postgraduate degree.

Partner teacher- a highly qualified professional educator in pre-K through fifth grade who works collaboratively with another professional to build effective lessons for students.

Overview of the Study

This chapter establishes the need for the completion of this study. What were the successes for teachers and graduate fellows of the 5-year *Science First!* NSF-GK-12 Grant? What were the barriers for teachers and graduate fellows of the 5-year *Science First!* NSF-GK-12 Grant? In Chapter 2, I include a review of the literature that pertained to STEM history, Grants in Education, NSF grants, *Science First!* Grant, graduate fellows, partner teachers, content specialists, poverty in elementary schools, and collaborations. Chapter 3 consists of the methodologies and procedures used to gather data including a description of the participants, the procedures used, and method of data analysis. Chapter 4 presents the data collected and the findings of the study. Finally, Chapter 5 provides the conclusions, summary, and recommendations for future research.

CHAPTER 2

REVIEW OF LITERATURE

History of STEM in Education

The practice of integrating content subjects such as math and science to help provide useful contexts for what is being learned is not a new idea. The idea of content integration was originally explored more than a century ago by the Committee of Ten at Harvard as a way to standardize the agrarian school system of the late 1800s (Ostler, 2012). The committee described the facets of a good industrial school system as a set of generalized skills that would promote excellence and a more comprehensive knowledge base for students. In fact, the spirit of integrated instruction in STEM was actually honored in education more in the late 19th Century, as the nation's economic focus moved toward industrialization. In the early 1990s the National Science Foundation formally coined the STEM acronym we use today to refer to the individual content disciplines of science, technology, engineering, and mathematics, but without the intent to formally integrate the subjects in schools. The term STEM was coined by Judith Ramaley when she was assistant director of the education and human resources directorate at the National Science Foundation (NSF) from 2001 to 2004 (Chauvot, 2009). Ramaley's concept of STEM situates learning in the context of solving real world problems or creating new opportunities a pursuit of innovation. Spurred by a public and private sector push for global competitiveness STEM has become a lightning rod for education.

The creation of the National Science Foundation (NSF) in 1950 was fueled by the launching of Sputnik and the fear that the United States would lose military superiority and prowess if the United States did not invest in the education of future scientists and engineers (Duschl, Shouse, & Schweingruber, 2008). By the late 1960s there were nearly 30 K-12

curriculum projects sponsored by NSF; science instruction became investigation and inquiry-based; "hands-on" became the mantra; and teaching the processes of science to get students to think like scientists became the goal. Much of that investment was made in the National Science Foundation, which supported the creation and revision of curricula in biology, chemistry, physics, and math (Cavanagh, 2007).

When the Soviet Union launched the first successful unmanned space flight in 1957, Americans were shocked; the response was immediate and intense (Garrett, 2008). These changes had a significant impact everywhere, but they were most obvious in public schools. Science curriculum shifted to laboratory, project-based activities; set theory was introduced in mathematics and problem-based learning evidenced the influence of engineering on the curriculum. In August members of Congress in both parties referred to Sputnik as they approved the America COMPETES Act, which called for billions of dollars in new spending on math and science education (Cavanagh, 2007). The 184-pound, unmanned aluminum beacon lasted just 3 months in orbit, but its legacy still resonates among U.S. educators and policymakers, who say lessons can be drawn from that Cold War era milestone, even if they disagree on what those lessons are. Many observers see parallels but also differences between the U.S. response to Sputnik, which prompted a wave of federal spending on math and science curricula, and today, when the challenges facing the United States in the global economy are more complicated. Though curricular areas were strengthened following the launch of Sputnik, American students have not demonstrated expected levels of growth in these areas, referred to collectively as STEM (science, technology, engineering, and mathematics) (Garrett, 2008).

In 1958 the U.S. Congress passed the National Defense Education Act (P.L. 85–864).

NDEA was aimed at stimulating and strengthening American education reform by providing \$1 billion over 4 years with the majority of funding was intended for those academically capable students, particularly in STEM areas, who did not have the financial means to pursue undergraduate or graduate degrees (Jolly, 2010).

The standards movement arrived in the mid-1980s and new curriculum frameworks of instruction were crafted for the reform of science and mathematics curriculum, instruction, assessment, and professional development for teachers (Duschl et al., 2008). The National Commission on Excellence in Education prepared The Nation at Risk Report in April 1983. The report contains summaries of the papers and hearings; a list of findings in content, expectations, time, and teaching; a set of recommendations; and aspects of implementation related to content, standards, and expectations for time, teaching, leadership, and fiscal support. (Nation at Risk Report, 1983)

Specific problems identified in U.S. science and mathematics education included the following:

- Critical shortages of physics, mathematics, and chemistry teachers exist at the secondary level.
- The average salary of a beginning math teacher with a bachelor's degree is now only 60% of the beginning salary offered by private industry to bachelor degree candidates in mathematics.
- Substantial numbers of unqualified persons are teaching science and mathematics in secondary school.
- Even certified science and mathematics teachers at the secondary level are in need of in-service training.

- New sequences of science and math courses and materials are needed to match stages of intellectual development of children.
- Elementary and secondary schools need access to microcomputers, low-cost supplies, and other resources. (p. 54)

Many of the same issues still challenge schools, teachers, and students today.

Recent national developments including the importance placed on STEM in awarding states federal Race to the Top funds, and the reauthorization of the No Child Left Behind (NCLB) or earlier know as the Elementary and Secondary Education Act (ESEA) have all given proponents hope that STEM programs will become more common (Schachter, 2011). The most important national initiative is changing the terms of NCLB to include student performance in science as a measure of Adequate Yearly Progress (AYP). Since NCLB became law in 2002, a school's AYP has depended on student results in reading and math, even though a number of states also test students in science. Because the accountability measure for students relies primarily on reading and math; science instruction has diminished over the past decade. The No Child Left Behind Act focuses on setting standards for student achievement and establishing criteria for highly qualified teachers (Garrett, 2008).

Where are we now with STEM and how do we continue to make an impact on student achievement? Why haven't the previous initiatives worked? Factors influencing this series of STEM initiatives include a globalized economy, fewer visas available to foreign-born students who want to study in the United States, an increasing lack of interest by U.S. students in STEM careers, and that the very students who sought STEM careers during the time of NDEA are now reaching retirement age (Friedman, 2005). "Forty percent of the general public and 61% of opinion leaders already identified math, science, and technology skills as the most important ingredients in the nation's strategy to compete in a global economy" (Zinth, 2007, para. 2).

Confounding this issue, gifted education has found it difficult to gain traction in the midst of 2001's No Child Left Behind Act, which focuses public K-12 energies and monies on seeking proficiency in reading and math as a goal for all students and ignores the needs of the most able students who could benefit from high-level math and science courses (Loveless, 2008).

Grants in Education

In these difficult financial times for education creative solutions are often required. Funding classroom projects is one more area where teachers are actively and inventively finding ways to supply their students with the resources that will enhance their learning (Reese, 2011). Schools and districts are beneficiaries of multiple opportunities to extend and enhance their core work of educating students through partnerships that either emerge from invitations outside of the school or district from corporations or universities or are sought through grant writing (Killian, 2011). Schools are looking for alternative funding sources to supplement their programming and provide resources for students and teachers. Grants can provide this avenue for them. Federal and state grants are often based in part on data and demographic information to guide distribution of funds. Reciprocally beneficial partnerships expand opportunities and extend the capacity of schools and districts. Schools have much to gain and potentially much to lose from partnerships. Partnerships can give schools flexibility to explore and access extension of services and alternative programming for students to meet their needs. The sure way to find and enter partnerships that add value to each partner is to take adequate time to build relationships with potential partners, assess potential partnerships, evaluate partnerships they enter, and avoid partnerships that might detract from their priorities and immediate needs. Partnership relationships are building throughout grants with communication of needs, resources, and evaluating the effectiveness of the programming.

A multitude of corporations and institutions want to provide for educational sites through grant funding. According to the Foundation Center, more than 26,000 grants of almost 3.9 billion a year went to education in 2005 (Henke, 2008). Funding provides a form of investment in their community, the future, and a method of showing appreciation towards education and teachers. Seeking funding for schools has become so competitive that trainings and teams of grant writers for districts have been developed to research and apply for optimal grants.

Grants have provided for schools educational needs as far back as the 1800s. In 1862 the first Federal Grant education program, The Morrill Land Grant Act program, provided colleges with land to build schools. The first grant to provide funds for students to attend school was in 1944, The Serviceman's Readjustment's Fund, called the GI Bill of Rights. Similar government grants followed with the Education Opportunity Grants 1965, would later be reestablished as the current PELL grants issued now. Several grants followed such as; State Student Incentive Grant 1972, Academic Competiveness Grant, and TEACH Teacher Education Assistance for College Higher Education. Most were for higher education and support for college and career postsecondary education.

Established in 2008, the AFT Innovation Fund aimed to unlock great ideas in education, proposed by classroom professionals and their unions. The Innovation Fund allows AFT members to tackle head-on the most vexing issues in school reform, such as teacher development and evaluation, through a consensus building process with teachers, district personnel, and community members (Rose, 2011).

Recent grant funding came with the First to the Top Funding of 2008. Two years after Congress passed the American Recovery and Reinvestment Act, nearly \$100 billion in economic-stimulus aid for education has been handed out-including nearly \$5.3 billion as part of

six grant competitions. The grants ranged from money under the high-profile Race to the Top program for states to a lesser-known competition to award emergency construction aid to school districts. Ten states and their districts did not receive any competitive funding. Of those that did, Florida and New York came out on top in total dollars. On a per-student basis, the District of Columbia, Delaware, and Tennessee were big winners (Education Week, p. 33). This grant money will further challenge schools and states to develop plans and meet requirements for student learning for accountability. The monies are used to further student achievement and development. There is an extension of the grant for states to apply for monies to continue and add additional programs for schools in the next two years.

Grants have found their place in education as a supportive resource for students, teachers, and administrators in these difficult times. They range from billions of dollars to states to small amounts for the classroom or teacher. The impact differs of course but according to the increase of grants from the 1800s to present day, there must be a positive influence on education.

NSF Graduate Fellow Research

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 to promote the progress of science; to the national health, prosperity, and welfare; to secure the national defense (NSF, 2000). With an annual budget of about \$6.9 billion (FY 2010), it is the funding source for approximately 20% of all federally supported basic research conducted by America's colleges and universities. In many fields such as mathematics, computer science, and the social sciences, NSF is the major source of federal backing. NSF fulfills its mission chiefly by issuing limited-term grants currently about 10,000 new awards per year, with an average duration of 3 years to fund specific research proposals that have been judged the most promising by a rigorous and objective merit-review system. Most of these

awards go to individuals or small groups of investigators. Others provide funding for research centers, instruments, and facilities that allow scientists, engineers, and students to work at the outermost frontiers of knowledge. One essential element in NSF's mission is the support for science and engineering education from pre-K through graduate school and beyond. The research they fund is thoroughly integrated with education to help ensure that there will always be plenty of skilled people available to work in new and emerging scientific, engineering, and technological fields and plenty of capable teachers to educate the next generation.

The National Science Foundation established the Graduate Teaching fellow Education Program in K-12 to facilitate the transfer of content knowledge and encourage the use of inquiry-based teaching methods, familiarize teachers and students with scientists and their research methods, and familiarize college faculty and graduate students with the role they can play in K-12 education (French, 2005). The GK-12 branch of NSF connects graduate students back with the elementary and secondary student and curriculum. This connection broadens the landscape for all groups in the STEM disciplines and deepens professional communication skills and development. The National Science Foundation has encouraged the collaboration between scientist and educators to improve undergraduate education (Huziak-Clark et al., 2007). The intent of the NSF is to build college student awareness of educational needs and interest for students in science and math disciplines. The bonus of the program is the academic achievement of students and the content growth of teachers in the classroom. The NSF continues to maintain its emphasis on collegiate student growth and STEM awareness. National Science Foundation's Math and Science partnership program seeks foremost "to improve student outcomes in high-quality mathematics and science by all students, at all pre-K-12 levels" (NSF-02-061; NSF,

2001). The NSF sets high expectations and quality control evaluation standards to monitor grants and keep all parties focused on learning.

Through university and school collaboration, the NSF hopes to narrow the gulf between the world of school science and the world of the scientist both by increasing the levels of scientific literacy among the general population and by increasing scientists' understanding of K-12 science education (NSF, 2000). The mutual exchange of information between the university personnel, graduate fellows, and teachers creates a rich environment for STEM knowledge growth in the learning environment. Building these ties between two learning institutions takes time, structure, patience, monitoring, and relationship building with trust. Trautmann (2008) found three outcomes through the GK-12 program study; a perceived increase in the content knowledge of teachers, the provision of positive role models for K-12 students, and the strengthening of school and university relationships. NSF grants have shown educators grow in science and math content knowledge with the graduate fellows as models and the students respond to the graduate fellows as scientists. Many NSF grant programs are placed in economically disadvantaged schools. Students in these schools build positive relationships with the graduate fellows and begin to mold an image of what a career as a scientist and mathematician could be for them. NSF-GK-12 Program is an incredibly powerful idea, but it is useless without university professors and K-12 teachers willing to build partnerships (Levey, 2005). The relationship between the university graduate fellows and partner teachers is crucial for the communication of content to be effective for all parties: teachers, graduate fellows, and students. Each party needs to be open to the give and take of information and learning new content and methods of implementing that content in meaningful ways.

NSF personnel do not intend on making GK-12 fellows teachers through the grant, instead they want to prepare science and engineering graduate students with additional skills that will broadly prepare them for professional and scientific careers in the 21st century (NSF, 2007) NSF challenges graduate fellows to extend their collegiate experience through their fellowship with partner teachers to build on communication skills, presentation skills, flexibility, research, and general impact on the community.

Science First! GK-12 Grant

Science First! GK-12 Grant was awarded in 2007 to a southeast university and local elementary school from the National Science Foundation. This grant was a three million dollar grant for 5 years. It provides nine graduate fellows annually to one high poverty school of 90% economically disadvantaged elementary school with 50% minority. The focus on the STEM disciplines fits with the school's math, science, and technology signature status. The grant is unique to NSF due to all the resources and graduate fellows being placed in one school site. Graduate fellows were chosen to participate through interviews and screening. They are master level students and typically are in the program for 2 years. Teachers at the elementary school are given the option to participate and receive incentives through a stipend and support with a graduate fellow support and knowledge base.

The grant is managed by a principal investigator (PI) from the university and Co-PIs from the university STEM departments as well as the principal of the elementary school as a Co-PI and a science teacher Co-PI. The team cowrote the grant with the following goals:

1. To ensure fellows are endowed with the necessary skills to face the career challenges of the 21st century that involves an intricate blend of research, teaching, and outreach in STEM disciplines, all conducted in an increasingly diverse scientific environment.

2. To give fellows the opportunity to bring their STEM research into the K-12 classroom.
3. To improve student performance as measured by standardized tests; to build a lasting interest in science and mathematics; to have many students declare a career interest in science.
4. To actively engage teachers in meaningful curriculum development, graduate coursework, and contextual learning that will improve their content knowledge in several disciplines.
5. To enhance fellows' communication and collaborative skills, their appreciation of the vital importance of STEM learning in the early grades, and their awareness of the interconnectedness of scientific fields; to build in fellows an appreciation of scientific disciplines other than those in which they are specializing; to prepare fellows to be effective teachers.
6. To improve the teachers' communication and collaborative skills.
7. To complete, at the rate of 25% per year, an entire curriculum mapping project for four subjects and at six grade levels.
8. To disseminate the materials within the school's system, regionally, and nationally; to disseminate the nature of the GK-12 fellows' experiences and learning; and to disseminate the impact of the project on graduate education.
9. To work with teachers and administrators at other elementary schools and the middle school (grades 6-7) and junior high school (grades 8-9) to examine the feasibility and mechanics of a similar curricular integration at other elementary schools and at the 6-9 grade levels.

10. To have all stake holders work in teams, and as equal partners, at each stage of the project.
11. To continue to build strong partnerships between university and elementary school, partly through institutionalization of a GK-12 program that involves both upper class and graduate students.
12. To recruit a diverse body of fellows who mirror the racially and ethnically mixed student population at NSE.

The grant provides teachers a tiered contract with multiple opportunities for involvement in STEM participation. Graduate fellows and teacher collaboration in lesson planning and teaching is Tier I of the grant and provides both parties growth in the content areas with preparation each year before school during summer institute training. Tier II of the grant provides teachers the opportunity to participate in a STEM professional development of their choice. Tier III of the grant provides teachers graduate level courses with credit in a STEM discipline to increase content level knowledge for teachers. Teachers are given the option of signing up from year to year for participation in the grant. They are also given options of Tier participation.

The grant also gives the elementary school of high poverty extra funds for STEM projects. The school has an outdoor classroom with two ponds, a class meeting space, and a dig pit to mimic the fossil site nearby. The grant also provided the science lab with state of the art materials and technology for teachers to implement their lessons. Students are instructed by the teachers and fellows weekly pre-K through 5. Related arts teachers in physical education, library, arts lab, and guidance participate as well in the grant. Graduate fellows find methods to bring the STEM language to these special area classrooms and teachers.

Graduate Fellows

Graduate students from universities apply for the opportunity to partner with teachers in extended learning opportunities in their collegiate experiences. The acronym GK-12 is used to mean that the fellows provide content knowledge and instructional support in classrooms from grades kindergarten through 12 (Mumba, Chabalengula, Moore, & Hunter, 2007). Graduate students apply through the university, interview, and are selected to participate in programs for NSF grant GK-12 programs. Fellows shatter the stereotypes of nerdy scientists and geeky engineers through their innovative approaches to disciplines that might otherwise intimidate students (Levy, 2005). Graduate fellows bring current research methods to the classroom and make science identifiable and approachable to students and teachers. Scientists become accessible to students and they can imagine a life changing possibility. Page, Wilhelm, and Regens (2011) explained that selection is based on year in degree program, transcripts, and statement of interest, recommendation letters, and an essay about presenting their research for a K-12 audience. Because a K-12 classroom differs significantly from graduate school, many GK-12 programs offer a course or a series of seminars to prepare the fellow for the classroom (Baumgartner, 2007). Graduate fellows may also participate in summer programs to familiarize themselves with the school personnel, the curriculum, and procedures of the grant. Graduate fellows attempt to exist in two distinctly different worlds, that of the science laboratory and that of the science classroom (Thompson, Collins, & Metzgar, 2002). Making that shift from research to sometimes a kindergarten classroom smoothly can be eased with the support of a classroom teacher.

Graduate students implement their expertise in a STEM discipline to work in area schools to support students and teachers. The partnership affords fellows the opportunity to

teach and receive feedback in order to improve teaching skills, to communicate with nonscientific audiences, to adjust lessons based on understanding, and to work collaboratively with teachers (Page et al., 2011). In classes with rigid curricular requirements, the fellows redesigned traditional lessons to teach required topics using a more inquiry-based approach (Trautman, 2008). Graduate fellows help teachers expand their curriculum with in-depth planning. The graduate fellow builds with the teacher lessons that require students to use more research, analytical, and critical thinking skills. Working with partner teachers, fellows determine where and how inquiry projects could help meet class-specific needs and enhance established curricula.

Mumba et al. (2007) conducted an 8-year GK-12 study looking specifically at instructional planning for graduate fellows with partner teachers. Fellows help partner teachers infuse new content into the curriculum, act as role models for students, and learn about how K-12 schools and teachers operate. Science and math graduate students are matched up with K-12 educators to plan and instruct in the same disciplines. The questions were posed in the study: How do the fellows plan for the classroom? What do they think about their instructional planning? How do those plans relate to current best practices? The fellows used planning procedures while consulting teacher partners and examining the curriculum to identify topics, goals and objectives, activities, means of assessment, and instructional materials. The fellows had to consider antecedent factors of age of students, abilities, grade level, class size, type of students, and facilities. The antecedent factors would then impact the scope and depth of the content. Resources the fellows used included the university, science journals, textbooks, library, and the internet. The assessment of the planning was through the teacher and student feedback.

The fellows attributed the success of science lessons to the collaboration with the planning with the partner teacher.

Graduate fellow outcomes are the primary focus for NSF and include the areas of communication, teaching, collaboration, and team-building skills. Page et al. (2011) reports on a study through the NSF called the Collaboration to Advance Teaching Technology and Science (CATTS). The study followed over 135 fellows for 10 years of funding while reaching over 100 classroom teachers and thousands of students. Fellows participated for one and half years with half of a year spent in classes for training in educational pedagogy and training. The fellow spends the following year in the classroom teaching for approximately 15 hours a week with the partner teacher. Fellows are paid a stipend for participation in the grant. Fellows and teachers completed surveys and monthly journals throughout their experience to provide data for the grant. The results of the study found a positive impact on the graduate fellows, teachers, and students. The graduate fellows, through a pair sample t test, had improved communication, teaching experience, collaboration, team-building skills, confidence, use of inquiry based methods, lesson planning for various ages, public speaking to nonscientists, and development of their teaching philosophy. An unexpected outcome of the grant was 11 teachers pursuing a degree in K-12 education and 72% wanting involvement in an outreach program of some sort. The awareness of science education and pedagogy became more apparent and attitudes towards time dedicated to science as well as resources in the schools. Fellows became problem solvers and advocates for reform and change as a result of their participation in the grant. Teachers had more resources and lessons for them to access later; however, the study indicated fellows did not have confidence they would use them later.

Cormas and Barufaldi, (2011) conducted an outside evaluation of 31 NSF GK-12 studies spanning 1999 to 2005. The researchers contacted the NSF program leader for the Principal Investigators of the 31 awardees and surveys were sent out in 1999 and 2005. Data were used for this study to show the impact of the NSF funds and science and math on graduate fellows, teachers, as well as effective evaluation systems. Five of the effective research based characteristics professional development appear in over half of the evaluations and include:

- Requires resources money and time 94%
- Treats teachers as professionals 76%
- Involves collaboration between teachers and others 62%
- Professional development is on-going 52%
- Improves communication skills 52%

The two emergent characteristics derived from the analysis included improves communication skills 52% and has real world application 38% (Cormas & Barufaldi, 2011). The study provided data on graduate fellows and teachers with recommendations for professional development support in research based texts and pedagogy skills. The study gives a comprehensive view of GK-12 grants and the impact they had on teachers over a 5-year period of time.

Mitchell et al. (2003) conducted a qualitative analysis of case studies from 12 sites in partnership with K-12 schools and a quantitative analysis of survey data gathered from all GK-12 sites. The strongest aspects of the programs were (a) gains in content knowledge for teachers; (b) Fellows were positive role models for students, (c) increased collaboration in school-university relationships, and (d) improvement of communications and instructional skills for fellows. Weaker aspects of the programs included (a) fellows' and teachers' roles needed clarification

and (b) summer training did not provide time for relationships to form between teachers and fellows and did not prepare fellows for the classroom (Cormas & Barufaldi, 2011).

GK-12 Fellowships provide one way in which graduate students can begin learning to teach in a well scaffolded environment (Trautman, 2008). Graduate students work collaboratively with teachers, students, and college administrators. Through collective planning the graduate fellow has to balance graduate school work, grant work, studying, and daily living. Time management becomes crucial in being an effective graduate fellow in a GK-12 grant. Although the details of execution differ from site to site, all of the programs offer structured opportunities for graduate students to work side by side with experienced teachers and to reflect on their teaching experiences. The desired outcome for graduate fellows is to develop into faculty with good teaching skills, awareness of current best teaching practices, and good communication skills (Van Hook et al., 2009).

Partner Teachers

A partner teacher is equipped with the educational vocabulary and pedagogy of the pre K through 12 curriculums. Typically, successful, collaborative relationships develop between teaching partners who are willing and able to work together because they understand the value of collaboration for themselves and their students (Jones & Morin, 2000). Teachers and the graduate fellows need to see the mutual benefit of the work they build together for the success of the grant. Teachers and graduate fellows have to be open to ideas and willing to be flexible in their thinking to challenge each other for the benefit of the students they are leading. Teachers benefit from using a knowledgeable colleague in supporting teacher practices (Onchwari & Keengwe, 2010). Teachers who received this support developed a reflective aspect that caused them to examine their roles as teachers. Bringing in a hands-on approach to learning for students

and building deeper skills content can challenge teachers to reflect on all areas of teaching (Thompson et al., 2002). The same set of strategies could apply to other content areas or be integrated into science. A skill set is in place for the partner teacher in the school procedures, lesson planning, instructional strategies, student engagement, and classroom discipline. There is evidence that partnerships between teachers and fellows create added value (Barnes, Carpenter, & Bailey, 2000). The success of a teaching partnership depends not only on an attitude of mutual respect for one another's areas of expertise and potential contributions but also on a sense of equality within the relationship (Jones & Morin, 2000). The relationship between the graduate fellow and partner teacher is based on the understanding from the beginning of their strengths and the professionalism set in place by the grant leadership. The communication and planning between the graduate fellow and partner teacher is based on the protocols set by their prior meetings and guidelines. Successful, collaborative relationships are non-hierarchical; mutual respect for one another's ideas and contributions occurs within a framework of authentic "give and take" that supports the spontaneous sharing of ideas.

Dimitrov (2008) studied math and science partnerships with the NSF GK12 funding. The study followed student achievement data for 3 years comparing it with teachers who partnered with a fellow in the MSP program and those who did not. The data were collected from years 2002 through 2005. Schools that had the MSP program showed growth each year in math and science proficiency test scores. The schools with positive changes were in much higher numbers and higher mean effect size compared to schools with negative changes or no change in math or science proficiency. There was a positive relationship in elementary and high school teacher participation and MSP activities; no evidence for middle school found.

Wong and Socha (2008) also studied the math and science partnership evaluation process with the National Science Foundation. The Wong and Socha study looked at student achievement within the same state using other schools not using fellows as comparative data. The overall goal of the study was to set up protocol for evaluating NSF MSP programs and their effect of student achievement trends. State standardized test scores were used for data because they were consistently used at all schools and could be collected and monitored over time. Achievement gains, or value added, scores were used to measure the growth of students from year to year. Using value added scores eliminated some variables rather than achievement data; such as lack of parent involvement or other data contamination. The study concluded with a detailed method of matching schools for comparative analysis in multiple categories in a large scale for the MSP program. The matching protocol was drilled down to subgroup populations and matched to nonparticipating schools within the state that were similar.

Yin (2008) was the third researcher to study the math and science partnership evaluation process with the National Science Foundation. Yin took a comprehensive look at the evaluation framework, the design and implementation of each model, major themes and activities of programs, and student achievement measures. The study took place over 2 years with data collected from 35 programs. All 35 MSP projects were making progress in collecting and assessing student achievement data. The collaboration with state agencies on data could help alleviate some of the frustrations some programs are having with consistency and trends in reporting results. The researcher sets up the following questions to ask to assist programs in evaluating their program with such diversity in assessments, levels, activities, and desired outcomes.

1. How has the MSP Program affected, influenced, or been associated with changes in the K-12 mathematics and science teaching force, K-12 student achievement in math and science, and other outcomes associated with the program?

2. What factors or attributes appear to have accelerated or constrained progress in the MSP Program's achievements?

3. How have disciplinary faculty (math, science, and engineering) from IHEs participated in the MSP Program, and what has been their role in the program's achievements?

Topics:

4. The MSP's Program features, including MSP-related discoveries and innovations in math and science education worth developing on a large scale.

5. The processes influencing, interfering, or associated with the outcomes of the features.

6. The conditions associated with the demonstrated quality and innovativeness of the MSP Program.

Thompson, Metzgar, Collins, Joeston, and Shepherd (2002) conducted a 1-year, observation- and interview intensive, qualitative study of one site in partnership with middle and high schools. The primary findings from the conference paper were (a) fellows' and teachers' collaborations increased content knowledge for teachers; (b) fellows and teachers formed strong collaborations and interactions; (c) students witnessed scientific interactions in the classroom that helped students understand the social aspect of science; (d) curriculum knowledge increased for teachers; and (e) fellows reported increases in student learning of the nature of science and ideas concerning instructional techniques (Cormas & Barufaldi, 2011).

Zhang, McInerney, and Frechtling (2011) explored the effect of the engagement of university science, technology, engineering, and mathematics (STEM) faculty in the Math and

Science Partnership program. The findings suggest that K-12 teachers benefited from the engagement in terms of improved approaches to teaching and learning, increased knowledge of subject matter content, and increased confidence. STEM faculty benefited from new ideas about teaching and learning, insights into research, more knowledge of the K-12 education system, and a broader understanding of education overall. Student achievement also improved, although direct attribution to faculty involvement was unclear.

Partner teachers provide the script or model for fellow to bring their content to the K-12 classroom setting. Fellows learned a great deal about how to plan for teaching through practice and through interactions with partner teachers and K-12 students (Mumba et al., 2007). The partnership between the teacher and the fellow was structured with the state standards as a tool and weekly meetings for structuring the plan. Their curricular orientations will likely shape, as well as continue to be shaped by, the initiatives they undertake, the role they play in classrooms, and the curricular, instructional, and assessment activities they choose to be involved in, design, and implement (Christodoulou, Varelas, & Wenzel, 2006). In most cases the fellows' lesson and unit planning involved the following procedures: consulting partner teachers, examining existing curriculum used by the teachers, identifying topics, formulating goals and objectives, identifying appropriate state learning standards, developing activities and assessment tools, and gathering necessary materials for activities (Mumba et al., 2007).

Content Specialists

In the 1980s Shulman (1986, 1987) suggested that there are seven knowledge bases required for teaching. Three that are related to this study are (a) content knowledge, (b) knowledge of general pedagogy, and (c) pedagogical content knowledge. Content knowledge is related to the discipline and includes subject matter knowledge and ways of working in the

disciple. General pedagogy constitutes the common strategies and procedures used in teaching. Shulman suggested, however, that PCK was different from both content knowledge and knowledge of general pedagogy: he wrote that it consists of such knowledge as how to represent subject matter to students, ideas about student conceptions and understandings of specific learning difficulties students may have.

Moyer-Packenham and Westenskow (2012) studied student achievement results in mathematics and science with claims that K-12 teachers should be better prepared to teach basic concepts in these disciplines. The focus on teachers' mathematics and science content knowledge has been met by efforts to increase teacher knowledge through funded national initiatives focusing on mathematics and science. The study looked across projects in the National Science Foundation's Math and Science Partnership program to determine how partnerships developed processes for measuring growth in teacher content knowledge. Pre- and posttesting were used for measuring growth in content knowledge, with 63% of the mathematics and 78% of the science teachers showing significant gains in content knowledge. Results revealed two pathways for promoting teacher content knowledge growth: content explicit, where the goal of growth in teacher content knowledge was explicit in the activity, and content embedded, where the goal of growth in teacher content knowledge was embedded in the activity.

Teachers with higher levels of content knowledge, attitudes toward mathematics, and self-efficacy are better able to produce higher student achievement than teachers with lower levels (Evans, 2011). Attitudes toward mathematics are important because there is a reciprocal relationship between attitudes toward mathematics and achievement in mathematics (Aiken, 1970). Adler, Ball, and Krainer (2005) said, "How well teachers know mathematics is central to their capacity to use instructional materials wisely, to assess students' progress, and to make

sound judgments about presentation, emphasis, and sequencing” (p. 14). Further, Adler et al. suggested that teachers with high content knowledge could help narrow the achievement gap in urban schools. There was concern about the lack of content knowledge held by these teachers because many did not study mathematics extensively as undergraduates as many traditionally prepared teachers did. The findings in this study suggested that teachers improved their content knowledge and attitudes toward the subject after taking a reformed-based mathematics methods course (Evans, 2011).

Teachers’ knowledge of science subject matter has been identified as one of the contributing causes of teachers’ low self-confidence in teaching science (Appleton, 2006). Appleton’s later (2008) research suggested that elementary school teachers work with pedagogy content knowledge in different ways. These teachers usually start with the idea that science should be activity based and work from specific activity idea (Appleton, 2006). The majority of elementary school teachers tend to have limited knowledge in both science content knowledge and in science pedagogy content knowledge, given that few elementary school teachers are science discipline specialists. Science professional development literature by demonstrating that elementary teachers need considerable support in developing their knowledge base, which Appleton (2008) shows includes science pedagogy content knowledge, when learning how to implement new ideas and change their science teaching practice.

Scientist and teacher partnerships have the potential to increase teachers’ content knowledge and understanding of scientific inquiry and provide real-world examples of the applications of subject matter (Loucks-Horseley, Love, Stiles, Mundry, & Hewson, 2003). These partnerships can facilitate more coherent science education from K-12 through higher education (Tanner, Chatman, & Allen, 2003). Pegg, Schmooch, and Gummer (2010) found value

through their research in the scientist and science educator partnerships in mentoring teachers. Pegg et al. found four considerations in these partnerships: The mentors' roles are multifaceted and should include a focus on both content and pedagogy. The mentoring relationship should be viewed as a partnership and not an evaluation or judgment. Mentoring visits should be coordinated so that the expertise of mentors is specific to the teachers' curriculum when possible. A sustained relationship throughout the year provides support and increases the likelihood that teachers will be able to successfully implement the lessons of the initial workshop.

Huziak-Clark et al. (2007) found that 89% of teachers reported improvement in their content knowledge and ability to plan inquiry based science and math lessons because of their participation in the PRISM, NSF-funded program. All the fellows reported that the teachers' content knowledge improved.

Teacher content knowledge is important because it is a necessary, but not sufficient, condition for good teaching (Ball et al., 2005). Teachers have the instructional information to convey the content to the students. Teachers have the strategies and norms in place for appropriate intervention of content level skills. Teacher knowledge is intertwined, it's the DNA of the classroom; it acts in a complex, nonlinear manner to create and foster student interactions and learning (Martin, 2009). The teacher is the component in the formula who can structure the classroom environment for the optimal student learning. The teacher can help trouble shoot any planning issues before hand, pre teach necessary skills, navigate through materials, and adjust content as necessary (Rigelman & Ruben, 2012). The classroom dynamics are also the teachers charge. Student behavior and classroom management are important in getting the classroom lesson implemented. The partner teacher gains new content knowledge from graduate fellows.

The graduate fellows and partner teachers collaborate to successfully implement content knowledge that is relevant and meaningful to students.

Impact of Poverty on Elementary Education

As mentioned in the previous section, the teacher's content knowledge, educational strategies, and classroom management are instrumental for effective teaching. However, equally important are the economic factors facing a school community. New research tracing the achievement gap between children from high and low income families over the last 50 years shows the gap between high and low income families has grown about 40% and finds that it now far exceeds the gap between white and black students (Reardon & Bischoff, 2011). Despite these numbers, federal policies have not met the challenges facing schools with high levels of poverty. No Child Left Behind defined subgroups by minority status, proficiency in English, and income, but only to ensure schools accounted for disadvantaged populations. Policy makers challenge schools to make up the difference or deny the correlation between family background and student achievement (Ladd & Fiske, 2010). The most important civil rights battleground today is educational opportunities for the poor (Kristof, 2012).

The link between poverty and education is pivotal according to Friedman (2011). This is seen at the earliest levels of education. Parents earning less than \$15,000 had enrollment rates in college of almost 20% lower than parents earning more than \$50,000 a year. Furthermore, 46% of Americans growing up in poverty and failing to receive a college degree were destined to remain in poverty. Often teachers feel a sense of helplessness when dealing with issues of poverty and carry with them myths about the "Culture of Poverty". For educators to maximize their effectiveness they must be able to challenge their views on class and poverty. Gorski identified the following myths of the Culture of Poverty;

1. Poor people are unmotivated and have weak work ethics.
2. Poor parents are uninvolved in their children's learning largely because they do not value education.
3. Poor people are linguistically deficient.
4. Poor people tend to abuse drugs and alcohol (2008).

With over 43 million families below the poverty level including 13 million families with children under the age of 18, (2010 Census), the impact of poverty on education is a growing reality. School systems have implemented policies in an attempt to address the impact of teaching, but few resources have been made available to schools. Programs for stable housing, expanded school meals, expanded access to quality preschool programming, increased dental and physical health access, increased quality after-school programming, fully resourced schools and policies to enable parents, families, and communities to meet the needs to thrive educationally (Mistry & Wadsworth, 2011) are all key components to lessening the impact of generational poverty on education.

Parker, Grenville, and Flessa (2011) presented a case study that found teachers in schools with high poverty had created positive school climate, community, and a culture of leadership through: (a) teaching excellence and high-quality collaboration amongst teachers; (b) parental engagement along with community partnership; and (c) shared leadership amongst administrators and teachers. Teacher participants attributed school success and a positive school climate to teaching excellence and high-quality collaboration. Balancing social and emotional needs with academic needs was a common struggle amongst all schools.

Contrary to current literature, the future of children may not be bleak because of poverty, family discord, violence and abuse, illness, parental illness, and many other factors. Protective factors including the temperament of the child, unexpected sources of support from inside the family or the community, and self-esteem lead a majority of at-risk children to succeed in life (Rak & Patterson, 1996). Counselors can have a huge impact on maximizing their skills for success.

Kannapel and Clements (2005) conducted a research project looking at high poverty and high performing elementary schools in Kentucky. Through this research they look for common themes and threads.

- Review and alignment of curriculum
- Individual student assessment and instruction tailored to individual student needs
- Caring, nurturing environment of high expectations for students
- Ongoing professional development for staff that was connected to student achievement data
- Efficient use of resources and instructional time

Faculty in the study's schools did not make an issue of the fact that many of their students were "in poverty." Disadvantaged students appeared to be treated in fundamentally similar ways as advantaged students. Individual learning needs were targeted for attention rather than categorizing students as part of an at-risk group held to different performance expectations.

Reeves (2003) investigated the 90, 90, and 90 schools: 90% free and reduced lunch or poverty, 90% from a minority background, and 90% in academic achievement. Through his research of inner city urban schools, suburban schools, and rural schools; he included 4 years of

test data and over 130,000 students. The recommendations found through the study of the most effective schools were:

- A focus on academic achievement
- Clear curriculum choices
- Frequent assessment of student progress and multiple opportunities for improvement
- An emphasis on nonfiction writing
- Collaborative scoring of student work

Reeves concluded with,

Perhaps the most compelling argument against any research about success in high poverty schools is the observation that there are cases where teachers are doing all of the right things, and yet student achievement remains low. There are no magic potions to deliver improved student achievement. The best that researchers and policymakers can do is to examine the preponderance of the evidence and draw appropriate conclusions.

(p. 19)

Collaboration

Collaboration is recommended to enhance learning, support curriculum development, and facilitate research (Huziak-Clark et al., 2007). Reformers seeking to increase student understanding and interest are looking to collaborative partnerships to support improved science, technology, engineering, and mathematics teaching (Schneider & Pickett, 2006). Anderson (2002) emphasized the need for collaboration: “ Collaboration is integral not only to the technical dimension of reform endeavors, but to the cultural dimension...Collaboration is a powerful stimulus for the reflection which is fundamental to changing beliefs, values and understandings.” (p. 9). Collaborative work, however, relies on communication and joint

ownership; all partners should learn and benefit from collaboration (Huziak-Clark et al., 2007). The benefits in these collaborations between graduate fellows in science and classroom teachers seem to be greater access to current scientific knowledge and practices, increased understanding of the work of scientists, and enhanced subject matter knowledge on the part of students and teachers (Thompson et al., 2002). One teacher is not viewed as more of an expert than the other; they work in partnership, equally supporting and learning from each other to implement teaching activities and strategies from the summer institute for the improvement of classroom practices (Murray, Ma, & Mazur, 2009).

Many reform documents have called for the specific collaboration of scientists and mathematicians with K-12 teachers to improve K-12 education (National Commission on Mathematics and Science Teaching for the 21st Century, 2000). Collaborative relationships between teachers and university faculty and students are the basis of many projects and their value and benefit for all sites have been celebrated by researchers (Baird & McClary, 1998). Researchers stress the need for collaborations among a variety of players, like teachers, schools, districts, and scientists. Collaboration takes the form of coteaching partnerships between graduate students in mathematics or a science and K-12 teachers. These partnerships serve as a means of providing on-going professional development for both the teachers and the graduate students. The findings suggest that the collaborations between the fellows and the classroom teachers had a positive impact on each of the participant's pedagogical skill and on the teachers' content knowledge (Huziak-Clark et al., 2007).

Collaborative partnerships are strongly encouraged in efforts to improve instruction for science, technology, engineering, and mathematics students at all levels (Schneider & Pickett, 2006). Extensive and long-term scientist and mathematician teacher collaborations facilitated by

professional development in inquiry-based teaching can be an effective way to change conceptions about inquiry and to promote inquiry-based teaching in K-12 classrooms (Hook et al., 2009). When individuals make different meaning from the same words or explanations, the miscommunication presents challenges in building a community or collaborative relationships (Lemke, 1990).

In a study by Schneider and Pickett (2006), two engineer faculty members and two science education faculty members collaborated to design a course for future engineering and science teachers. This study was an examination of course design and collaboration impact during the process. The partners had common goals and regular meetings with a product of mutual interest. Collaborators need to make concerted efforts to understand their partners and make their own ideas explicit. All four partners met weekly to discuss course content, activities, assessment collection, students, and other course details.

In spite of a strong interest in partners' professional areas and mutual goals, specialized language and professional cultural differences presented obstacles to understanding and development progress of the planning. While collaborating on the study, a difference in professional language sometime hindered the process. The meaning of words within the context of an engineer and an educator slowed the planning and frustrated the partners. Schneider and Pickett found it important for partners to realize that it will take time and effort to develop productive collaborative relationships and improve instruction. The engineering and science collaboration study lasted only for a year, so data on instructional design and partnership are limited.

Through the GK-12 programs implemented by the NSF sustained partnerships are formed between university scientists and K-12 science teachers working together in the school setting

(Thompson et al., 2002). A leadership team from the university and leaders from the schools build a guiding team to lead the grant and collaborate with the graduate fellows and teachers. The PI and co-PIs make up this team with some teacher representation. The leadership team builds professional planning opportunities and the partnerships for the fellows with contracts each year. These partnerships between the schools and the university are essential in planning and trust building between the institutions. The effectiveness of the grant implementation depends on the prior planning of the leadership team and their decision making. The communication and coordination of services the leadership team displays sets the tone for the entire efficacy and effectiveness of the grant.

Summary

Professional partnerships come with benefits, risks, and barriers. Funding for increased learning opportunities for students and staff has become limited and school systems have to be creative in accomplishing their tasks. Educators are looking towards grants for a funding source to implement successful programming. The National Science Foundation has found that a reciprocal relationship between a University and elementary school can indeed work. This partnership builds community ties and provides students and teachers with content knowledge that would be difficult to replicate in any other arena. Thompson et al. (2002) found an enhanced breadth of content knowledge and improved understanding of teaching science with their GK-12 program.

Pairing science and math graduate fellows with elementary school teachers builds vocabulary, knowledge, and excitement for students and teachers. The relationship between the pair requires communication of the content and the instructional norms of a school setting. If there is not productive communication, planning, and partnering between the pair, the instruction

could be flawed and unsuccessful. Thompson et al. (2002) found source of tension was the differing views of science and science teaching held by the graduate teaching fellow and the partner teacher in a GK-12 NSF grant program. Communication and planning between the two is essential in relaying the appropriate context of the classroom and expectations of each party. The relationship will evolve from a common place of student expectations and learning. Expectations need to be clear and defined through curriculum planning and mapping. The common thread of the graduate fellow and teacher partnerships of successful or unsuccessful grants has been the relationships between the teacher and the graduate fellow.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

The purpose of this study was to examine the perceptions of teachers and graduate fellows in one school regarding the barriers and successes during their participation in a 5-year National Science Foundation Grant. Specifically, the study addressed perceptions of effectiveness of two party collaborations, how this grant translated at one elementary school, the overall impact of poverty and STEM relevance in graduate and elementary education, and the barriers and success associated with a multiyear NSF grant. This qualitative case study was an emergent design and was conducted in a city school system in upper East Tennessee. Qualitative research is based on a constructivist philosophy that is concerned with understanding social phenomena from participants' perspectives (McMillan & Schumacher, 2006).

Method of Study

Qualitative method was used to determine the participants' perceptions of the barriers and successes in science and math instruction during the duration of the grant. For this qualitative case study the researcher used individual interviews with participants to gather data. Because the data were based on the personal experiences of a small number of participants, a case study design was used. A case study was used because the *Science First!* NSF Grant is a bounded system (Merriam, 2008). Qualitative research is inquiry in that the researcher collects data by interacting with selected persons and describes and analyzes individuals' thoughts, beliefs, and perceptions (McMillan & Schumacher, 2006).

Research Questions

1. What were the successes for teachers and graduate fellows of the 5-year *Science First!* NSF-GK-12 Grant?
2. What were the barriers for teachers and graduate fellows of the 5-year *Science First!* NSF-GK-12 Grant?

Role of the Researcher

As a participant in the NSF grant and also being a part of the leadership team, I had a research assistant conduct the interviews. The researcher worked collaboratively with the research assistant to analyze and code the data from the interviews. The research assistant was trained through the CITI training in research ethical protocol and was not involved with the grant. I was the principal of the school of the grant implementation and have been an employee of the school system for over 20 years.

"Because the primary instrument in qualitative research is human beings... the philosophical assumptions underlying this type of research is that reality is not an objective entity; rather, there are multiple interpretations of reality" (Merriam, 69, 1998, p. 22). The end result of this study was the researcher's interpretation of the participants' beliefs of barriers and benefits of participating in the *Science First!* 5-year NSF-GK12 grant.

Participants in the Research

The teachers and graduate fellows chosen to participate in this research were all participants in the NSF-GK-12 *Science First!* Grant at some point from 2008-2013. The study applied to those teachers and graduate fellows who were a part of the *Science First!* Grant. The teachers serve in a high poverty of 90% economically disadvantaged Title I elementary school in

East Tennessee. The graduate fellows were pursuing their master's degrees in a STEM field at a university in East Tennessee. The graduate fellows were different every 2 years according to their rotation of tenure in school. Teacher participation was through a contract with the grant leadership committee. Teachers' participation was voluntary and they were paid a stipend each year for their participation in the *Science First!* Grant as well as money for staff development and instructional supplies. Graduate fellows applied through the University for *Science First!* Grant participation and also followed a contract with the leadership team. The instructional grades represented in this study were preschool, kindergarten, first, second, third, fourth, and fifth. Special area subjects were also participants with science lab, arts lab (art and music), library, physical education, and guidance. The small size of the school and high risk population made it a prime candidate for the grant and research for STEM implementation. Each year every grade level participated and every teacher participated with only minor exceptions due to personal reasons. Teacher degrees differ from year to year with over 75% having their master's degrees. Graduate fellow's degrees differ each year depending on their major area of study. The grant has had paleontologists, biologists, mathematicians, chemists, and more.

Data Collection

Interviews were conducted and analyzed from nine teachers and seven graduate fellows. All interviews were set up at a convenient time and place for the teacher and the graduate fellow. An interview guide was used for the teacher (Appendix A) and an interview guide for the graduate fellow (Appendix B). A research assistant was brought in to conduct the interviews as I was a participant in the grant. All interviews were digitally recorded to ensure accuracy of participants' words. Someone outside of the grant transcribed these recordings. All participants

were given a pseudonym to protect their identities. Yin (2003, p. 59) listed skills for data collection necessary for research authenticity:

- *Asking good questions and interpreting the answers*
- *Being a good listener and not being trapped by own ideologies or preconceptions*
- *Be adaptive and flexible*
- *Firm grasp of what is being studied*
- *Unbiased by preconceived notions: acceptance of contrary evidence*

Data Analysis

Coding sessions using the constant comparison method occurred after the interviews were completed (Strauss & Corbin, 1997). Each set of questions was analyzed individually after completing interviews to identify patterns and categories in the data. Themes were established, interviewer's observations noted, and case records established for access (Patton, 1990). The information was used to gain an accurate picture of themes regarding barriers and successes between the graduate teaching fellows and teachers throughout the first year as compared to each consecutive year. The researcher looked for themes leading to these pictures of barriers and successes in the grant.

Validity and Reliability of the Study

Careful design can increase the validity and reliability of the study. Yin (2003, p. 38) suggested to approach reliability by taking as many steps as operational as possible and to conduct research as if someone were always looking over your shoulder.

Several steps were used by the researcher to ensure the control of bias. The questions of the study were developed to match the needs and development of the grant. To enhance the internal validity of the study the researcher provided a detailed account of the focus of the study, the researcher's role, the participant's role, and the basis for selection of data gathering, triangulation, and analysis. An auditor was used to ensure that the transcript was accurately reflected from the recorded interviews. The researcher analyzed the transcribed interview documents and based conclusions on the data. The researcher and research assistant worked as auditors of the data and examine the findings as they emerge from the data. Internal validity was evaluated through patterns in the data from the interviews, building of explanations, and addressing rival explanations (Yin, 2003 p. 34). Purposeful sampling was used through choosing participants who had worked on the grant with a range of years of experience from the years 2008-2005.

The reliability of a study refers to the extent to which the research findings can be replicated. In a qualitative study it is difficult to get repetitive results in a traditional sense. Therefore, Lincoln and Guba (1985) suggested thinking about "the 'dependability' or 'consistency' of the results obtained from the data" (cited in Merriam, 1998, p. 206). The results of the data should be dependable or be trustworthy rather than be replicated. The researcher and research assistant identified the same themes through coding, comparing, and making sense of data.

Ethical Protocol

Before beginning the study the following procedures were conducted. Authorization from the East Tennessee State University Institutional Review Board (ETSU-IRB) was obtained. The

IRB is established to ensure that none of the participants are harmed, their privacy protected, and that each member is provided with informed consent. Permission to conduct the study was sought and obtained from the school district's director of schools and the administrator at the school site. An initial e-mail included a description of the study and a request for permission to set up an interview with the research assistant. Subsequently, a list was made of willing participants for interviews. Phone calls were made by the researcher, and direct permission was given by the participants for interviews. The research assistant used the semistructured approach that included a mix of more and less structured questions for the interview as outlined by Merriman (1998). The Informed Consent form was presented to each interviewee before the interview occurred. Care was taken to make sure each participant signed and understood the Informed Consent Form.

A reflection guide with the interview questionnaire was developed for the documentation of observations during the interview process. This documentation was used as a means for the interviewer to write reflections of the interviewee responses immediately after the interview took place. It was important to make sure that observations were recorded quickly and accurately. Pseudonyms were used to conceal identities. All participants signed a contract each year for participation in the grant and research. Participants were told their participation in this study was voluntary, and they could withdraw at any time during the process. Interviews were conducted one-on-one with the outside interviewer and digitally recorded with the permission of the participant. Steps were used by the researcher to ensure the control of bias; McMillan and Schumacher (2006) suggested several that were used during this research: an auditor, research assistant, and member checking. An auditor was used to ensure that the transcript was accurately reflected. This is seen as a form of triangulation where an outside source is used to validate

materials (Mathison, 1988). A research assistant to conduct the interviews and member checking where the interviewee is allowed to review the information that had been recorded for accuracy were also used.

Summary

The analysis of qualitative data can range from organizing a narrative description of the phenomenon, to constructing categories or themes that cut across the data, to building theory (Merriam, 1998, p. 196). In pursuit of an understanding of how teachers and graduate fellows relationships affect the grant, I triangulated data collected from graduate fellows' interviews, teachers' interviews in search of data linked to the phenomenon. I employed ethical protocols using the guidelines and standards of the ETSU-IRB.

CHAPTER 4

FINDINGS

The purpose of this study was to examine the perceptions and viewpoints of the teachers and graduate fellows participating in the *Science First!* Grant regarding the barriers and successes. Data were collected through interviews with 16 grant participants, 9 graduate fellows and 7 teachers. Although a script was used, follow-up questions were used to probe further meaning. Purposeful sampling was used by selecting teachers and fellows that have been connected to the grant in a variety of ways. The research examined the perceptions of fellows and teachers about the barriers and successes of the *Science First!* Grant related to the following research questions:

1. What were the successes for teachers and graduate fellows of the 5-year *Science First!* NSF-GK-12 Grant?
2. What were the barriers for teachers and graduate fellows of the 5-year *Science First!* NSF-GK-12 Grant?

In collecting data, the ultimate goal was to examine the perceptions of fellows and teachers about the barriers and successes of the *Science First!* Grant. The focus of data analysis was to see if themes emerged as to successes and barriers of the grant.

The study involved 16 participants who are teachers and fellows who have participated in the *Science First!* Grant. These 16 participants were selected and asked to volunteer in this research study because they fit one of the following two criteria: (a) a teacher participating in the grant, or (b) a fellow from the university. All research participants were accommodating and gracious as the interviewer worked to set up face-to-face interviews. Each interview lasted from

30 to 45 minutes. Participation was voluntary, and before the interviews began the Informed Consent process was explained in detail and signed by each participant (see Appendix C). All interviews were taped and participants were assigned codes to protect their identities. After each interview tapes were transcribed verbatim and verified by an independent IRB trained auditor. Additionally, all transcripts were reviewed by the interview subjects to verify authenticity.

Research participants are listed below in Table 1. Partner teachers were all females and ranged in years of experience from 1 to 17 years as teachers of elementary education in prekindergarten through fifth grade. Graduate fellow participants were in a master’s degree program pursuing a degree in a STEM discipline. There were four male graduate fellows and three female fellows in this research.

Table 1.

Research Participants

Participants	Gender	Experience	Teacher or Fellow
Teresa	Female	7	Teacher
Mackenzie	Female	12	Teacher
Marsha	Female	9	Teacher
Whitney	Female	13	Teacher
Courtney	Female	12	Teacher
Nedra	Female	17	Teacher
Leah	Female	11	Teacher
Veronica	Female	10	Teacher
Jasmine	Female	7	Teacher
John	Male	1	Fellow

Table 1. (continued)

Tracy	Female	1	Fellow
Dora	Female	2	Fellow
Lanny	Male	1	Fellow
Melinda	Female	2	Fellow
Craig	Male	1	Fellow
David	Male	2	Fellow

After a process of analysis the frequency of words and phrases were used to identify themes of barriers and successes in formulating the data. Coding is a process of shorthand designation to various aspects of data so you can easily retrieve specific pieces of the data. The designations can be single words, letters, numbers, phrases, or combinations of these (Merriam, 2001).

Themes

Eight themes were identified. These themes were (a) relationships, (b) mutual appreciation, (c) increased academic depth, (d) professional growth, (e) communication, (f) time, (g) expectations, and (h) preparation.

There were four identified successes by partner teachers and graduate fellows of relationships, mutual appreciation, increased academic depth, and professional growth. Table 2 and Table 3 represent the data of partner teachers and graduate fellows for the 16 participants interviewed in this study and the successes identified.

Table 2.

Partner Teacher Identified Successes

Relationships	9 out of 9 partner teachers
Mutual Appreciation	6 out of 9 partner teachers
Increased Academic Depth	9 out of 9 partner teachers
Professional Growth	8 out of 9 partner teachers

Table 3.

Graduate Fellow Identified Successes

Relationships	7 out of 7 graduate fellows
Mutual Appreciation	7 out of 7 graduate fellows
Increased Academic Depth	5 out of 7 graduate fellows
Professional Growth	5 out of 7 graduate fellows

There were four identified barriers by partner teachers and graduate fellows of communication, time, expectations, and preparation. Table 4 and Table 5 represent the data of partner teachers and graduate fellows for the 16 participants interviewed in this study and the barriers identified.

Table 4.

Partner Teacher Identified Barriers

Communication	9 out of 9 partner teachers
Time	5 out of 9 partner teachers
Expectations	9 out of 9 partner teachers
Preparation	9 out of 9 partner teachers

Table 5.

Graduate Fellow Identified Barriers

Communication	7 out of 7 graduate fellows
Time	7 out of 7 graduate fellows
Expectations	7 out of 7 graduate fellows
Preparation	7 out of 7 graduate fellows

Grant Successes

Relationships

One of the most prevalent themes that emerged from the interviews was the strong relationships that were developed through the *Science First!* Grant. Several teachers stated that their relationships continued after the fellows completed their assignments.

Partner Teachers. Teresa, a kindergarten teacher of 7 years, was very pleased with the professional and personal relationship she established with her fellows. She stated:

“Hopefully we can maintain some of the relationships we have at ETSU which will enable us to use these (and others) resources....But because of my connections I would use the Gray fossil site and other valuable resources. I have had very positive relationships with my fellows and look forward to ways to maintain the positive relationships. Some obviously you grow closer than others but that is common in any relationships.”

Mackenzie, a 12 year related arts teacher, said it this way:

“I have never really had a problem asking for help. However, the relationships developed in the end have been a big plus and have helped me understand additional ways and resources I might access for my students.”

Marsha, a 9 year teacher, became excited when she spoke about relationships she had. Marsha reported that the relationship have not only made her more aware of the local resource she can access but also helped her appreciate how to incorporate new ideas into her classroom. She said of her relationships:

“I would call ETSU or other resources and feel as if I have those connections now. I really believe in accessing community helpers. As we have become more comfortable in the process I have been able to add so many things to my lessons, things I never thought of. I could not have done this if these relationships have not grown over time.”

Whitney, a 13 year veteran, related how she has developed positive relationships with the fellows she has collaborated with. She said although she had many strong relationships her last one was the most dynamic. The fellow has decided to pursue a teaching career and they stay in close contact often sharing ideas on teaching and relying on each other’s expertise.

“Relationships really depended on the fellow, but all of mine have been good to be honest. The last fellow I had was awesome and was ready to go from day one. Then I had some who were pretty good eventually it just the transition was a little longer. The last one has decided to become a teacher and we talk or text all the time. If I have a science question she is the first person I call. I know she has relied a lot on me, just to talk about lesson plans, standards or behavioral issues in her class. But it is a relationship I value and has helped me become a better teacher. I know that I am more comfortable expanding these relationships and reaching out to the university because of the grant”

Courtney, a 12 year teacher, talked about how trust had been an important part of the relationship. Courtney said her good relationships grew as the grant continued and there was a

greater understanding of what was expected of each other. She stated that she has had good professional relationships with her fellows. She expressed:

“I have asked specifically to have additional math and science supports and will continue to do that in the future due to the collaboration we have developed. These relationships have grown over time as we have become more comfortable with each other. I have never been afraid to ask but now I know more about who to ask and what resources are available to me due to the positive relationships we have.”

Nedra, a 17 year veteran teacher, noted how the relationships that she has developed have continued even though she has been moved to different grades and believes the school has benefited from the positive relationships the grant has forged. She is not sure how she would stay as connected to the university because she relies on the fellows for those relationships. She said:

“I would not really know where to begin to continue relationships with ETSU. I rely on the fellows to provide those contacts and if not them it comes from the leaders of the program. I would not know how could provide that information for me. I hope it will be provided to us at the end of the grant. But the relationships have helped me understand more about the process and how to incorporate the different disciplines across curriculum.”

Leah, an 11 year teacher, spoke about how the relationship has allowed her to expand the depth of her knowledge. Noting that had it not been for the grant she would not have to have the access to various levels expertise, Leah has been pleased with the positive results of the school and grant relationships. She said:

“Their research was so particular or so focused and it helps to have that level of expertise and that has been a huge positive for us here. So much of what I do is directed on reading and language arts and math that science sometimes gets shorted a bit. So the relationship has helped

to hold you more accountable and inspires you to make sure you include science in a variety of ways.”

Veronica, a 10 year teacher, simply stated the relationships improved as the communications improved. Saying:

“I think it was an obvious parallel, as we continued to improve the grant, our relationships were improved. When the tension continued to decrease, obviously that enabled us to be more effective in our goals and our relationships grew.”

Jasmine, a 7 year teacher, responded:

“The first year my fellow never showed up so obviously that hurt the relationship. The next fellow was not much better but I really think that was due mostly to communication. But really the last four years of the grant have been fabulous and we have had great relationships. My current fellow is wonderful. I asked (and she provided) more in-depth lesson to match our SPI’s. So not only do we get along personally she has helped professionally as well”

Graduate Fellows. The fellows also expressed a great deal of appreciation for the relationships that were established. John said:

“The relationship was so helpful. Being able to have open and honest conversations with the teachers has been so valuable because they have so much more experience than I. Just being able to get feedback on things like classroom strategies, classroom management has really helped me improve.”

Tracy agreed:

“I felt very fortunate to have been a part of the program. The relationship with the school, the teachers, and the other fellow has all benefited me immensely. I think back and think about

how much I have grown and how much I have enjoyed this experience and so glad I had the opportunity.”

Dora, who participated in the grant for 2 years as a fellow, stated:

“I was trained as a teacher and had some experience. The relationships really improved my teaching and my ability to communicate in an effective way with students and just the overall additional experience was helpful. Plus being surrounded by other teachers seeing them model and learning from them was important.”

Lanny said it this way:

“I definitely think the relationship was important. I worked for a year with Teach for America and I felt as if I was prepared, however it was with high school students and it was with very specific methods. I was terrified of facing 20 4-5 year old children in a classroom and learned entirely new approaches. It also helped me be better able to share my research on a very basic level. The relationships with the teachers were critical because they understood my fears and made accommodations to make me feel more comfortable and that was really important as I progressed through the year.”

Melinda agreed:

“Having 2 years was critical. You were able to get to know the teachers better, the students better, and the culture of the school better. The longer you are someplace the better you are able to strengthen those relationships and the more those relationships benefit everyone.”

David was also involved as a 2-year fellow and said:

“The extra time was really important because I think everyone is just that much more comfortable with each other and the comfortable with the entire grant. I know as we strengthened

our relationships we were able to have much more open and honest communication about any issues that may arise.”

Craig concluded:

“I was helped by the relationships we developed. I did not have a wealth of experience before my opportunity as a fellow and I really grew and learned to trust the feedback I received. When you trust someone in a professional relationship you are so much more prepared to use that to make improvement. I really feel as if my ability to speak in front of groups has improved tremendously and my understanding of public speaking has improved too.”

Mutual Appreciation

Mutual appreciation for each participant’s craft was another strong theme which emerged throughout the data.

Partner Teachers. Teresa found while working with her graduate fellow that in the beginning having the fellow observing was very helpful.

“The graduate fellow learned our approaches to teaching and classroom management which helped her to be more prepared and effective...just simple things that are very important like how to get 5 year olds to transition from carpet to centers.”

When asked about benefits from the graduate fellow, Teresa responded,

“Absolutely, especially in science; kindergarten is so reading based. We want discovery and that is what every child wants to do is to discover the world.”

Mackenzie also found that appreciation from the graduate fellows through the grant from modeling expectations.

“I think they have been able to see me role model what my expectations for students are and in doing so they have been able to translate that into what they needed to do. But I do believe

everyone once they actually see all that we do...especially in related arts....they have a deeper appreciation.”

Whitney experienced a similar appreciation with her fellows over the grant with the fellows’ exposure to new environments of learning.

“They have had a much better understanding of everything that is involved in teaching. I think the natural reaction for someone who has not been exposed to K-5 students is to think that it will be easy. The information might seem simplistic but it was the entire process that really matters; how to present it, how to manage the students, and how to prepare appropriate differentiation.” Whitney expanded by explaining her appreciation for what the graduate fellows brought to the classroom, “They provided a much deeper level of understanding that allows the students to really enjoy the lesson. I also think there was such value in having experts in the field present lessons. It was great for students to see actual practitioners’ present information and they were good role models for our students.”

Courtney saw the appreciation of the graduate fellows as the grant has gone on and developed.

“They had a greater understanding of what their requirements were and what the expectations were for them and for the students in our classes.” She added her appreciation for their presence and if there was a particular subject that I did not know as well or was less comfortable with they were able to provide additional instruction or resources, making the content deeper.

Nedra stated her perception of the fellows’ evolution of the appreciation of elementary teaching.

“Definitely I think people in general have no idea just how difficult it is to teach and I think the fellows were no exception. But after they were exposed to what we do, what it takes to do it, I think most had a much greater appreciation of how hard it is. I also think it showed in how much more comfortable they became with the presentation of the material.”

Leah corroborated:

“I think they probably came in thinking ‘this can’t be that hard’ and then realized how difficult it can be to relate their information to a K-4 level was hard, even understanding how to make the verbiage work at a K-4 level. Trying to match expectation to reality in the classroom was a very important thing. I think this could have been improved with better communication from the two entities (ETSU and North Side) about what is realistic. The students loved having them in class. They knew they were the experts and just having someone else in the class to bring them information helped with keeping the material fresh and kept students engaged.”

Veronica saw the appreciation between the teachers and the fellows evolve over the 5 years.

“I saw teachers seeing their fellow as a true partner and a valuable resource.”

Jasmine had appreciation for the graduate fellows and the skills and impact they brought to the high poverty classroom.

“She kept them interested and engaged. I also think it impacted students because she has changed the way they see a scientist because my fellow would say ‘I am young, female and I am a scientist.’ I hear students use scientific terms I did not think they would and this is a direct result to the continual exposure. I hate that it ended because I feel just now we have figured it out and are ready to see real gains, but it is going away. They have broadened my understanding and provided me with new resources. I have thought of ways I can incorporate these lesson in my future lessons. I do plan on using the ORC.”

Graduate Fellows. John as a graduate fellow appreciated the educational experience and journey. He took his cues through the teacher modeling.

“Just being able to get feedback on things like classroom strategies, classroom management has really helped me improve, especially the art of teaching. Sometimes it is in the structure of my lessons and sometimes it is as simple as spending additional time. I may call on them specifically or not depending on the child. Sometimes I encourage a partial answer and even if it may not be technically correct (in a scientific sense) it is correct for that lesson. The teachers do model this very well. I am amazed at everything these teachers do and try to tell them at least once a week (if not more) how much I admire what they do and appreciate them.”

Tracy confirmed support for teachers.

“I definitely have so much more appreciation for what teachers do. I go home some days and all I want to do is to take a nap. Some teachers just go and go and go...there is no down time and I just can't imagine having that level of energy constantly. I have tried to make sure they know how much I appreciate them.”

Lanny had previous experiences in education with high school, but bringing concepts down to elementary preschool and kindergarten levels became a challenge.

“I found that I thought I understood better the high school because of my experience but I think everybody thinks elementary is so easy. It is definitely not, it is amazing how hard teachers work and how much they accomplish.”

Dora confirmed the appreciation in collaborating with the teachers she came in contact with through the grant.

“Every teacher I have met or teacher I meet in the future I make sure they realize that I appreciate just how difficult it is to teach. I think that anyone that is exposed to teachers in any meaningful way has a new and deeper appreciation for just how difficult the job is.”

Melinda had a definitive elevated view of what was involved with teaching, how much work and how much energy it takes for teachers to do what they do all day long was amazing.

“Some days I just wanted to go home and take a nap. How much effort and energy it takes is really amazing. At the beginning, I just assumed kids were all at the same level as I have progressed I have built differentiation into my lessons and I feel as if that is an area I have grown a lot. I never realized the wide variety of student abilities that a teacher can face in one class.”

Craig summed it up with an appropriate analogy.

“Being in the school environment your whole life you think you know what the teachers role and responsibilities were but after you do it you realize just how hard it is. I would compare it to riding in a car your entire life does not prepare you to drive.”

David came in with an open appreciation for teachers.

“I have always had great respect for teachers so I would not say this is new to me. I grew up around teachers. My dad is a professor and my mom is a teacher so I think I have always had a deep appreciation.”

Increased Academic Depth

Partner Teachers. Most of the participants believed one of the successes of the grant was the ability for the teachers and students to have increased academic depth. The ability to have access to an academic specialist in their classroom, access to the Online Resource Center (ORC), and access to the Content Coursework improved academic accuracy and depth.

Teresa said:

“Access to the fellow changed my views about what problem solving was and should look like. Problem solving can be “Self-Discovery “we have seen this at conferences. Especially in science and math you really see the benefits and effects of problem solving. A lot of what we have done and we have planned together I can incorporate in new and different ways. Especially with Common Core and the emphases on taking students to a new and deeper level, this will be vital. Some lessons have been placed on the ORC and others have been given to me directly and I know that will help me as we move beyond the grant.”

Mackenzie agreed, even though she works in the area of related arts, she believed having access to additional expertise helped her incorporate new ideas across the curriculum and by emphasizing these discipline in nontraditional settings it helped the overall academic depth school wide. She said:

“I definitely saw academic growth. To be honest I saw that is something in the very first year of the grant. And even as we have continued to move through the remaining years it has gotten better and better. You see it when we have people come to talk about those subjects our students know so much more and are excited to share their info. It has made an immeasurable difference. I think I have grown as well in accuracy; depth and excitement have all improved greatly. I know when I have covered information in class I would also refer to the fellow if I had questions about the specifics of issues. It has been nice to have a resident expert available to you.”

Marsha was amazed at how much information her 4-year-old students were able to digest. She became animated as she shared:

“Before the grant science was less of an interest but now with science being one of our centers it has my students excited. They line up now to get to participate and that is a very good

thing. I now have students that know all the planets. They know the Sun is a star and that Pluto is no longer considered a planet. That is a level of growth I did not expect for 4-year-old students. In the past I might not have corrected some of their ideas or expected them to have that base level of knowledge, to use the Sun as an example. I might not have felt the need to correct if they referred to it as a planet, but now because of the grant I know they know the difference so. My expectations are higher.”

Whitney concluded:

“The fellows were providing much deeper level of understanding that allowed the students to really enjoy the lesson. I also think there was such value in having experts in the field present lessons. It was great for students to see actual practitioners present information and they were good role models for our students. The fellows were able to present information in a much deeper level. So that really enabled students to really appreciate science on a whole new level. One fellow did a lesson on the Depew wolves and our field trip was where they had found fossils for the wolves. It was a great real world connection.”

Courtney appreciated how much students were excited about science and math and the benefit of having an expert teach. She stated:

“Every time the fellows came to my class students were excited. So to get kids more excited about math and science that was a good thing. I think this was especially true because you had an expert presenting the material and it is someone different. I think that variety was good for students. It also increased my academic depth because if there was a particular subject that I did not know as well or felt less comfortable with they were able to provide additional instruction or resources and this made the content deeper.”

Nedra appreciated how the academic depth impacted stereotypes in a very positive way. Having young female professionals who modeled career opportunities has been a key factor in the grant success. She said:

“The increased academic awareness has been especially impactful with girls. I think it was a great experience for our girls at school (particularly in a high poverty school) to see female role models that were scientists. That expanded their view of career opportunities. I also think the boys benefited from this because it broke the stereotype of a scientist as an old man. It can be a cool job in a lot of different fields. I feel as if our students are very well rounded now when it comes to math and science and although it may not always be measured in tests, for a variety of reasons, compared to the knowledge of other schools.”

Leah concurred:

“The students loved having the fellows in class. They knew they were the experts and just having someone else in the class to bring them information helped with keeping the material fresh and keeping students engaged. And their research was so particular or so focused and it helped to have that level of expertise. So much of what I do is directed on reading and language arts and math that science sometimes gets shorted a bit. So it held you more accountable and inspired you to make sure you included science in a variety of ways.”

Veronica, who worked specifically with science students, saw the increased interest. She said:

“Students are so much more involved in science...when student come to me there is definitely much more basic content knowledge. They are much more interested in Science. In my classroom it has alleviated fear and improved content knowledge and made me much more comfortable and confident with the subject matter.”

Jasmine saw the same growth from students. She stated:

“My fellow always kept my students interested and engaged. I also think it has impacted students because she has changed the way they see a “scientist” because my fellow would say, “I am young, female and I am a scientist.” Also I hear students use scientific terms I did not think they would and this was a direct result to the continual exposure. I hate that it has ended because I feel just now we have figured it out and are ready to see real gains... but it is going away.”

Graduate Fellows. The fellows also believed they have seen the academic benefit of having experts in the classroom.

John said it this way:

“I think we, the fellows, have had a very significant impact on academic growth. For instance, the lesson on habitat, I would show pictures and have discussions of the various habitats and creatures that go far beyond their normal content, and then the students would have to match the animal with the habitat. I am not sure how much it is reflected on test scores, but I do feel as if we offer a level of depth that would not otherwise be there.”

Tracy agreed:

“ For example my area of expertise in graph theory, I can give them several different ways to solve problems using my discipline that is outside the norm of what students at the elementary level experience. So when things are introduced that are new it affects how they approach tasks and that is problem solving. So by introducing new material they have to investigate and problem solves in order to accomplish the task and I believe this impacts academic depth.”

Dora, who had teaching experience prior to becoming a fellow in the program, saw how the two disciplines have come together to benefit student growth. She said:

“Because of my previous experience, I felt that I was able to make some of the transitions a little easier than others. I was able to use my knowledge of teaching that involved behavior management, differentiation, and childhood development to be able to use both my teaching experience and the theories which we were required to teach was a natural process combined with my expertise has provided additional growth opportunities.”

Lanny, who understood how important it was to recognize student educational levels, said it this way:

“I think it took me a long time to realize the different ability levels especially students with special needs. I really had to think about different or more appropriate ways to present materials to different age groups, but after I understood that process better I was able to use what I learned and share my discipline in age appropriate ways. I recognized as students develop there was a definite stratification of learning which challenged me, but as I learned I was amazed at the material 4 year old children were able to connect with.”

Melinda stated:

“I think I had a tremendous impact on their academic growth because I began the process by telling students I am going to make them scientist. Then I took them through the method of what it is like to use scientific methods. I really think this has been an effective method and this is probably enhanced by the fact that this was my second year with these students. So we grew together and I believe this was a big advantage. The more comfortable I was the more comfortable they were. The first couple of weeks last year I was stressed... Very stressed...but we grew together.”

Craig was more direct. He mentioned:

“I am not sure how we could not have positively affected the academic progress. It has been good both ways, but to have a content specialist imbedded in your classroom has to benefit every teacher.”

David concurred:

“It was difficult for me at first to present my research at an elementary level. I relied so much on the teachers I worked with to provide me with ideas, but once I saw how I could present my material in a way that benefited the students I felt as if I had a great impact on depth and accuracy in the classroom.

Professional Growth

Partner Teachers. One of the goals for the participants in the *Science First!* Grant was to provide professional development in high level content areas for science and math through the graduate fellow and teacher collaborations and content level courses at the university.

Teresa found collaboration with her graduate fellow as a key factor in her professional growth. She was able to build on her science and math content knowledge through their interactions and planning.

“A collaborative effort at times but they did help me think about how to integrate science more frequently throughout the curriculum.”

Mackenzie saw the professional development piece of the grant grow throughout from year 1. She appreciated the options of choice of conferences as opposed to being directed to them. She started as a participant and grew to a presenter with STEM integration topics.

“I probably was helped more from a professional development aspect. Just being able to choose professional development that was specific to my content area was a great opportunity and one of the real special opportunities the grant afforded me.”

Marsha accessed the expertise of the graduate fellows she was paired with throughout the *Science First!* Grant as well. She would rely on them for the deep content of subject matter and her portion would be to see how to present it appropriately to young students. As an example a unit on the solar system:

“I don’t think I would have ever used the Solar System. I will also be using the ORC. I think it will be a helpful tool.”

Whitney confirmed her graduate fellow as a professional growth piece from the grant. She found growth through some of the content based graduate level classes at the university as well.

“I still email one of my fellows all the time. I feel like she helps me and because she has gone into the teaching profession. I feel I have been a great resource for her as well. She continues. Some of the content classes were helpful, especially Paleontology because the wealth of knowledge they have in their information.”

Courtney concluded the same on graduate level classes and professional growth. The graduate fellows deepened her understanding of science knowledge and integrating into other subjects.

“Some of the university classes have been better than the others. Some professors were better able to make the material applicable to my students. The collaboration with graduate fellows has helped me ask: ‘How can I use science in other curriculum?’ I have seen my fellows incorporate it in different ways.”

Nedra saw the professional growth change with the graduate fellow she was assigned each year. The content area classes were also according to the professor and amount of content accessible for the teacher and student.

“Graduate fellows brought content knowledge specifically in science. I feel as if I am a better science teacher than I have been in the past. It has been a growth process. Some of the content classes were helpful (the Paleontology) but to be honest there were very different expectations between the professors and the teachers.”

Leah professionally grew through her content knowledge and focus on the content within throughout the grant.

“I have increased my content knowledge. The more you know the more you are able to just focus on the delivery of the lesson. I think like anything the more confident you are the better you are at providing that service.”

Veronica developed leadership skills and content knowledge growth through the *Science First! Grant*. The graduate level content classes were a source of in-depth knowledge used to build science and math content.

“Because of my position problem solving was required. But my relationship with professionals has increased my confidence. I feel as if I come from a strong base of knowledge but being able to coordinate and collaborate with a another professional has been instrumental in my growth. Oh my Gosh, they have improved me in many ways and that process has improved over the 5 years. Because we were able to give feedback, we have professor that have been able to tie it more into what we are able to bring to the classroom. That was not always the case in the past. The Paleontology class was fantastic. It would be great to be able to use the course work or align it to teacher academic progress. Overall our resources have been great. We now have so many resources to help our students.”

Graduate Fellows. John found growth in taking the language of scientist into a more user-friendly format as a future benefit for his success.

“Sometimes communication of my thoughts and ideas about science was just as simple as not trying to use technical jargon. I was conscious of the fact that not many people use some of these terms. I did not see myself as a scientist but rather someone who wants to enjoy and share the beauty of science with everyone. I think that helped me keep the “scientific” jargon to a minimum.”

Tracy discovered confidence in working with partner teachers, graduate fellows, and students.

“Yes, I do think I am much more comfortable. I also think being a part of gym class has been helpful, because you are forced to interact more. Just being in the activity requires a certain amount of activity and that has helped me be more comfortable. I have gained a greater ability to present in front of groups and I believe this will help me in the future.”

Melinda agreed.

“I had no teaching experience before I came here so everything I have learned is from watching and observing in the classroom. Watching individual teachers teach. A lot of what I have evolved into is to try and teach multiple students in multiple ways.”

Craig communicated his professional growth through a new job interview success story. The interviewer of the job made the comment that the reason he would be receiving the job was because he was able to effectively make technical information better understandable to others.

“I did not have a wealth of experience before my opportunity as a fellow. I really feel as if my ability to speak in front of groups has improved tremendously and my understanding of public speaking has improved.”

David adjusted his scientific language for growth as well.

“I tried not to get too technical. I think everyone I deal with typically does not have the same expertise so I feel as if I am used to talking in a way that makes the information I am trying to share in a way that is very understandable.”

Grant Barriers

As noted several successes were identified by both teachers and fellows, even though all participants agreed that the grant presented several barriers. The most common of these were (a) communication, (b) time, (c) expectations, and (d) preparation.

Communication

Partner Teachers. All of the teachers who were interviewed related some aspect of communication that prevented the grant from having optimal success. Although it was most notably visible at the beginning of the grant, it still was prevalent throughout the grant.

Teresa concluded:

“Communication was the single biggest issue that caused some barrier because you have so many people involved, two sets of employees, two supervisors, and two leadership styles, leadership changes, all these things affect effective communication. The beginning it was very top down style of leadership and teacher felt as if they had little to no input on anything related to the grant. It was almost like; ok here is this grant we have been awarded so make it work. When Mrs. Pickering was hired as our principal I finally really felt like we had genuine input. But there has always been some level of communication difficulties.”

Mackenzie said:

“Compared to the first 2 year we have certainly progressed. The fellows have been so much more prepared but I think those first two years it was so difficult for the fellows because it was not communicated effectively as to what they needed to be prepared to do. And in fairness, I

think we both, ETSU and North Side could have communicated better. I am not sure anyone really knew what we wanted to accomplish. ETSU would tell the fellows one thing and the school had different ideas on what was to be expected. Once we understood more of what our goals were, from a communication standpoint and we were all on the same page, ETSU started having the fellows do mock lessons at the University school. I think that helped and also they presented their research to us and we would make suggestions on how it might fit with our students, various ages and our standards. Understanding the definition of what was going on is so vital. I just think we did not define roles, responsibilities etc. as well as we could have.”

Marsha agreed:

“Communication was definitely our biggest issue. Even as we improved overall, it was still an issue. It would show up as little things. Things like if we had a bad fellow, who did we report it to, what was the protocol, just things like that. I know we are a lot better now, but I still feel as if it was our number one struggle.”

Whitney indicated that communication was a definite barrier; however, she also believed much depended on who the people involved were. She said:

“Communication was a big factor but it really depends on the fellow. The last fellow I had was awesome and was ready to go from day 1. Then I had some who were pretty good eventually it just the transition was a little longer. If I felt comfortable, it was much easier to address issues as they arose and we would not need to get administrators involved. But when you had one who was not very good, as I did, at all and eventually had to be replaced we were not always sure of the process and it took a long time. This fellow was just being arrogant in their approach, thinking there was not much a lowly teacher could provide her as a way of appropriate feedback. We had a lot of growing pains but that seemed to be addressed by ETSU, by providing

a liaison that helped address some of the communication issues. Growing pains and how we communicated were big factors.”

Courtney was succinct in her assessment about the need to have communication and input from all parties, she said:

“Placing teachers and fellow together without teacher input has created some issues. We were just told, especially at the beginning, that you will have this fellow and they will have these responsibilities and that is a recipe for disaster. It was really not fair to either party to expect a few people to make decisions and not communicate those expectations to everyone involved.”

Nedra stated:

“To me communication and expectations go hand in hand. But I often felt as if I was not in the loop so to speak. I was told this was what was going to happen and sometimes I felt I was not sure of the specifics. I feel as if this as true for the fellows as well. I overheard a conversation between two fellows just the other day and they were talking about how they are told one thing (about their role) and the school was told another thing. I heard one say we were doing the grant the wrong way. So maybe we have still a long way to go when you think of communication.”

Leah was clear that many of the issues could have been less complicated if communication was handled better from the beginning. She said:

“I just believe we needed much clearer communication from the beginning. A lot of our transitional issues were related to us not having enough conversations up front and how this should look like in practice. I realize you cannot have everybody involved in initial meetings, but it would have been great to have some input early on. Maybe a survey or some way to provide initial feedback would have worked. We realized that we had to do a better job communicating. I believe we made some structural changes that enhanced the process. We had a change in

leadership at our school and ETSU provided a liaison that certainly benefitted the process, however, so much of our difficulty could have been eliminated if we had better communication from all parties at the beginning.”

Veronica strongly expressed how lack of communication presented barriers. She said:

“Our relationship has improved greatly between the 1st and 2nd year because the communication between the two leadership teams is so much better. Fellows were unclear of what they should do. There was a huge disconnect between theory and reality.” She continued “Communication was so key because the more we were able to share with everyone involved, not only did it make the process go more smoothly it also helped alleviate tension. As we became more familiar with each other the communication was so much better. The communication really has improved in many ways as the process has improved over the 5 years because we were able to give feedback. I think that also shows a comfort level when you can have open and honest communication the end result is that you have a better product.” She concluded by saying “It always goes back to the confidence I have with the fellow and the relationships we have developed to be able to communicate effectively and professionally.”

Jasmine responded:

“Communication is so important because my first year my fellow never showed up. The next fellow was not much better but I really think that was due mostly to communication. They never really knew what was expected of them and I think we did not really know all the specifics about it being implemented. Communication is so difficult when we had two sets of people telling two sets of groups different things at different times it presented a lot of problems, especially early. It did improve greatly over time and the last year has been fabulous.”

Graduate Fellows. The fellows all agreed with the teachers concern over communication difficulties.

John said:

“Being able to have open and honest communication with the teachers has been so valuable because they have so much more experience than I. Just being able to get feedback on things like classroom strategies, classroom management has really helped me improve. Part of communication has to do with better preparation for the fellows, more contact before the school year with the teachers, more opportunities to discuss the needs of school students etc. Also just how to deal with each other, some fellows complain that if there is an issue, rather than discussing it the problem goes straight to the top and that causes hard feelings. If the communication structure had been more effective some of this could have been avoided.”

Tracy agreed:

“Communication is the key to everything. If you do not have good communication you are creating problems. I felt as if I was communicated with pretty well but I know when the fellows would meet you would often hear how they wish people had communicated more with each other.”

Dora had a different take, she stated:

“I have always prided myself on my ability to communicate. And I think one of my big strengths because of my background as a teacher was to be able to communicate how I wanted to work with students, so that was not as big an issue for me. However, I often heard my colleagues discussing the issues they had with goals not being communicated with the partners.”

Lanny said:

“Communication was a big concern which I tried to overcome with my teachers but sometimes it was just impossible. I felt out of the loop of the school culture. As an example I showed up on Dr. Seuss day and had a lesson prepared but had I know it was his day I could have incorporated it into my lesson. The Lorax was a great fit to my research. So it things like that, being a part of the school but not really a complete part that if we had better communication could have made us so much more effective.”

Melinda stated:

“Communication is key, until you walk in the teachers shoes you have no clue about everything that is involved in their work. This is also true as to how they see our, the fellows, role as well. My goal was to make the teachers lives easier and it to bring information both they and their students can use in the future. I felt like last year especially when I sat down with my professors and they talked about what to expect that they did not have a real appreciation for all a teacher does and due to that I felt under prepared. It was better this year due to it being my second year but I still feel as if we had more open communication we could have not have had as many issues.”

Craig said:

“I heard many of my colleagues say they wish they had better communication. But for me, the teachers I have worked with have provided me with great communication and clear feedback and it has helped me grow tremendously.”

David said:

“The main barrier is that the teacher and the fellow and they may be intimidated by each other. The teacher may realize they do not have expertise in math or science and the fellow will recognize the strength of the teacher in overall student needs and classroom management etc.

There needs to be time to develop a mutual respect that your area of expertise is teaching and mine is science for example...but that takes time. If we had had better communication I think this could have been avoided.”

Time

Time for the partner teacher and the graduate fellow during the 5-year life of the *Science First!* Grant became a recurring theme in the data.

Partner Teachers. Nedra found it hard to incorporate the graduate fellow’s research into the classroom because of the time constraints of the elementary school calendar:

“Not until TCAPS are over just because we feel we are losing time on task and their research does not always fit with the standards that we are required to teach. Even though I think it is valuable there is conflict for us to accomplish what is required as teachers first.”

Leah agreed with state standards being a teacher’s focus:

“The graduate fellows’ research may be so narrow that might not fit exactly with a standard so finding the appropriate time to present it can be tough. Teachers were so time driven by standards that we don’t have much time to spare to “fit” things in that do not apply to our standards.”

Jasmine also found time a challenge for the partner teacher and the graduate fellow:

“Making sure the goal of the grant and the time required did not interfere with the overall goal of school and time required to accomplish this.”

Graduate Fellows. John, a graduate fellow, found the tight elementary standards focused schedule and the class schedule for fellows presented a logistical issue for each party:

“A barrier that I believe was not fixable was that no matter how much we lightly tread...we were already intruding on an already very tight schedule that was filled with high

stakes for the teachers. So I believe it was imperative to make sure my lessons conform to what the teacher needed to fit their requirements.”

Dora added:

“Time was such a huge factor for teachers. They faced such pressure with TCAPs, standards and everything else it was just difficult to get anything else accomplished no matter how worthy the goal. Sometimes that really stifled our creativity...because we were so tied to presenting what fit into the teachers’ standards.”

Lanny was always searching for more time in the classroom:

“I wish we had more time. Teachers were so driven by their time that they just could not fit in anything “extra” and if I was teaching a lesson in two parts and there was a 3 or 4 day gap it was hard to make the appropriate connections. If I had 30 minutes I was lucky.”

Craig had 1 year with the grant due to the ending of the funding. He would have liked to have had the benefit of the second year to sustain the collaboration and use the first year knowledge to be more successful:

“It would certainly be more helpful if I had another year. I think the lack of experience I had was a huge barrier and if I were able to have another year I would be able to hit the ground running.”

David shared time as a priority in planning:

“Time was a big barrier. We both had so many responsibilities and it was difficult to be able to get together and schedule time just for planning. Because I feel if you have time for planning you can eliminate a lot of other issues. It was difficult but it needed to be a priority.”

Expectations

Expectations for the job responsibilities of the partner teacher and the graduate fellow and implementation of the grant goals were a barrier at times for the *Science First!* Grant.

Partner Teachers. Teresa acknowledged that teachers' and graduate fellows' expectations improved over time:

“Overall the graduate fellow’s teaching skills improved dramatically. Having different fellows made it difficult because you are starting over with a new person. But once they learned what the expectations were for a teacher in the class, they improved. I think lower grade level was more difficult for the fellow to get their research and information to an appropriate level.”

Mackenzie agreed:

“Defining things as simple as dress codes, where the fellows, some of them, did not feel as if they applied to them, became a yearly expectation. But also things that were much deeper than that such as the actual role they would play, who spent the classroom money, how to fit into a classroom environment etc.”

Marsha saw growth in Graduate fellow and partner teacher expectations:

“In the beginning, there was a big difference in expectations on both sides; teachers thought it would be one way, and the fellow thought and were prepared for something very different.”

Whitney saw the evolution of the expectations for both parties over time as well:

“There was just a big breakdown especially at the beginning between what we thought the fellows’ roles were and what they were told their roles were. I think the professors were not even real sure what they wanted to get from the program, so it continued to evolve as we moved forward together.”

Courtney recounted the frustrations of the lack of expectations in the beginning of the *Science First!* Grant implementation:

“It took time before we really knew what to expect from each other and early on there was not great coordination.”

Nedra discovered the expectations for the grant to be confusing for graduate fellows:

“Graduate fellows were told one thing by their leadership and we expected another.”

Leah recounted from the beginning of the grant:

“Neither group really knew what their roles were and had poor information about what the others roles in the grant were.”

Veronica explained how expectations became defined each year:

“The graduate fellows and partner teachers did not have clearly defined roles and expectations in year 1. The tiered contract in year 2 stated more defined roles for the partner teachers and graduate fellows to match the goals of the *Science First!* Grant. Each year the contract was adjusted.”

Jasmine explained:

“The first year people had no clue. They were not teachers and really had no clue what they were doing, and the information they were given about what to expect was not always accurate. I do believe the teacher’s institute has helped change this some. We also did a better job defining roles as the grant continued. The teacher was in charge of classroom management and the fellow was responsible for their disciplines content.”

Graduate Fellows. Tracy found that expectations were unclear in the beginning of her contract:

“We were not totally clear on what each other’s roles were, even among the fellows sometimes we thought or heard different things. I understand that it is a lot better but I still believe it could have been improved.”

Dora found the same angst among her tenure with the *Science First!* Grant:

“The teachers at the school really had no idea, especially in the earlier years of what we were supposed to do. So when you would have conversations about what the expectations were it would take some time just to figure out how, when, and where we fit into their already busy days.”

Lanny saw the expectations to be confused by both groups:

“Some teachers thought my goal was to learn how to teach. My goal was to learn how to relate my research to different age groups. So I think we had different expectations about each other’s goals.”

Although David did not experience unclear expectations directly, he did recall conversations with colleagues who did:

“I did hear some of my colleagues express frustrations about teachers not communicating, unclear expectations but I did not experience these issues.”

Preparation

The preparation for the graduate fellows to enter the elementary school classroom and for the partner teachers to accept them into the classroom was noted as another barrier through the data collected.

Partner Teachers. Teresa saw it more in the beginning of the graduate fellow experiences of year 1 and the connections for young children to the science information. She also saw the need for pedagogy skills of elementary classrooms needed for graduate fellow scientists and mathematicians:

“Fellows needed better preparation for teaching and the expectations for real world classrooms.”

Mackenzie saw the graduate fellow preparedness improve over the time of the *Science First!* Grant:

“Compared to the first 2 years the fellows have been so much more prepared. I think those first 2 years it was so difficult because I am not sure anyone really knew what we wanted to accomplish. ETSU would tell the fellows one thing and the school had different ideas on what was to be expected. Of course that all depended on individuals as well. Some were more prepared than others and some had more passion than others. But from a communication standpoint once we were all on the same page they started having the fellows do mock lessons at the university school and presented their research to us and we would make suggestions on how it might fit with our students’ various ages and our standards.”

Marsha saw a difference in preparedness over time of the grant and experience level the graduate fellows with elementary education pedagogy:

“I think they have improved a lot. You can tell from the beginning of the grant to now, they are much more prepared and the growth from the beginning of the year to the end of the year was very noticeable with individual fellow. At first no one really knew what they were doing.”

Whitney also found preparedness depended on the graduate fellow’s experience and evolved with the *Science First!* Grant 5-year life:

“It really depended on the fellow. The last fellow I had was awesome and was ready to go from day 1. Then I had some who were pretty good eventually it just the transition was a little longer. I also had one who was not very good at all and eventually had to be replace. I think this was a result of just being arrogant in their approach.”

Courtney confirmed:

“I think it really depended on the fellow some came pretty prepared. Although I don’t think anyone can learn all they need to learn until they do it. But some of the fellows are pretty natural but some needed more work. This was harder at the beginning because we did not always communicate well with each other. Between ETSU and the school, I mean. She continued. The teaching has improved especially with how to deliver a presentation with small children. Each new mentor had to kind of start from the beginning and learn best practices. Even those fellows that were more prepared really needed to be acclimated to what my classroom expectations were and how to make and prepare lessons.”

Nedra saw preparedness as a barrier for some fellows in particular disciplines and not others throughout the grant:

“For our science fellow I saw definite improvement, but for my math fellow there was little improvement mostly because I believe it was not a priority for him. In math a fellow did not improve because he even thought he was an expert in math; he was working with several teachers who had a wealth of knowledge in reference in math, and he did not want to take any instruction. He was coming unprepared and was frustrated because he thought some of the other science fellows were getting to do the fun stuff.”

Leah did not find them prepared as teachers but saw that as the role of the partner teacher and the graduate fellow as the content specialist:

“I am not sure that it was their job to have them prepared to be teachers. I am the teacher and they are the research content specialist and I think that was the way it should be. However I do think more could have been done to accomplish less friction from the beginning. I think the two I currently work with one math and one science have grown quite a bit since the beginning of the year. I think it varies depending on the skill set and level of the individual but they have

grown in their ability to present material on age appropriate levels, classroom management, the questions to ask, and how to engage students. But some of that is the teacher responsibility. We changed the way we approached what we did with our fellow to match their strengths. One was much more comfortable and effective in a large classroom setting and continued to grow. The other just did not fit as well so we designed his time to work more in small groups and it was much more effective for him but more importantly for our students. We met as a group of teachers and tried to develop ways that would enable him to be more effective. And we have continued to adjust accordingly.”

Veronica saw preparedness grow from input and grant leadership organization:

“Graduate fellow preparedness for teaching has improved greatly between the first and second year because the communication between two leadership teams was much better. Fellows were unclear of what they should do. There was a disconnect between theory and reality.”

Graduate Fellows. John wanted more support in his role in the elementary classroom:

“I do wish we would have had more preparation. I felt underprepared and I think that hindered the process initially. I almost had no preparation. I will say the Gk-12 class was helpful, But it was more of an opportunity to share success and frustrations and brainstorm ways to be more effective. I would have liked more preparation.”

Tracy noticed the difference in preparedness of pedagogy from graduate fellow requirements and elementary education pedagogy:

“As far as my research goes, I was definitely prepared. But I did not know everything I needed to know about the classroom set up and all that is required with teaching. However, I am not sure that there is any way to be 100% prepared because of what our different roles are.”

Dora had experience in teaching with young students and coaching. She was comfortable in position in front of a classroom full of young students. She did observe her colleagues struggling:

“Being prepared to teach elementary aged students was not as much an issue for me because of my background. But talking to colleagues I certainly heard a lot about the difficulty in dealing with students at this age. So I would say they seemed not to be as prepared from ETSU about the difficulty of teaching this age. Some of my colleagues had no experience even speaking to young students and probably had last had a conversation with a student at that age back when they were that age, so maybe that is a screening issue.”

Lanny had a similar experience with older students but was challenged with the elementary aged child:

“I worked for a year with Teach for America and I felt as if I was prepared however it was with high school students and it was with very specific methods. I was terrified of facing 20 4 and 5 year old children in a classroom and learned entirely new approaches. It also helped me be better able to share my research on a very basic level.”

Melinda found herself more prepared the second year with the experience of observing the elementary setting and teacher pedagogy in action. The summer week-long teacher institute for training with teachers supported that preparation:

“Last summer, I really felt thrown into this. But this summer I think it was better. I felt the teacher’s institute was very helpful this past summer. But to be honest the most helpful thing for me has just been observing a teacher really getting to see how it is done in a real world experience is so valuable. I do think the grant has gotten better and preparing fellows as we have progressed.”

Craig was not sure how preparation for this type of teaching experience could have evolved except through the actual experience itself and with the support of the partner teacher:

“I could have had more educational background experience. But I do think there is a lot to be said about coming in and learning the process. I believe it helped me to better appreciate and be able to provide students the lessons that meet their individual needs, the way they think and learn as individuals. Sometimes when you are put in a situation where you have to sink or swim there is a greater urgency to figure it out. We did some mock lessons with the students at the university school; however that is such a different group of students. I am not sure it translated into much. But by watching, observing and getting positive feedback from the teachers. I feel as if I am much more comfortable. I also think that we had some real defined roles so as I was presenting a lesson, if the teachers felt as if a student was acting up then they would address it. I did not feel as if I needed to be the enforcer.”

David agreed:

“I think it worked out but it could have been more. I am not sure you can ever really have enough preparation but some of the preparation was modeled in a way that did not actually apply to what we were doing.”

Summary

Analysis of the data reveals that several strong themes emerged from these interviews. Strong relationships developed between the graduate fellow and the partner teacher as well as the elementary school and the university. Through these relationships students grew academically and teachers grew in content knowledge. Both groups developed a deeper appreciation for each others' profession. The process of the grant found challenges in communication, although more prominent in the first year, it remained a concern throughout the life of the grant. The

expectations and preparations of the graduate fellow and the partner teachers were obstacles for the *Science First!* Grant. Time as a structure to negotiate between the needs of the elementary classroom needs, the university schedules, and the grant goals was a balancing act each semester.

The *Science First!* Grant brought success and challenges. Participants reported disappointment in the end of the grant. The process of the grant implementation made improvement each year and participants looked forward to future STEM partnerships and learning. Further findings are discussed in Chapter 5.

CHAPTER 5

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Introduction

The purpose of this study was to examine the perceptions of graduate fellows and partner teachers of the barriers and success in the implementation of the *Science First!* Grant at one school in East Tennessee. This qualitative case study was conducted by interviewing 16 participants in the Science First NSF-GK12 grant awarded in 2008-2013. Nine partner teachers and seven graduate fellows were chosen through purposeful sampling. A list of participants was available through the contracts signed with the *Science First!* Grant leadership team organization. Respondents signed an Informed Consent Form (Appendix D) and an interview guide was used (Appendix A).

Meyrick (2011) reported the advantage to integrating STEM curriculum into all content areas at all grade levels is that it provides students with informal practice creatively solving problems long before they need to decide on a course of study for college. The emergence of STEM curriculum in the public K-12 educational system provides opportunities for all level learners to master skills and content important for 21st Century learning. Developing students' reasoning skills, critical thinking skills, creativity, and innovation through integrated and connected STEM curriculum and pedagogical practices provides equity among learners from diverse backgrounds. The NSF-GK12 *Science First!* Grant provided an avenue for one high poverty elementary school the opportunity to increase teachers' content knowledge in the STEM disciplines through the graduate fellows' expertise and content graduate level classes. The grant also exposed students to more in-depth teaching and hands on resources.

Research Questions

Research Question #1

1. What were the successes for teachers and graduate fellow of the 5-year *Science First!* NSF-GK-12 Grant?

Relationships

Interview responses to this study noted four important themes as related to a successful grant implementation. Building a relationship between the partner teacher and the graduate fellow became a consistent theme. Both groups of participants found it to be a critical component of successful STEM implementation in the elementary classroom. Trust and honesty during the development of these positive relationships were common and provided students with a productive learning environment. The professional collaboration between the partner teacher and graduate fellow encouraged lessons with a greater depth of knowledge and the ability to discuss extenuating issues such as student issues openly. The partner teachers and graduate fellow have seen some relationships extend beyond their tenure on the grant to years beyond. There has become a mutual benefit of shared information as the graduate fellow have moved on in either different careers or teaching.

The relationship with the university was another discovered outcome from the research. Participants reported that the contacts made would make them more comfortable to later reach out for support. The leadership team was noted as resource for continued involvement and communication between the school and the university. There was also noted the relationships for STEM field trips and extension lessons and resources for students at the university through places and personnel. The content classes and graduate fellow provided these resources.

Mutual Appreciation

Partner teachers and graduate fellows describe a mutual appreciation for each other during their work together. Partner teachers valued the content knowledge and support the graduate fellows brought to the classroom and the lessons they taught. The role the graduate fellows brought high level student engagement and real scientists and mathematicians to the high poverty classroom. Partner teachers acknowledged the positive role model of the graduate fellows to the future of at risk students.

Graduate fellows formed an almost immediate appreciation for partner teachers. The graduate fellows described the partner teachers' job full of multiple roles and responsibilities and exuding vast amounts of effort and energy. The graduate fellows reported the difficulty in the amount of information partner teachers had to accomplish. Words that kept coming up in the interviews were amazed, lots of energy, and effort on the actions of partner teachers graduate fellows worked with during the grant. Graduate fellows appreciated, as the partner teachers did of them, the modeling and feedback given during the lessons prepared.

Increased Academic Depth

Partner teachers and graduate fellows agreed on the benefits of academic growth for students in science and math. Science and math material was presented in new and different methods with meaningful levels of inquiry. Science and math lessons were engaging for students with real world connections. Academic growth came from students who saw scientists, male and female, as role models and imagined a different future for themselves.

Graduate fellows were viewed as the content specialists and increased level of depth. They introduced new material to investigate and problem solve. Accuracy, academic growth, and connections were common terms found through the interviews of the graduate fellows.

Professional Growth

Partner teachers grew professionally through collaboration with their graduate fellows and the graduate level content courses. Teachers recounted the accuracy of content and knowledge built through planning together with the fellows and interacting with the material. The professional development achieved gave partner teachers confidence in presenting science and math lessons. They are comfortable with using the Online Resource Center where lessons built together are stored. One teacher stated, “The more you know, the more accurate your focus is when instructing.” Leadership skills in math and science venues have become a success story for several partner teachers through workshops, school jobs, and also within the school community.

The conferences offered yearly and content specific graduate level courses offered at the university were another form of professional development. Three degrees were awarded because of this grant to partner teachers. The yearly conferences reinforced the partner teachers’ and graduate fellows’ STEM content. Partner teachers explain the conferences became more meaningful when they were given the option of conference choices as opposed to the conference being chosen for them (a change made after the first year). The content courses were beneficial to build content knowledge according to the professor and how they were able to make the material applicable.

Graduate fellows found professional growth in different ways. A consistent theme of professional growth for graduate fellows was the transition of translating the technical jargon of science and math to a more user-friendly vocabulary. The challenge in the beginning was to share their joy of science and math with an audience of preschool to fourth grade students. Presenting information in front of large groups of peers, teachers, students, and professional

groups has created confidence and language adjustment development. The graduate fellows attribute this growth to the modeling of partner teachers and having to teach to multiple abilities in multiple ways. One fellow credited his new job after the grant to the growth he made while working with teachers and students. The new job interviewer told him he was able to break down information in a meaningful way to be understandable to others.

Research Question #2

1. What were the barriers for teachers and graduate fellows of the 5-year *Science First!* NSF-GK-12 Grant?

Communication

The beginning of the grant presented the most prevalent communication issues, but overall communication was a barrier throughout the grant. The leadership in the beginning of the grant didn't communicate clearly the goals of what was to be accomplish and how. There were two different schools with two different sets of roles and responsibilities for the partner teachers and graduate fellows. The leadership changed and the grant team's communication saw some improvement. Protocol issues still presented a communication dilemma with whom to report issues to and the outcome results of the grant. Participants reported smoothness in the communication when a liaison was hired to handle the details of the grant for graduate fellows and partner teachers. Participants wanted more conversations up front and saw a few people making the decisions.

Communication between the partner teachers and the graduate fellows was facilitated by the weekly planning opportunities and relationships developed between them. The communication about lessons was hindered when graduate fellows were not well informed of school and classroom events and instruction. Several partner teachers and graduate fellows

reported the communication between them increased productivity of lessons and time when each was able to give regular productive feedback. This type of communication created effective and professional partnerships.

Time

Partner teachers in the grant struggled with the time element of including another instructor in the classroom. The scheduling of the graduate fellows to present their research or incorporate a science or math lesson became secondary to the state testing, state standards driven curriculum already present. The elementary school calendar and school day was packed from bell to bell with teachers pressured especially in a high poverty school to focus on a demanding program of study.

Graduate fellows realized time was a barrier more than teachers because it didn't impact the teachers' ordinary schedule. The graduate fellows saw time as imposing on the partner teachers' day. The tight daily schedule of the elementary classroom found the graduate fellows conforming to the needs of the teachers. There was pressure on teachers driven by standards and time. The graduate fellows were fit in to the schedule and stifled some of the creativity of their lessons. The logistic scheduling of two school schedules posed a problem each semester with university class schedules and the school time constraints. The 1-year fellows wanted the second year to have the experience and ease of transition. The end of the grant prevented the second year.

Expectations

The expectations of the *Science First!* Grant participants and goals of the grant were confusing and undefined in the beginning. The coordination of the grant was unfocused with the graduate fellows being told one thing by the leadership team and their partner teacher telling

them something completely different. The roles and responsibilities of the participants were unclear. Expectations became more transparent with the introduction in year 2 of the tiered contract outlining roles and responsibilities and the summer teacher institute. The contract was updated each year with input from participants. The summer teacher institute gave teachers and fellows the opportunity to collaborate and make long-term plans. It also gave the leadership team the time to review the grant's goals and expectations. Partner teachers reported that some expectations such as school norms of dress code, school vocabulary, and who spent grant funds given to the partner teacher weren't clearly defined.

Graduate fellows and partner teachers discovered that the first year of their partnership was the most frustrating. The partner teachers stated that they started over every time a new fellow began and the graduate fellow had no idea the expectations in the elementary classroom. Some graduate fellows thought their responsibility was just to present their research in the primary classroom. The expectations of the roles of the fellows were interpreted through each participant's perception. The expectation's barrier of the grant coordinated with the communication and time of coordinating the how, when, where, and why roles and responsibilities of all participants and leaders.

Preparation

The graduate fellows and partner teachers reported wanting more training for the challenges this partnership brought with the *Science First!* Grant. Both groups described a lack of pedagogy skills for the graduate fellows and lag time for instruction due to the instruction of best practice skills and classroom procedures. Partner teachers discovered the level of preparedness depended on each fellow's prior experiences, passion for students, and natural skill ability. Partner teachers recognized fellows are not prepared as teachers but were scientists. The

partner teachers modeled appropriate teaching strategies and guided instructed fellow along their strengths.

The preparation of graduate fellows for the classroom experience was a yearly obstacle for the success of all participants. Everyone came with different expectations and experiences from various educational backgrounds. The grant provided increased levels of preparedness each year. The summer teacher institute evolved over time with feedback to support preparedness. Graduate fellows presented mock lessons to an area year-round school to be better prepared for the classroom. Graduate fellows obtained their most valid preparedness through observing teachers and actual experiencing the learning process.

Conclusions and Recommendations

Through this research, personal experiences, and the examination of thoughtful, reflective, and honest responses shared by graduate fellows and partner teachers who agreed to participate in this study, the researcher was able to draw specific conclusions. The National Science Foundation took a risk in awarding one school three million dollars for STEM integration with a local university. The rewards and responsibilities that followed that award helped participants grow educationally and professionally. The positive results from the *Science First!* Grant translated to long-term changes in STEM instruction with the Online Resource Center, the increased content knowledge of partner teachers, and the professional partnerships achieved through the grant.

The data collected and analyzed from this study support the following conclusions:

1. The coordination of a major NSF-GK12 grant can provide STEM support and academic depth for high poverty schools with leadership.

2. Positive relationships between the graduate fellows, partner teachers, and the two participating institutions are critical in fostering successful grant implementation.
3. Professional growth through the grant partnerships was obtained.
4. The participants gained a mutual appreciation for the roles and responsibilities of each other.

The NSF-GK12 *Science First!* 5-year Grant funding has ended. The continuation of the GK-12 branch of NSF was not funded in the 2013-14 year. However there are recommendations for grant effectiveness based on this study.

Recommendations for Partner Teachers

1. Recognize the important role of relationships. The graduate fellow is a scientist or mathematician and eager to support pedagogy expertise. Build on strengths to guide instruction.
2. Communicate with any professional clear expectations in the classroom. Be aware of time constraints and the manner pedagogy styles impacts classroom collaboration.
3. Provide increased observation opportunities for graduate fellows.
4. Be open to professional growth in all forms. The content specialist and graduate level courses were provided to heighten STEM understanding for teachers and students.

Sometimes professional growth is at a higher level than the classroom level and elevates basic understanding of concepts.

Recommendations for Graduate Fellows

1. Recognize the important role of relationships. The partner teacher is a professional teacher with experience in the classroom pedagogy. Build on strengths to implement STEM effectively in the classroom.

2. Communicate with other professionals and discuss areas of expectations, student issues, teaching strategies, and other concerns.
3. Work to find time and structure in the school program to meet the needs of graduate fellows and the partner teacher. Compromise may be necessary but the initial time and planning prove beneficial.
4. Provide opportunities for the partner teacher to explore research and understand the world as a scientist and mathematician. Letting the partner teacher understand research techniques and methods will encourage them to have the flexibility to explore with techniques and ideas out of their normal scope.

Although not included in this specific data, general ideas were developed from the participant interviews to merit some recommendations for the *Science First!* Grant leadership team.

Recommendations for Grant Leadership Team

1. Provide multiple avenues for participants to give feedback regularly when working between two institutions like a university and K-12 school. Consider feedback and adjust accordingly for the benefit of the goals of the grant.
2. Design and communicate clear and consistent expectations to all participants from the beginning. Create checkpoints and a liaison for participants to check with for clarity and support.
3. Provide structured preparation for graduate fellows in the pedagogy of elementary schools and partner teachers in receiving content specialist in the classroom.
4. Evaluate the implementation of the grant through multiple methods of participant input and outside observations.

Recommendations for Further Research

1. Examine the academic progress of students who were participants in this 5-year GK-12 *Science First!* Grant in science or math using state assessment growth measures or achievement.
2. Examine the 5-year collected data of surveys and interviews collected on this 5-year GK-12 *Science First!* Grant and compare to other similar grants.
3. Examine the future career paths of the first student participants of the *Science First!* GK-12 Grant participants.
4. Examine the impact the grant had on graduate fellows who have left since the *Science First!* GK-12 Grant.

Researcher's Final Thoughts

The *Science First!* GK-12 grant influenced instructional practices and in turn student learning. In this study the positive relationships that were developed and academic depth achieved were a direct result of the *Science First! Grant*. Participants reported an increased focus and time on STEM content. Partner teachers worked with graduate fellows who were content specialists in math and science. The collaboration of pedagogy and content specialists worked to provide each participant the skills necessary for the students to have a high quality STEM program.

The research and findings show successes and barriers of the grant. I was a participant on the leadership team of the grant. Knowing the research information and the schools enlisted in this study well, I come away with a promising conclusion. I see students from a high poverty school with a limited view of the world enlightened with the hope of a different future. The *Science First!* Grant showed them new careers possible for all people. It brought in real

scientists and mathematicians who maybe did not look like them and gave them the opportunity to ask questions they may not have ever thought of before. Beyond any other wonderful success of the grant, my wish is that our students find a chance to explore new possibilities.

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APPENDICES

APPENDIX A

Partner Teacher Interview Guide

Science First Grant!

1. How has fellow's teaching skills improved during teacher/fellow collaboration?
2. How has the fellow displayed skills needed for teaching either math/science/technology through problem solving investigation?
3. Is the ETSU graduate fellow more comfortable interacting with students after working in m classroom?
4. Has the ETSU graduate fellow shared his/her research through some age-appropriate means?
5. Has the ETSU graduate fellow had a better understanding of the K-12 classroom and classroom needs?
6. Has the ETSU graduate fellow had a positive impact on the students' interest in math or science?
7. Has the ETSU graduate fellow had a positive impact on the level of scientific or mathematical depth in lessons taught?
8. Has the ETSU graduate fellow had a positive impact on the level of scientific or mathematical accuracy of lessons taught?
9. Did the ETSU graduate fellow need more preparation before entering the classroom?

About my teaching:

10. The fellow has helped me increase my use of problem solving investigation in teaching in the following ways.
11. I plan on using problem solving investigation as a teaching strategy as I develop new lessons in the following ways.

12. I plan on using the activities/lessons that my fellow and I developed and implemented in the following ways?
13. The content classes increased my skill set and improved my teaching in the following ways?
14. Through collaborating with my graduate fellow, my science or math content level has increased and improved my teaching in the following ways.
15. I am more likely to collaborate with a scientist or mathematician in the future.
16. What barriers/if any exists

APPENDIX B

Graduate Fellow Interview Guide

Science First Grant!

1. Has your- the graduate fellow's teaching skills improve during teacher/fellow collaboration?
2. Has your- the graduate fellow displayed skills needed for teaching either math/science/technology through problem solving investigation?
3. Are you more comfortable interacting with students after working in m classroom?
4. Did you need more preparation before entering the classroom?

Graduate fellow Questions:

5. Did you have the skills to adjust my lesson to various age groups?
6. Were you able to communicate your thoughts and ideas about math and/or science in layman's terms to other adults or non-scientists?
7. Did you have knowledge about what it means to be a teacher?
8. Has this experience improved your understanding of how students learn?
9. What-if any barriers did you incur?

APPENDIX C

INFORMED CONSENT

PRINCIPAL INVESTGATOR: Sharon D. Pickering

TITLE OF PROJECT: “Perceptions of Teachers and Graduate fellow in one school regarding the barriers and successes made during their participation in a National Science Foundation Grant”

INFORMED CONSENT DOCUMENT FOR FELLOW OR INSTRUCTORS

This Informed Consent will explain about being a participant in a research study. It is important that you read this material carefully and then decide if you wish to participate.

Purpose:

The purpose of this research study is to examine the perceptions of graduate fellow and teachers regarding the barriers and successes of the NSF G-K 12 Science First Grant.

Procedures:

You will be asked to participate in one on one interview with a research assistant not associated with the grant during the last semester of the grant. The purpose of the interview is to assess the perceptions of participating graduate fellow and teachers of the barriers and successes of the five year grant.

Each interview will take approximately 30-40 minutes.

Possible Risks/Discomforts:

There are no known risks.

Benefits of Participation:

None anticipated, but to contribute to the body of knowledge of the benefits and barriers of implementing STEM grant in a high poverty elementary school.

Alternative Procedures:

There are no alternative procedures; except not to participate.

Contact:

If you have any questions, problems or research-related injuries or problems at anytime, you may call: Sharon Pickering at (423)434-5249. You may call the Chairman of the Institutional Review board at (423)439-6054 for any questions you may have about your rights as a research

subject. If you have any questions or concerns about the research and want to talk to someone independent of the research team or you can't reach the study staff, you may call an IRB Coordinator at (423) 439-6055 or (423) 439-6002.

Participation in this research experiment is voluntary: You may refuse to participate. You can quit at any time. If you quit or refuse to participate, the benefits or treatment to which you are otherwise entitled will not be affected. You may quit by calling Sharon Pickering, (423)434-5249. You will be told immediately if any of the results of the study should reasonably be expected to make you change your mind about staying in the study.

Confidentiality:

Every attempt will be made to see that your study results are kept confidential. A copy of the records from this study will be stored at the researcher's home for at least 5 years after the end of this research. The results of this study may be published and/or presented at meetings without naming you as a subject. Although your rights and privacy will be maintained, the Secretary of the Department of Health and Human Services, the ETSU IRB, and personnel particular to this research have access to the study records.

Consent:

By signing below, you confirm that you have read or had this document read to you. You will be given a signed copy of this informed consent document. You have been given the chance to ask questions and to discuss your participation with the investigator. You freely and voluntarily choose to be in this research project.

Signature of Participant

Date

Printed Name of Participant

Date

Signature of Investigator

Teacher, Woodland Elementary School, Johnson City
Schools, Johnson City TN 2003-1994

Teacher, John Adams Elementary School, Alexandria
City Schools, Alexandria, Virginia 1994-1989

Teacher, Early Learning Center, Johnson City, Tennessee
1989-1986

Honors and Awards:

2008-2013 NSF-GK12 *Science First!* Grant Co-PI

Chosen for Academy of Coaches, Wachovia National
Education Foundation, Johnson City Schools,
Johnson City TN 1999

National Board Certification 1999, Early Childhood
Generalist (#019903892), recertified 2009

Teacher of the Year, Cumberland Mills Elementary

Teacher of the Year, Woodland Elementary School, 2001

Teacher of the Year, District Winner, Johnson City TN,
2001