STEM Program Implementation: A Case Study Analysis of Perceptions, Resources, Equity and Diversity

James. A. (Jim) Egenrieder

Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirement for the degree of

Doctor of Education

in

Curriculum and Instruction

William J. Glenn, Co-Chair

Rosary V. Lalik, Co-Chair

David L. Trauger

Walter D. Mallory

Catherine E. Scott

April 27, 2015

Falls Church, Virginia

Keywords: Education, Elementary, Equity, Exclusivity, Fidelity, Implementation, Magnet Program, Magnet School, Math, Math and Science, Perceptions, School-within-a-School, Science, STEM

STEM Program Implementation: A Case Study Analysis of Perceptions, Resources, Equity and Diversity

ABSTRACT

This case study examined the perceptions of administrators, teachers and parents of the implementation of an elementary school science, technology, engineering and math (STEM) academy program that featured characteristics of both magnet school programs and school-within-a-school programs. I conducted interviews of key personnel, informed by classroom observations and a survey of parents to determine how stakeholders perceived equity in the access and allocation of opportunities and resources. The STEM Academy selected students from neighboring elementary schools and was housed within a larger K-5 elementary school. I found the STEM Academy teachers were widely praised for their innovations and teaching excellence, and alignment with emerging best practices. However, there were perceptions that their curriculum was neither sufficiently documented nor aligned with school division priorities, and was insufficiently communicated with school division central office leaders Academy parents, teachers, and community partners praised the Academy's approach to curriculum, instruction, and uncommon learning experiences; but resentment and perceptions of inequity and exclusivity among most other stakeholders compromised the program implementation, leading to administrative and political pressure that challenged the Academy's sustainability. I provide discussion and recommendations concerning elementary STEM programs, highlighting the importance of stakeholder perceptions and program evaluation. I also provide several suggestions for further research.

DEDICATION

This project is dedicated to my many colleagues over the years, even before I considered expanding my career to consider science education or STEM education and workforce issues. Through their own behavior, those in agricultural and environmental science, engineering and public policy inspired me to keep asking "Why?" and How?" and "How do we fix that?" My colleagues in education challenged me to explore my own epistemology to better understand how others learn, and through their own endeavors motivated me to develop good ideas into better ideas, find partners and thoughtful sponsors for those ideas, and develop them to emphasize students' outcomes.

As an older graduate student, I was strongly motivated by the many professors and mentors who so comfortably treated me with collegial respect and encouragement. In doing so they transformed me in the way I reached out to my students, whether they were in a summer camp or a graduate course. Similarly, my doctoral cohort program colleagues shared their experiences, challenges and goals so openly, I learned much humility, and thereby reoriented my perspective and perceptions regularly. Those who were also part-time graduate students reminded me that all things are possible, even if we can never control all of our priorities or schedules.

My most important colleagues are those who were once my own students. Their accomplishments during my 16 years as an educator have helped me to recognize those important formative influences in which I saw them pivot or accelerate in their own pursuits. In many, many cases, they have gone on to develop expertise or pursue meaning in special ways, and in both ways became my teachers.

ACKNOWLEDGMENTS

There are several individuals who made this document possible, and are deserving of special acknowledgment.

My committee chairs, Dr. William (Bill) Glenn and Dr. Rosary Lalik, are directly and indirectly responsible for nearly every meaningful, transformative opportunity I've enjoyed as a doctoral student and faculty member. Individually and collaboratively, they have set the best examples, motivated me, reoriented me when necessary, and guided me in directions I would not have discovered on my own. In their unique ways, both bring out the best in others, and demonstrate how to find meaning in every place, every story, and every phenomenon.

Similarly, my Committee members have played many inspiring roles. Dr. David Trauger's background in fisheries and wildlife, and enlightened approach to meaningful, transformative graduate education convinced me that I'll always want a connection to teaching at any level, but particularly in professional graduate programs. Dr. Trauger and Dr. Lalik also supported my first university grant-funded adventure in designing interdisciplinary graduate coursework in Watershed Systems Stewardship that continues today, building cross-disciplinary and trans-disciplinary connections between Math and Science Education, Natural Resources, Environmental Engineering, Landscape Architecture and Urban Planning.

In addition to having many shared interests and local school connections, Dr. Walt Mallory is an ever-ready shot of adrenaline for a weary student, quick to share ideas, strategies, knowledge, examples, stories, contacts, and a wealth of optimism.

Dr. Cathy Scott has been the best of examples professionally and academically, and a lead partner in many programs and ideas for which we received local and national attention; but

she also regularly reminds me of all that educators can be, how to overcome obstacles and disappointments, and how to create light without unnecessary heat.

My collaborative partners over the last decade have made so many contributions to my experiences: at Virginia Tech, my colleagues in both the School of Education and the College of Natural Resources and Environment, who accomplish many important things and change the lives and careers of so many young people; my colleagues at the National Institute of Aerospace who find and exercise so many opportunities to help STEM teachers; my doctoral cohort colleagues who provided examples and insights not otherwise available; and my colleagues in Arlington Public Schools and other school systems, particularly in technical and professional education (Career and Technical Education), who have continued to aim for things that others are only now beginning to appreciate.

My family has supported me throughout, beginning with my parents, who did not have opportunities for the higher education experiences they encouraged for me, and I'm particularly grateful for their support for me exploring agriculture, environmental science, and fish and wildlife biology despite the job outlook for such careers at the time.

Of course my wife, Diane Allemang, has endured the almost daily interferences of my graduate studies and stresses but regularly finds opportunities to lighten every moment where stress might otherwise take hold. She manages a large team of scientists and policy staff, and demonstrates daily both a tolerance and appreciation of idiosyncratic behavior. She encourages and supports nearly all of my expanding curiosities and explorations, even the expensive ones, and truly enjoys the associated adventures of trying, learning, and mastering new things.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PREFACE

Protection of Confidentiality of Study Participants

The names of institutions and individuals referenced, cited or otherwise appearing in this document are fictitious. Any resemblance or similarity to all or part of the names of actual institutions or individuals is unintended and purely coincidental.

CHAPTER 1 - RATIONALE

This chapter begins with the larger, national emphasis on mathematics and science education to address the concern for developing future scientists and engineers in the United States. In that context, I describe a case study of the efforts of a small team within a large school district to implement an elementary science, technology, engineering and math (STEM) academy beginning in 2002. I describe the significance of the case study research project, the research goals, participants, and timeline; and I provide definitions of relevant terms.

National Programs Emphasizing Mathematics, Science and STEM Education

The American Association for the Advancement of Science introduced Project 2061 in 1985 as a long-term project to help all Americans achieve literacy in Science, Mathematics and Technology (AAAS, 1993)[1]. The Project 2061 *Science for All Americans, Benchmarks for Science Literacy* and the complementary *Atlas of Science Literacy* provided the foundation for state and national standards and also the stimulus for engaging all stakeholders in the investment in what students should be capable of understanding in grades 2, 5, 8 and 12.

In the 1990s, school systems began to address the concerns raised by international comparisons of students' learning in math and science by developing programs emphasizing math and science preparation, mostly in the middle school years (Beaton, et al, 1996; Barro & Lee, 2001; Mullis et al., 2004). The growing concern for developing future scientists and mathematicians led to efforts to engage students in earlier grades to build skills, experiences and exposures that would create enthusiasm, motivation, and resilience in this study of science and

[1] The name *Project 2061* recognizes that Halley's Comet was last visible on Earth in 1985; today's elementary school students will likely be parents or grandparents at the time the comet returns in 2061.

math. Early implementers were rewarded with corporate support, and resources and opportunities from multiple science-based agencies. As initiatives in school choice expanded with the No Child Left Behind Act, students with strong interests or aptitude were increasingly distinguished and rewarded with access to special programs (U.S. Department of Education, 2008).

In many areas of the country, industry provided both encouragement and support for school systems willing to address future workforce needs through innovation. Hailey et al. (2005) described how these early programs provided models for identifying new strategies, best practices, and new curricula that were promoted through professional development and teacher organization journals. Although these innovative programs initially were distinct from other academic programs and curricula early in their implementation period, teachers in other programs often narrowed those distinctions quickly. Sharing became an important part of national organizations' conferences and was significantly enhanced by the evolution of Web 2.0 resources in the mid-2000's (Alexander, 2006).

The Ailanthus Academy teachers followed a Hands-On Math and Science (HOMS) elementary curriculum aligned with national and state-specific standards. HOMS was a project of the AIMS (formerly *Activities Integrating Math and Science*) Center for Math and Science Education, part of the AIMS Education Foundation and originally funded by the National Science Foundation. HOMS is now an integrated, indistinct part of AIMS Math and Science programs but the emphasis on hands-on activities remains (AIMS Center for Math and Science Education, 2014).

Influence of Curriculum Standards and Metrics of Accountability

The reauthorization of the Elementary and Secondary Education Act of 1965 in 2001 as the No Child Left Behind Act (U.S. Department of Education, 2002) required states to develop assessments in math and reading measured annually in grades 3-8 and once during high school. Notably, testing in science was also required once during grades 3-5, 6-9, and 10-11. Many states already had established curriculum standards and metrics of accountability based on proficiency in standards-based exams in math and reading - and in many cases science and social studies also - and accordingly, these subjects became priorities for elementary educators. Sometimes that attention has been actualized through the design and implementation of special programs such as academies and magnet school programs. Yet little research has examined the development or efficacy of those programs. The lack of knowledge is especially apparent at the elementary school level, where fewer such programs exist, even while increasingly authorities clamor for the development of such programs.

Creation of the Ailanthus Elementary STEM Academy

The Academy Programs developed by Piedmont Public Schools in the 2002-2003 academic year were intended to be an expansion of curricular options for all students across the county (Interview with D. Clinton, October 7, 2012). To recognize that no educational program should adopt a "one size fits all" philosophy, the school division developed the academy prototype – a school within a school – to provide additional academic choices for students and parents.

Piedmont Public Schools opened two Academy Programs in its 50+ elementary schools. Cyprus Elementary offers a Foreign Language Partial Immersion Academy designed to provide a foreign language experience in the elementary school setting. Students are selected through an

application process, which is open to any rising first-grader at Cyprus Elementary, but only Cyprus Elementary.

The Ailanthus STEM Academy program was intended to promote student achievement and encourage students to further pursue their personal interests in math and science. Based on the HOMS (Hands-On Math and Science) teacher training program, a plan for curriculum and pedagogy was outlined with teachers and support staff, and teacher leaders developed plans for innovative learning activities. Career opportunities in the fields of mathematics, science, and engineering were to be emphasized and explored, with an emphasis on computer literacy (Interview with P. Geary, October 1, 2012).

HOMS trainer Duana Clinton described the four key features of the initial planning: 1) The teachers would work in teams to present the lesson concepts and learning activities so that instruction would be student-centered and emphasize engagement through inquiry and differentiated instruction; 2) The teachers would focus on the integration of mathematics, science, and technology into all curricula; 3) Students would work in teams on problems intended to help them develop and enhance their skills and knowledge; and 4) Students, supported by teachers, would conduct experiments in a well-equipped science lab developed for the STEM Academy (D. Clinton, personal communication, October 2, 2012).

The STEM Academy at Ailanthus Elementary was developed to offer students a fast-paced program of study that combines instruction in core subjects with enriched coursework in science and mathematics (Interview with Academy teachers, October 8, 2012). Instruction would emphasize hands-on laboratory experiences intended to develop problem solving and higher order thinking skills. Students would be required to apply to the STEM academy for admission. Only students who attended Ailanthus Elementary and its adjacent attendance areas of Alder,

Boxwood, Chestnut, Dogwood, Sycamore, and Tupelo elementary schools would be eligible to apply for the Academy. The STEM Academy would recruit 26 Ailanthus Elementary students and another 26 from the combined feeder schools for a total of 52 students in each grade of the Academy (Interview with P. Geary, October 1, 2012).

Purpose of the Case Study

The purpose of this case study is to inform current knowledge about elementary level STEM programs by providing a record and analysis of stakeholder perceptions. These perceptions concern both an elementary STEM academy program implementation as well as the adaptations of the program that ensued within the hosting elementary school programs that were not part of the academy. The case study will inform the design and implementation of future STEM programs, and particularly those that serve as magnet programs, distinct school-within-a-school programs, or integrated curriculum school-wide programs.

Statement of the Problem and Significance

The Ailanthus STEM Academy program had attracted resources from a variety of government, non-profit and business partners that were not available to other schools, or even non-Academy teachers within Ailanthus Elementary School (D. Clinton, personal communication, October 3, 2012). Throughout the first 10 years of the program's implementation, questions and concerns from stakeholders accumulated, leading the Piedmont School Division's elected school board to question the feasibility of continuing the program. While the unique features and additional resources implemented as part of the Academy seemed to create positive perceptions among many stakeholders toward the program, others expressed contradictory perceptions, ostensibly challenging the positive image of the program. Yet to date there had been no careful analyses of the relationships between perceptions, resources, and

program implementation to inform the decision to be made about the future of the Ailanthus STEM Academy (D. Clinton, personal communication, October 26, 2012). Similarly, there had been no analysis of how implementation strategies and decisions have contributed to undesired outcomes, and how perceptions of program outcomes may influence the future and replicability of the STEM Academy.

Nature of the Study and Research Goals

This project analyzes stakeholder perceptions concerning the Ailanthus STEM Academy program. I collected data in Fall 2012 as part of a program evaluation directed by a school division central office administrator on behalf of the elected school board. The data included the following:

- transcripts and notes of interviews with teachers and administrators;
- notes from classroom observations; and
- parents' responses to an on-line survey.

Documents related to the creation of the Academy were not available from either school division leaders, or those who facilitated or participated in the program creation, but information describing the Academy and application procedures was available on school division web pages. In this case study analysis, I used qualitative analytical strategies to explore stakeholders' perceptions concerning the development and implementation of the Ailanthus STEM academy. The primary strategies for data collection were face-to-face interviews and telephone interviews with past and present program designers and implementers, and past and current school-based and central-office administrators. These interviews were informed by teacher and classroom observations in the Ailanthus STEM Academy, the larger Ailanthus Elementary School, and a

feeder elementary school. Parents also requested to share their perceptions through an online questionnaire. Their responses became another source of data.

The findings of this analysis will inform recommendations for new protocols for implementing and evaluating elementary STEM programs. It will also inform models for measuring fidelity of implementation of similar programs. Perhaps most important, this analysis will illuminate the human dimensions of participating in change and adapting to innovation.

Research Questions

In consideration of the problem as described above, I established the research questions below.

RQ1. What distinguishing features of the creation, implementation and adaptation processes of the Ailanthus STEM Academy program were perceived as salient by interview participants?

RQ2. How did perceptions of the program differ among interview participants, and how did perceptions change over time?

Participants in the Case Study

The selection of participants was guided by the Assistant Superintendent of Instruction in response to a directive from the Piedmont School Board. Participants included three current or former Ailanthus administrators, three current and former central office staff, four Academy teachers, and two representatives of other schools. A total of nine classroom observations informed the interviews, and included Academy 3rd, 4th and 5th grade classes, the same grades in non-Academy Ailanthus classes, and 2nd through 5th classes in a feeder school. As a researcher working with the Assistant Superintendent of Instruction, I was not allowed access to School Board members, PTA representatives, and administrators and teachers in the elementary World

Languages magnet program, or the secondary magnet programs. However, the scope of available interview participants was sufficient to develop an understanding of the perspectives of Academy stakeholders, and particularly those most directly connected to the Academy. A list of all Piedmont personnel described in this case study is included in Appendix A. Documentation of the Academy curriculum was not available, and later discovered to be non-existent, except for teacher notes in binders shared with me during a classroom observation.

Data Collection Timeline

Data collection was performed during Fall 2012, under the guidance of the Assistant Superintendent of Instruction as requested by the Piedmont School Board. I conducted initial phone interviews in early October 2012 and visited the school later that month. I interviewed the current principal and assistant principal on October 8, followed by six classroom observations, and an interview with teachers. Three feeder-school classroom observations and a feeder-school gifted resource teacher interview were conducted in late October 2012. Phone interviews with other central office staff were conducted throughout this time period based on availability. At the request of parents attending the September PTA meeting, a parent survey questionnaire was issued in mid-October 2012. All data collection from key personnel and parents was completed by the end of October 2012.

Definition of Terms

For the purpose of this study, I used the following definitions of relevant terms.

An *academy* is a program within a school division with a specific emphasis, curriculum, or participants. In the context of the Piedmont School Division and Ailanthus Elementary School, academies will be programs within a school, whose participants (students and teachers) follow a plan or curriculum distinct from the larger school.

Attitude is the reflection of beliefs and emotions in how perceptions influence thinking and behaviors.

Case study is the detailed, descriptive analysis of a person, program, event or institution developed through either an explanatory, exploratory, or interpretive approach.

Constructivism is a theory of knowledge acquisition in which a person's existing knowledge, experiences and understandings influence how new information is perceived and interpreted.

Curriculum is the combined, planned academic experiences for students. The National Science Education Standards defines curriculum as "the way content is delivered . . . the structure, organization, balance, and presentation of the content in the classroom." (National Research Council, 1996).

Differentiation or *differentiated instruction* is that which attempts to reach all students through multiple or individualized strategies and learning activities that meet a broad array of students' abilities, interests and needs.

Engineering is the use of design-based solutions to solve problems. Design processes begin with identifying a problem and recognizing criteria and constraints for a solution, then brainstorming and researching, then developing and testing models or prototypes.

Fidelity of implementation is the measure of whether a program has been implemented consistent with the intent of the developers.

Instruction is often subsumed as a part of curriculum, but otherwise distinguished as the teacher behaviors and strategies used to create student experiences. Piedmont Public Schools has two separate departments (with assistant superintendents), one for Curriculum and one for Instruction.

Integration is the intentional cross-disciplinary, interdisciplinary, trans-disciplinary blending of traditionally distinct curriculum areas.

Magnet programs are those that attract students, through self-selection or parent-selection, from one or more general programs, sometimes across established school boundaries, based on aptitude for a specified curriculum, instructional approach, or demographic criteria. Magnet programs may be distinct schools or may exist within a comprehensive school. Academy programs are often implemented or branded as magnet programs, others may serve student cohorts with specific needs, exclusively within a school or school boundary, and participation may be by default rather than choice or an application process.

Mathematics, math or maths is the study of relationships between things, real or imagined, based on logic. Sometimes these logic-based relationships are quantified with numbers. Numeracy is an important component of elementary mathematics education.

Perception is the way an individual recognizes, interprets and understands another person or thing.

Project-based Learning (PjBL) is curriculum and instruction that emphasizes in-depth inquiry driven by relevant, driving questions, student autonomy, opportunities for revision and reflection, and a public audience for the products of student projects. *Problem-based learning* (PbBL) is a subset of PjBL in which students try to solve a problem, emphasizing innovation and design-processes. Increasingly, teachers implement project-based and problem-based similarly or simultaneously, and the only distinction is whether student projects are explicitly solving a problem.

Replicability is a determination of whether a program, strategy, or practice can be repeated, duplicated or implemented similarly in other settings. Increasingly, proof of

replicability is a requirement of grantors sponsoring proof-of-concept projects and pilot implementation projects.

School-within-a-school programs are those that operate within a larger institution but with distinct student cohorts and typically with separate administration, budgets, faculty, and reporting. Academy programs may be implemented with these distinctions, or may be distinguished only by the participating student cohort.

Science is a process for answering questions based on observation and experimentation, or other means of identifying relationships (e.g., correlational, causal) between and among variables and outcomes. This term is also used to name the body of knowledge derived from such processes.

Stakeholders are the persons or organizations that have interests or concerns relevant to the implementation, operation, or outcomes of a program or project.

STEM is the acronym representing Science, Technology Engineering and Mathematics. It is sometimes also used to refer to education programs and more recently, to a wide variety of aggregated technical topics, strategies and opportunities.

STEM education and more explicitly, *integrative STEM education* are the educational efforts that emphasize the intentional, interdisciplinary integration of science, technology, engineering and mathematics curricula with each other (Sanders, 2009), and also with other traditional disciplines of social studies, reading and other language arts, world languages, health and physical education, and the visual and performing arts. A frequently cited definition of STEM education is attributed to Nancy Tsupros, Kohler, and Judith Hallinen (2009) in their

report on STEM education focus groups in Southwestern Pennsylvania although the report does not actually contain the popular and ubiquitous definition[2]:

> STEM is an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy.

Technology is any purposeful modification of the natural world. Technology is both a part of engineering and a product of engineering design processes, and therefore technology (tools or products) and engineering (processes) are often conflated. Technologies include such diverse products or tools as pencils, tissues, probeware, microscopes, computers and mobile devices, engines, vehicles, satellites, and their many components or subparts.

---

[2] See also NSTA WebNews http://www.nsta.org/publications/news/story.aspx?id=59305 . In a personal communication with Nancy Tsupros, she described how this definition of STEM was developed over a period of time between 2007 and 2009 and may actually have been taken from a variety of activities including the report from the STEM Study that was completed in southwestern PA in 2008, a presentation that focused on that study that was made at the PA Intermediate Unit 13 STEM Academy for Educators on August 6, 2009, and work with the STEM Network in southwestern PA, although most people credit the report I have cited.

CHAPTER 2 - REVIEW OF LITERATURE

This review of relevant research literature is focused on six topics: 1.) Components of elementary STEM programs; 2.) Diversity and equity in magnet and school-within-a-school programs; 3.) Evaluation of integrative STEM programs; 4.) Exploratory case study approaches to program implementation; 5.) Frameworks for evaluating programs from research on fidelity of implementation; and 6.) use of perception data in studying program implementations and adaptive processes.

Components of Elementary STEM Education Programs

Elementary science and math curricula are influenced by several national and state programs, policies, and metrics of accountability; and also influenced by concerns for international competitiveness. The Position Statement of the Board of Directors of the National Science Teachers Association (NSTA) on Elementary School Science (NSTA, 2002) emphasized the following key principles for elementary science programs:

- The elementary science program must provide opportunities for students to develop understandings and skills necessary to function productively as problem-solvers in a scientific and technological world.
- The learning environment for elementary science must foster positive attitudes towards self and society, as well as science.
- Teacher preparation and professional development must enable the teacher to implement science as a basic component of the elementary school curriculum.
- The school administrators must be advocates for elementary science.

- The instructional implementation and support system for elementary school science must include the combined efforts of all aspects of the community: parents, educators, businesses, and other organizations.
- Assessment must be an essential component of an elementary science program.
- Elementary school science instruction must reflect the application and implementation of educational research.

Emphasis on Inquiry-Based Instruction

Martin and Hand (2009) provide the following components of inquiry-based classrooms: active investigations; dialogical interactions; and collaborative work among students. Morrison (2011) cited the National Science Education Standards (National Research Council, 1996) and the benchmarks for science literacy (AAAS, 1993) emphasis on teachers involving students in authentic investigations of students' own questions, ideas, and understandings, and recognizes this as a constructivist practice supporting meaningful learning. Morrison also recognized the importance of students constructing their own understanding of real-world, relevant problems rather than "right-answer" verification, and the importance of overcoming many elementary teachers' limited understanding of science or their confidence as teachers of science subject matter and science pedagogy (Appleton, 2007; Weiss et al., 2003; Crawford, 2000).

Project-based learning. Project-based learning (PjBL) has been part of the school curriculum for nearly a century, and typically involves students in project design, including problem-solving investigations or other experiences that give students extended periods of time to work alone, or in teams, without extensive involvement of the teacher. The resulting products can be the primary means by which teachers assess students' understanding, and the utility of products to larger audiences can be a strong motivator for students (Egenrieder, 2010).

John Thomas (2000) highlighted five important criteria of project-based learning:

1. Project-based learning projects are central, not peripheral to the curriculum;
2. Project-based learning projects are focused on questions or problems that drive students to encounter and struggle with the central concepts and principles of a discipline;
3. Projects involve students in a constructivist investigation;
4. Projects are student-driven to some significant degree; and
5. Projects are realistic, not school-like.

PjBL has also been strongly associated with learning by doing (Blumenfeld et al., 1991) and science education, and has been encouraged in nearly all curriculum areas (Railsback, 2002) and promoted as an important component of interdisciplinary and trans-disciplinary teaching and learning (Drake, 2007). Projects typically result in products or outcomes that not only demonstrate understanding but may also benefit others. Educators rely on either scientific methods, engineering design processes, or both to guide students through PjBL learning activities (Egenrieder, 2010).

Problem-based learning. Problem-based learning (PbBL) is sometimes considered a subset of PjBL. PbBL is consistent with engineering design processes which most often begin with defining a problem and criteria and constraints, and then brainstorming solutions. Models or prototypes are developed, tested, evaluated, and redesigned and tested again. Whereas engineers historically shared their work with the patent office or their employer's patent clerk, engineering and problem-solving outcomes often now end with reporting and sharing outcomes (Egenrieder 2010), emphasizing communities of practice and knowledge management and expanding teams' intellectual capital (McMahon et al., 2004).

Across the K-20 curricula, both PbBL and PjBL teaching and learning strategies include characteristics of inquiry-based models, including the use of authentic content and assessment, a reduced or less didactic role for the teacher, more cooperative learning, reflective self-assessment, constructivism, the development of adult communication skills, community involvement, and cognitive, authentic uses of technology-based tools (Savery and Duffy, 1995).

Emphasis on Curriculum Connections and Integrative STEM

Integrative curriculum and cross-curricular connections are increasingly recognized as the most important features of STEM (Sanders, 2009; Tsupros et al, 2009). An intentional, rigorous integration often means that curriculum models rely on applied learning, involving the use of real data and computational thinking in decision-making, or community-focused project-based or problem-based learning. The resulting cross-curricular connections become both explicit and rigorous, addressing students' commonly asked question, "Why do we need to learn this?" and that innovation and deeper understanding happens at the intersections of established domains (Johansson, 2004). Rigorous integration also includes the assessment of cross-curricular connections, testing both the applied learning in a real-world context, and also assessing the theoretical understanding in a more traditional format (Pearson, et al., 2010).

Emphasis on Planning using a Backwards Design Model

Backwards-design planning begins with identifying intended or desired outcomes. Grant Wiggins and Jay McTighe (1998) introduced a backwards-planning strategy for educators called Understanding by Design (UBD) that has been widely adopted for professional practice among educators in developing, refining, planning, implementing and sharing lesson-based units of learning. Using UBD templates, teachers begin with identifying *Enduring Understandings*, align them with established or official objectives or standards of learning, and then identify conceptual

questions, assessment strategies and the sequence of learning activities for successful teaching for understanding or teaching for meaning. Later in an article on teacher professional practice Wiggins and McTighe (2006) provided the following relevant guidance for how UbD can be used by educators to validate teachers' professional practice:

> To improve professional practice, educators need sound principles about how learning works to guide their pedagogical decisions, actions, policies, and practices. Such principles as teaching for fluent and flexible transfer, incorporating big ideas that connect isolated facts, and providing user-friendly feedback make learning meaningful for students and teachers alike. Schools need a standard that enables them to decide, case by case, whether a teaching practice or professional development activity is truly professional...School leaders need to continually demand new learning and help staff clarify which practices advance, and which unwittingly impede, learning in their schools (page 26).

Emphasis on Magnet and School-Within-a-School Programs

Both magnet programs and school-within-a-school programs may focus on particular curricular areas such as science, art, technology, language immersion, and writing, or they may provide a particular approach to pedagogy for a specific learning style or level of achievement. The setting for this case study was a STEM magnet program within a larger elementary school setting, and the STEM program attracted students from other nearby elementary schools.

Magnet Programs

Magnet programs are usually designed to attract students from one or more general programs, from multiple school attendance areas, and sometimes across established school

district boundaries, based on aptitude for a specified curriculum, instructional approach, or demographic criteria. Self-selection or parent selection distinguishes magnet programs from other resource-based programs for students with special needs or students requiring extra supervision.

Magnet programs may be distinct schools or may exist as programs within a comprehensive school. The competitive atmosphere and branding of these schools is often intended to make these opportunities appealing to parents, students, and also some teachers and administrators. These programs often attract special partners, resources, and opportunities that may not be available to other students, thereby creating concerns for equity and diversity.

Diversity and equity of magnet programs. An exploration of the impact of magnet programs on diversity and equity reveals that magnet programs may sometimes reduce diversity and increase achievement gaps, but at other times they may be constructed using criteria to have the most equitable outcomes. Goldring and Smrekar (2000) reviewed available research on magnet schools and their impact on reducing racial segregation and shared findings from a three-year study of magnet schools in two urban districts. Surveys of parents and teachers on diversity indicated that both groups generally believed the goal of racial integration was worth the cost of busing associated with the development of magnet schools.

An alternative program in Arlington, Virginia, was developed for secondary students who purportedly would benefit from an environment in which independent thinking was exercised and encouraged over uniformity and compliance. The program was initially focused on project-based learning, student autonomy, and increasing flexibility with responsibility, and was under-enrolled. Over time, students began performing higher than other schools in many metrics, and applicants eventually were more than five times the number of available opportunities. Widely

supported efforts to align the student population with the demographics of the larger school division were challenged by a parent. Anticipating a court battle, the school division responded by creating a double-blind lottery providing equitable opportunities for a specified number of students from each elementary school attendance zone in the county. Nevertheless, applicants and attendees from Caucasian families remained disproportionately represented and greatly outnumbered others, even in attendance zones that were minority majority areas (Horwitt, 2004).

Performance and outcomes of magnet programs. Although student outcomes create interest and support for magnet programs, the outcomes may not be due to the unique features of the programs but instead due to the students the programs attract. In a study of magnet programs for Prince George's County Public Schools in Maryland conducted by Adcock and Phillips (2000), the researchers found:

1. overall, elementary students in magnet programs perform better than non-magnet students;
2. this outcome is largely due to the fact that more able students are self-selected for the magnet program; and
3. when student ability is accounted for in the research design, students in magnet school programs do not perform as well as students in non-magnet programs.

The authors confirmed the latter finding by demonstrating that talented and gifted students in magnet programs did not perform as well as talented and gifted students in non-magnet schools.

School-Within-a-School Programs

The term, *school-within-a-school* can be used to describe a variety of special programs, academies, magnet or honors programs, special needs programs, or curriculum-focused entities

that might exist in a larger school and school building infrastructure. The purposes of these programs vary accordingly, but generally promote a smaller environment for students with a shared specific need or interest, or a particular aptitude purportedly advantaged by concentrating students that share such similarities. A frequently cited description of school-within-a-school is from Mary Anne Raywid (1995):

> A school-within-a-school is a separate and autonomous unit formally authorized by the board of education and/or superintendent. It plans and runs its own program, has its own staff and students, and receives its own separate budget. Although it must negotiate the use of common space (gym, auditorium, playground) with a host school, and defer to the building principal on matters of safety and building operation, the school-within-a-school reports to a district official instead of being responsible to the building principal. Both its teachers and students are affiliated with the school-within-a-school as a matter of choice (p. 21).

The need for increased school capacity, rising school construction costs, and a concurrent increase in the demand for smaller-school environments has provided for a growing body of research on secondary school-within-a-school programs. However, little research is available on elementary school-within-a-school programs. Elementary schools are typically much smaller than secondary schools, and in particular the large urban schools that frequently identify "Houses" and "Communities" or other academically focused academies, charters, or school-within-a-school programs that vary in autonomy from the larger school.

Sarah Dewees (2007) of the U.S. Department of Education authored a report revealing that among other efforts to create smaller education environments within larger schools, the school-within-a-school model reflects the greatest autonomy and separateness, with separate

curricula and its own teachers; and the degree to which a school-within-a-school replicates a small school more closely, the more likely it will have the same positive outcomes. These outcomes include positive impacts on students, improved attendance and behavior, greater school satisfaction, greater self-esteem, and improved teacher morale and community. Dewees cites McCabe and Oxley (1989), McMullan, Sipe, and Wolfe (1994) and Raywid, (1996b) in identifying the most critical factors: commitment to full implementation; a complete separation of administration; a separate identity; and staff and student support.

Dewees also identified disadvantages of school-within-a-school programs from earlier research: Schools-within-a-school can sometimes create divisiveness when structures alter pre-existing relationships, when allegiances to the smaller program creates rivalries with the larger school (Muncey & McQuillan, 1991; Raywid, 1996b), inequitable tracking if only one population is recruited or accepted for a smaller program (Raywid, 1996a; McMullan et al., 1994), and perceptions of the conflicted role of the principal.

An analysis of student and teacher perceptions in secondary school-within-a-school Gifted and Talented Programs (Matthews & Kitchen, 2007) found that students and teachers in all programs studied expressed strong satisfaction with the academic programs, but all student and teacher groups also expressed concerns about the relationship between the special programs and the larger schools in which they were contained. Mathews and Kitchens also recognized the concern for perceptions of equity and diversity in their study of three Gifted and Talented Programs in different secondary schools. Mathews and Kitchens recognized the challenges of providing exceptional learners with a differentiated content and pace while coexisting without antagonism or perceptions of elitism:

> A school-within-a-school approach is one way to provide both specialized programming and also opportunities for exceptionally capable learners to interact with the general school population in ways that can be mutually enriching. Our results confirm earlier findings that when high-ability programs are housed in larger schools, educators need to pay attention to the relationships that are so established and work proactively toward (a) transparency and communication; (b) flexible access to Gifted and Talented Programs; (c) equitable access to equipment, facilities and field trips; (d) awareness of misconceptions and stereotypes; and (e) recognition of diverse pathways to excellence and achievement. (p.14)

Matthews and Kitchens also cite earlier studies of secondary school-within-a-school Gifted and Talented Programs that suggest resentment of congregated programs is inevitable.

Exploratory Case Study Research

Fitzpatrick, Sanders, and Worthen (2004) recognized case study, and in particular qualitative approaches to case study, as one of the most frequently used designs in evaluation (p. 307). These authors reference two seminal influences on case study design: Yin (1994) approached case study from a mixed qualitative and quantitative approach to build knowledge or theory; and Stake (2005) relied on a qualitative approach to understand an individual case. Fitpatrick et al. also acknowledged that individual case studies while primarily descriptive can also useful in examining outcomes:

> Consider case studies you have read that illustrated how a program or curriculum was implemented—the factors that influenced program adoption, early stages of implementation, problems encountered, frustrations endured, surprises experienced, adaptations that were made, successes achieved, staff and participant reaction,

> environmental influences and the like. Such studies give the reader a real understanding of the program, and the many different ways it might be viewed. The voices and perspectives of many different stakeholders involved with the program are heard. Explanatory case studies may explore outcomes describing the links between program actions and outcomes, examining differences among cases to help the reader better understand how outcomes are achieved. Case studies can also be useful in exploring needs of clients or students for an organizational needs assessment. Exploratory cases may be conducted to identify the needs of students, clients or the community or to explore problems in implementing a program or achieving outcomes. Exploratory case studies are merely less defined and more open-ended than descriptive and explanatory case studies. (p. 308)

This research project is considered to be an exploratory case study because it relied on perceptions from many stakeholders, who differed in their roles, goals, motivations, and interpretations of past events that were largely undocumented. Matthew Griffis (2014) explains that exploratory case studies often appear less structured (Stake, 2006) and are intended to unfold as the researcher encounters and explores the object of study, usually without hypotheses and supportive research to inform propositions or hypotheses (Yin, 2003).

Recognizing and emphasizing the flexibility and variability in exploratory case study designs and methods, three features identified by Fitzpatrick et al. (2004) are useful in characterizing all case studies:

1. a focus on a selected case or cases;
2. a desire for in-depth understanding; and

3. collecting data in many different ways, but focusing on qualitative methods such as observations, interviews, and the study of existing documents.

Patton (2002) describes how case studies can be layered, with a single case study employing multiple methods, recognizing that qualitative researchers may disagree on whether case studies are a method, or an approach relying on several methods (p.297). Patton describes well-constructed case studies as both holistic and context-sensitive, and recognizes cases as units of analysis that are usually determined during the design stage and become the basis for purposeful, qualitative sampling. However, he also allows that cases or units of analysis may instead emerge *from* the data collection (p. 447), relevant to this. Acknowledging that duality, Patton explains the processes and purpose of the case study:

> The case study should take the reader into the case situation — a person's life, a group's life, or a program's life. Each case study in a report stands alone, allowing the reader to understand the case as a unique, holistic entity. At a later point in analysis, it is possible to compare and contrast, but initially each case must be represented and understood as an idiosyncratic manifestation of the phenomenon of interest (p. 450).

Case studies also provide for analysis of the professional practices and adaptive processes that influence teacher's perceptions of change and the need for change. Shira Peterson (2013) describes the importance of readiness for change:

> The reason is that the concept of readiness to change…helps us see that implementation is a matter of not only "making things happen" but also of understanding what is happening and why and of engaging in collaborative processes to "meet people where they are".

Fidelity of Implementation

The methods for this case study, described further in Chapter 3, are exploratory and qualitative. This study is not designed to provide a measure of fidelity of implementation, not because of the qualitative nature of the data collection, but due to the lack of documentation in 2002 of the initial program design. However, fidelity of design and implementation provided both a context and complementary framework that will enable me to use this exploratory case study to make recommendations for implementation and evaluation of elementary STEM programs in Chapter 5.

Century, Rudnick, and Freeman (2010) offer a useful definition of Fidelity of Implementation (FOI) that can be applied to a wide variety of education interventions, "*The extent to which an enacted program is consistent with the intended program model,*" and acknowledge alignment with others' operational definitions and conceptual themes, although not all were developed in the context of education.

FOI is a relatively new and developing area of education research (Century, Freeman, & Rudnick, 2008), and it is sometimes considered in program evaluation and useful in revealing the role of teachers in program evaluation. The University of Chicago Center for Elementary Mathematics Education (CEMSE) developed a framework for measuring and accumulating knowledge about the FOI of science instructional materials (Century et al., 2008, 2010). The CEMSE framework is part of a larger model of school improvement that focuses on instructional materials as an important intervention leading to improved student outcomes. Century et al. (2010) acknowledge context and conditions as important considerations:

> ...programs are rarely, if ever implemented as intended. Implementation is shaped by various contexts and conditions that reside outside of the materials themselves (e. g. teacher content knowledge, teacher professional development experience, student

> demographics). Thus, in order to draw truly meaningful conclusions about instructional materials programs' effectiveness, it is essential to determine the extent and nature of their use – the fidelity of implementation (p. 2).

FOI is based on the work of several earlier researchers. Laurie Lewis and David Seibold (1993) identified a relevant, influential framework of three constructs relevant to new STEM program implementations at both the individual and organizational level influencing adoption of innovations: socialization, social influence, and structural processes. They later established a complementary framework of three dimensions of interaction-based coping responses - favorableness, decidedness, and focus on self vs other. They showed how these dimensions were influenced by participants' attitudes, concerns for performance, normative influence (conformity), and uncertainty, and also their perceptions of the context of change (Lewis and Seibold, 1996).

Science learning cycles have been studied in the context of FOI. Bodzin, Cates, and Price (2003) conducted a two-year case study of the implementation of a 4E learning cycle (Engage, Explore, Explain, Evaluate). In the National Science Foundation study, Bodzin, et al. emphasized the importance of acknowledging demands on teachers in considering fidelity of implementation:

> ...the designers of intended curricula need to be aware of the time demands on teachers in the field. Implemented curricula –by their very nature—must conform to the local pressures and capabilities of the teachers who implement them. Thus, if developers wish to market strong science products based on a learning cycle model and incorporating a heavy focus on scientific inquiry, they need to look for ways to address time and training constraints those teachers encounter. This likely means a combination of shorter activities

> and greater flexibility, as well as wrapping training in both product use and scientific inquiry around the product. Addressing these teacher needs and equipping teachers to succeed should, however, increase implementation fidelity and enhance the extent to which products meet their developers' goals (p. 12).

Maria Ruiz-Primo (2006) identified nine characteristics influencing fidelity of implementation. All nine characteristics could influence the participants' burdens, equitable distribution of resources, readiness for change, or documentation of the implementation and adaptive processes:

- *Complexity of the program*, including the difficulty of understanding what makes the program work - the more complex the treatment, the lower the fidelity;
- *Time required to implement the program* - the longer a program takes to mature the less likely that is implemented with fidelity;
- *Materials and resources required* - a program that requires additional materials and resources is likely to be implemented with poorer fidelity than planned;
- *Number of providers* - programs requiring more than one provider may be implemented with less fidelity;
- *Available implementation manuals* - manuals or guides enhance fidelity, unless they are of poor quality, overwhelmingly specific, or alternatively, too generic;
- *Training* - implementers must understand exactly makes a program successful;
- *Sites and context* - variations from the site and context envisioned by the developer influence fidelity;
- *Staff experience or commitment* - experience may have varied effects on fidelity, and reduced commitment reduces fidelity; and

- *Theoretical agreement* - alignment with other programs and guiding practices influences fidelity.

Ruiz-Primo (2006) also provided a summary of components considered in past studies of fidelity of implementation, mostly focused on teachers' behaviors, and concern for how few studies measured student outcomes. Ruiz-Primo specifically features the eight categories in science education used by Schneider, Krajick, and Blumenfeld (2005) to analyze the instructional events:

- accuracy of the scientific ideas;
- completeness of the scientific ideas;
- number of or time for opportunities for student learning;
- similarity with intended lesson;
- level of adaptation;
- level of instructional support to students;
- appropriateness of instructional support; and
- sources used for instructional support.

Use of Perceptions Data

This case study explored stakeholder perceptions concerning the design/development and implementation of a STEM academy. Several frequently cited researchers support the importance of teachers' perceptions and tools for identifying concerns through perception. Patton (2002) recognized how interviewees are operating within perceptions and argues the importance of observation-based fieldwork for understanding those perceptions (p. 264).

Researchers often examine the role and importance of teachers' perceptions, and concerns and feelings in successful implementation of change. Ghaith and Yaghi (1997)

explored relationships among experience, teacher efficacy, and attitudes toward the implementation of instructional innovation. These researchers found a negative correlation between teacher experience and their attitudes toward implementation of new innovations, suggesting that veteran teachers were resistant to new instructional practices. They also found a positive correlation between personal teaching efficacy and attitudes towards new innovations, suggesting an explanation for how teachers with similar experience in similar environments may have different perceptions and attitudes to new programs.

Hord, Rutherford, Healing-Austin and Hall (1987) developed the widely cited Concerns-Based Adoption Model (CBAM) for implementing change, which they used in conjunction with analysis of teacher concerns to establish six conclusions:

1. change is a process rather than an event;
2. change is accomplished by individuals, and influences them;
3. change is a highly personal experience, and paying attention to individual's responses enhances outcomes;
4. change involves developmental growth, and individuals express or demonstrate their growth through both feelings and skills, evolving with experience with the change;
5. change is best understood by teachers in terms of what it will mean to them and their practice, and what changes in their (or their students') beliefs and behaviors are necessary; and
6. facilitators should focus on individuals, innovations and context, as even small innovations have widespread effects.

The Stages of Concern (SOC) of the CBAM model is a tool used to identify the concerns of teachers during a program or process implementation, rather than mature programs. The SOC reveals teachers' feelings and perceptions about the change during implementation, and how they

can be “experienced”, observed and documented (Hall & Hord, 2006). The SOC can be used to match available resources with teachers’ needs, and Hall and Hord also establish the need for aligning interventions with the concerns of those influenced, and thereby support how teachers’ perceptions and level of concern can identify opportunities for program facilitators to intervene in a way that supports implementation. The CBAM and SOC are widely regarded as very useful for studying programs that are still in the early stages of their evolution, and could be particularly helpful in understanding adaptive processes during changes in program leadership.

More recently, Ornstein and Hunkins (2004) reinforced that all real change originates with individual participants, whose perceptions and concerns are most important. First individuals’ perceptions evolve, and through their changed behavior, individuals change. Second, change occurs when individuals’ concerns are recognized and acknowledged. Finally, all change is personal and for individuals to accept change they must have ownership of both the concern and the processes of the change.

CHAPTER 3 - METHODS

Overview

This study was conducted as a qualitative, exploratory case-study analysis of how perceptions and resource allocation relate to program implementation and adaptive processes. The analysis focused on how program design, implementation, and outcomes are perceived by relevant stakeholders. In this case study of the Ailanthus STEM Academy implementation, I analyzed data I collected during an evaluation of the Academy I conducted in September and October 2012. In that capacity, I asked questions of school and school district personnel, reviewed school and school division information from local and state education web sites, discussed the scope and availability of curriculum with school division administrators, observed classrooms during school visits, surveyed parents, and solicited a wide variety of perspectives during in-person and telephone interviews. I analyzed data in the context of two research questions.

Research Questions

The case study strategies and analysis were guided by the following two research questions previously stated in Chapter 1:

RQ1. What distinguishing features of the creation, implementation and adaptation processes of the Ailanthus STEM Academy program were perceived as salient by interview participants?

RQ2. How did perceptions of the program differ among interview participants, and how did perceptions change over time?

Data Sources and Collection

To address the research questions listed above, I relied primarily on transcripts of interviews with key personnel, conducted by telephone and face-to-face. Data from interviews were informed by classroom visits among all three grade levels of the STEM Academy, but also among non-Academy Ailanthus classrooms in grades 3-5. I also visited Academy feeder school classrooms including both gifted cluster and regular classrooms in grades 2-5, including classrooms of teachers that have the opportunity to identify second grade students as candidates for the Ailanthus Academy the following year. Observations of classrooms in grades 3-5 provided comparisons of feeder school classrooms with Ailanthus STEM Academy classrooms, and non-Academy classrooms at Ailanthus Elementary School.

I also conducted a survey of parents at the request of the principal on behalf of Ailanthus Elementary parent and teacher association (PTA) representatives. The PTA is a superset of the Ailanthus Academy parents and teachers that also includes parents of Ailanthus students not enrolled in the Academy program. Through the online questionnaire I collected open-ended responses to questions reflecting the research questions listed above.

My approach to data collection for this case study is an adaptation of an integrative design described by Greene, Caracelli and Graham (1989), in which methods and paradigms are mixed to increase understanding, depth and richness of results, mostly though not necessarily in a linear sequence. Key personnel were identified, recommended, and contacted by the Piedmont Assistant Superintendent of Instruction and the current Ailanthus Elementary principal. A list of questions for interviews of key personnel was approved by the Assistant Superintendent of Instruction, who was directed by the Piedmont School Board to guide my research.

As prescribed by Fitzpatrick et al. (2004), I used each data source for this case study to inform the next strategy of data collection and interpretation, allowing me to ask more refined or expansive questions. For example, an initial interview with the current Science Curriculum Supervisor (Dr. Piper Geary) informed and refined my interview questions with the Hands-On Math and Science (HOMS) trainer and former Science Specialist (Duana Clinton); and both informed later interviews with administrators and teachers, as well as my focus during classroom observations. Classroom observations informed teacher interviews. All explorations allowed for more engaging and nuanced dialogue during interviews rather than a more structured reading of interview questions.

When the parents asked the principal to include their perceptions, I developed an online questionnaire based on insights and questions gained from previous data analysis. (The questionnaire appears in Figure 2. *Parent Survey Online Questionnaire.*) My approach is described by Fitzpatrick (p. 320) as an *iterative* or *spiral* design.

Interviews of Key Personnel

Transcripts or notes from telephone and face-to-face interviews with key personnel were the primary data source for this study. Interviews lasted for as little as 25 minutes with former principal Ms. Huddleston and Dr. Moore, to over 90 minutes with HOMS trainer Duana Clinton and the group of Academy teachers. I recorded interviews with a digital voice recorder, and recordings were transcribed to individual documents with Microsoft Word. Some transcripts were created from recordings using Dragon Software, but the automated transcription process was insufficient for overlapping conversation, mixed dialects, multiple interviewees, and difficult spellings. Instead, recordings were transcribed phrase by phrase. Using a random name generator, I assigned pseudonyms for each interview participant before aggregating the

documents. The transcripts were reviewed to ensure that any name appeared on the list of key personnel under the appropriate pseudonym. The interview with 4th grade Gifted Science teacher Amy Harley, and Science Curriculum Supervisor Dr. Piper Geary were not recorded, although notes from the discussion with Piper Geary were included in the corpus of data for analysis. Transcripts and notes from interviews of key personnel are included in Appendices D through L.

Key personnel selection for interviews. Participants were selected for interviews or approved by the Assistant Superintendent for Instruction of Piedmont Public Schools. Interviewees included current and past program administrators, current and past curriculum supervisors and specialists, Academy teachers, teachers in the non-Academy program at Ailanthus Elementary, and teachers and administrators in Academy feeder schools. A total of 14 personnel were interviewed, including 11 face-to-face and 3 by telephone. Their pseudonyms and roles are included in Table 1.

I conducted telephone interviews using an informal dialogue with participants based on the guiding questions developed by me in collaboration with the Assistant Superintendent for Instruction. This strategy was based on the standardized open-ended interview approach described by Patton (2002, 344-347).

(continued on next page)

Table 1. Key personnel interviewed (listed in alphabetical order).

Teacher	School – Role (Grade)
Holly Christensen	Ailanthus Academy – ELA/Social Studies (4th)
Duana Clinton	Former Chrysalis Science Specialist, HOMS Instructor
Madison Croft	Dogwood - Gifted Resources
Kenny Dennell	Piedmont Asst. Superintendent Instruction
Ginger Fishman	Ailanthus - Principal
Dr. Piper Geary	Piedmont - Science Supervisor
Amy Harley	Ailanthus - Gifted Science (4th)
Loretta Huddleston	Ailanthus - Retired Principal
Benigna Kaia	Ailanthus Academy – Math/Science (3rd)
Minerva Kay	Ailanthus – Math Coach
Dr. Carolina Moore	Piedmont Gifted Supervisor
Dr. Janette Oakley	Piedmont Gifted Specialist
Cheyenne Ruskin	Ailanthus Academy – Math/Science (5th)
Nevil Tyson	Ailanthus Asst. Principal
Meryl Winfield	Ailanthus Academy – Math/Science (4th)

Four Academy teachers asked to be interviewed together, and they were joined by the Ailanthus Elementary Math Coach. At roughly two-thirds of the way through the interview – more than an hour of conversation – the teachers revealed that I was described to them by school-based administrators as a curriculum auditor. They shared that they had been anxious about discussing the lack of documentation of their Academy program curricula, which is

described in detail in Chapter 4. I explained my role was to write an evaluation of what about the Academy was distinguishable, what might be replicable, and how replication could be done.

Interview questions. Depending on the role of the person(s) interviewed, I used a conversational approach that evolved with the participants' responses to a subset of, or variations of interview questions approved by the Assistant Superintendent of Instruction (see Figure 1).

Interview questions for discussions with key personnel.

1. What attracts students and parents to the Ailanthus Academy?
2. What distinguishes the Academy program from the traditional Ailanthus Academy program? From other Piedmont elementary schools?
3. What is unique or special about the Ailanthus Academy curriculum?
4. What distinguishes the Academy curriculum from the traditional Piedmont elementary curriculum?
5. How was the Ailanthus Academy program and curriculum developed?
6. How has the Ailanthus Academy program and curriculum changed since it began?
7. What ongoing work continues to modify and evolve the program?
8. How has the curriculum in other Ailanthus Elementary classes changed since the academy began?
9. How has the curriculum in math and science classes in Ailanthus Academy feeder schools changed since the academy began?
10. How does the curriculum in Ailanthus Academy compare to the math and science curriculum throughout the school division?
11. What role did you play in designing, developing or modifying the Ailanthus Academy curriculum?
12. How is the Ailanthus Academy perceived by others in Ailanthus Elementary?
13. What challenges does the Ailanthus Academy program face in the next five years?

14. What components, if any, of the Ailanthus Academy should be replicated elsewhere in Piedmont?

15. What components, if any, of the Ailanthus Academy should be replicated elsewhere in the state?

Figure 1. Interview questions for discussions with key personnel.

The following excerpt of an interview with HOMS trainer and Science Specialist Duana Clinton is an example of how these questions were part of a conversational dialog:

Interviewer: What do you know about ongoing work that may have influenced the evolution of the academy? In other words, do you know if the teachers, who largely remain the same, have continued to pursue new initiatives or new professional development, or have they remained steadfast in some of the ideas that they were very proud of?

Duana Clinton: I don't know exactly where they've gone. I know that they were involved in a lot of curriculum development, and that Janette was overseeing the curriculum design. All of the school system follows Understanding by Design so that was the model that was being used in the development of the curriculum. I know personally they were feeling very strong about giving kids authentic experiences and that's where the community-based part was really important to them, and ongoing science. So they would go in repeated times to the State Arboretum to see the same thing over time and make sure that they could record that information. I know notebooking was a big piece of the work that they were doing, too. But I haven't really been involved to see what's going on right now.

Interviewer: So in addition, you mentioned notebooking, we talked about different types of experimentation and there was one other thing that you mentioned were significant components, Understanding by Design and...

Duana: Project-based, sometimes problem based, and then the real emphasis in real data, trying to think and act like scientists and developing those habits of mind. We actually used those phrases when we were first designing their work, you know, what were the habits of mind in mathematicians and scientists.

Interviewer: Many of the things you see reflected more commonly today, you were advancing those back then?

Duana: And those weren't as prevalent at that time. And in fact, an emphasis on Science wasn't very prevalent at that time. That was still when that might have been the stepchild in elementary.

Recruitment Documentation and Consent Forms. In coordination with the Virginia Tech Institutional Review Board (IRB), recruitment documentation and consent forms for interviews were not solicited for this research project. Participants for these interviews, whether conducted in person or by phone, were identified and contacted by the school division personnel. The Assistant Superintendent for Instruction for the Piedmont school division identified past and present school principals, past and present curriculum specialists, and past and present administrators of relevant special programs (e.g., gifted services, magnet programs, pupil services). No consent form was required or provided to participants for using these previously collected data for this case study analysis. Documentation relevant to the IRB is included in Appendix 13.

Classroom Observations

I observed eight Ailanthus Elementary classrooms after interviews with program designers were completed, but before interviews of teachers and school administrators. A list of classroom observations is included in Table 2. The observations were arranged and scheduled by Principal Fishman and included STEM Academy 3rd, 4th and 5th grade math and science teachers and their classes, STEM Academy English language arts and social studies teachers and their classes, and then the same grades in non-Academy Ailanthus math and science classes. These observations lasted between 20 and 45 minutes. The observations were unstructured, were not uniform in time allotted, and did not follow any established protocol. The purpose of the observations was to inform the subsequent interviews of key personnel, which included some of the teachers observed.

Ms. Fishman gave most teachers notice of my observations on the day of my classroom visit, although some non-Academy teachers were not given any advance notice except for my introduction by Assistant Principal Tyson as I entered the room while classes were underway. Because they were unstructured, not aligned with an observation protocol or rubric, and not repeated systematically, these observations cannot be considered a stand-alone data source. However, these observations were very helpful in guiding discussion during the interviews that followed.

Observations at Dogwood Elementary, an Academy feeder school, included grades 1-5, with heterogeneous classes (students identified as Gifted mixed with other students) with teachers who taught all subjects. The second grade teacher at Dogwood Elementary was team-teaching with the gifted resource teacher. The Dogwood principal forgot I was visiting - a commitment she made directly with the Assistant Superintendent for Instruction - and all

observations were unexpected by the teachers. The gifted resource teacher, Ms. Croft, also provided an unscheduled interview.

A list of all Piedmont personnel described in this case study, including the notes and transcripts of interviews, is included in Appendix A.

Table 2. Classroom observations (listed in alphabetical order).

Teacher	School	Curriculum
Marylou Carlisle	Ailanthus	Math/Science /Social Studies (5th)
Roxanne Chamberlain	Ailanthus	Math/Science /Social Studies (3rd)
Holly Christensen	Ailanthus Academy	ELA/Social Studies (4th)
Madison Croft	Dogwood	Gifted Resources
Amy Harley	Ailanthus	Gifted Science (4th)
Benigna Kaia	Ailanthus Academy	Math/Science (3rd)
Minerva Kay	Ailanthus	Math Coach
Cheyenne Ruskin	Ailanthus Academy	Math/Science (5th)
Krystal Saunders	Dogwood	all subjects (1st)
Cameron Weber	Dogwood	all subjects (4th)
Meryl Winfield	Ailanthus Academy	Math/Science (4th)
Ruth Woodhams	Dogwood	all subjects (2nd)

State-Level, District-Level, and School-Level Comparisons

Ailanthus STEM Academy exam data and demographic data cannot be compared to similar data within Piedmont Public Schools, or with STEM or math and science-focused programs elsewhere in the state as available. Ailanthus Elementary School data do not distinguish or disaggregate Academy student demographic data or student scores from non-Academy students. These data are not formally documented at Ailanthus Elementary School and

it would necessary to assemble these data on a student-by-student basis, and after receiving permission to do so. This is also true of the other six feeder schools, as Academy student scores are reported to the students' schools of enrollment rather than their school of attendance. These student-specific data were not available to me. Moreover, state reports do not distinguish the Ailanthus STEM Academy from Ailanthus Elementary School or as an identifiable identity (school or institution) for purposes of state reporting.

Parent survey

The October 2012 PTA meeting participants expressed a strong interest in participating in the 2012 evaluation of the Ailanthus Academy. Focus group discussions were not feasible or desired by administrators. An online questionnaire was created instead (see Figure 2). No identifiable information (e.g., name, address, phone, email, or IP address) of respondents was collected.

Parent survey participation. Invitations to participate in the survey were sent to parents by an email system (*Piedmont Connect*) capable of reaching 772 members on the Ailanthus listserv. The breakout of parent representation in the survey responses is summarized in Table 3. Parent Survey respondents represented parents of Ailanthus Academy students, parents of Ailanthus Academy students from other elementary schools, and parents of Ailanthus Elementary students not enrolled in the Academy. PTA members and survey participants could represent more than one category, and some provided additional details of their roles as school volunteers. There were 103 respondents, with 75 STEM Academy parents, of which 40 were feeder school (<u>not</u> Ailanthus Elementary) parents. An additional 28 respondents identified themselves Ailanthus Elementary parents that were not Academy parents.

Table 3. Parent Survey Respondents

	Ailanthus Elementary Parents	**Parents from Other Elementary Schools**
Total Participating	63	40
STEM Academy Parents	35	40
PTA Member	49	12
Classroom Volunteer	30	8
Community Partner	4	0
Fundraiser	6	1

All of the survey respondents from other schools were parents of Academy students, but more than half of the Ailanthus Elementary parent respondents (35 of 63) had a student in the Academy. Some parents were also teachers or teacher assistants at the school.

Surprisingly, several Ailanthus Elementary parents reported they were not aware of the Academy program within the school until they received the Piedmont Connect email message advertising the online questionnaire for this evaluation. Principal Ginger Fishman suggested these parents probably represented new parents of K-2 students not yet eligible for the Academy.

Disaggregation of parent survey data. The open-ended format of the questionnaire items and the overlapping identifiers of respondents do not facilitate correlations, as there was no way to disaggregate some parent respondents that have multiple subgroup identifiers.

Ailanthus Elementary Parent Questionnaire - STEM Academy

The Ailanthus STEM Academy is being reviewed by an outside evaluator for identifying which components of the program and curriculum, if any, should be replicated elsewhere in Piedmont Public Schools (PPS). This questionnaire (www.surveymonkey.com/s/XXXXX) provides an opportunity for Ailanthus Elementary parents to share perspectives and opinions. This questionnaire may be completed in as little as 7 minutes, but there is no time limit except that imposed by your Internet service provider.

Notice: Only one response to this questionnaire is allowed for each computer used. IP addresses are not included in survey results.

An asterisk (*) indicates a response is required for the question.

1. Briefly describe your relationship to Ailanthus Elementary or the Math and Science Academy. (Check all that apply. Please include all of your roles, and especially any role that influences the curriculum.)
   - Ailanthus Elementary parent
   - Ailanthus STEM Academy parent
   - PTA member
   - Classroom volunteer
   - Community partner for school activities
   - Fundraiser
   - Other (please specify)

2. What attracts students and parents to the Ailanthus Academy? (If you applied to the STEM Academy, please include your perceptions of that process.)

3. Are you pleased with the curriculum in your child's classes? (Is it increasingly rigorous and engaging?)

4. What distinguishes the curriculum in the Ailanthus STEM Academy classes from other classes in Ailanthus Elementary and the Academy's feeder schools?

5. How is the Ailanthus STEM Academy perceived by others (e.g., students, parents) in Ailanthus Elementary and the other feeder schools?

6. What components of the Ailanthus Academy, if any, should be replicated elsewhere in PPS? (elsewhere in the state?)

7. Other Comments (optional)

Figure 2. Parent Survey Online Questionnaire.

Data Analysis

Exploratory Case Study

I explored the perspectives of a range of stakeholders to initially identify whether any components of a STEM academy could be considered for replication elsewhere in a school system. I discovered a complex collection of concerns and expectations, with differences in perceptions based on personal and professional connections to the academy.

While case studies are investigations of phenomena with multiple sources of evidence within real life contexts (Yin, 1994), exploratory case studies build understandings throughout the collection and analysis of data, and throughout the writing and editing processes also. Exploratory case study models do not typically begin with a proposition or hypothesis (Griffs, 2014; Stake, 2005; Yin, 2003). Exploratory models are useful in pilot project implementations or other areas were previous research is not abundant (Yin, 2003). In answering both research questions, interviews were informed by earlier interviews, as well as other observations and information discovered. Transcripts of these interviews were disaggregated and recombined by topic or stakeholder groups, and recombined further during the writing and editing process.

Interview transcripts. Interview transcript data, informed by classroom observations and supplemented by parent survey data, were used to inform each of the research questions. Information from the transcripts was aggregated and disaggregated to develop a narrative relevant to each research question. Direct quotes of key personnel are used throughout the reporting of findings to reveal perceptions in participants' own words. Full transcripts of interviews of key personnel are included in Appendices D through L.

In answering Research Question 1, interview transcripts were analyzed to identify the distinguishing characteristics of the creation, implementation adaptation processes. Interviews

from the HOMS trainer, Duana Clinton, and the current science specialist, Dr. Piper Geary provided the foundations for structuring the answer, generally following the 15 interview questions presented earlier in this Chapter. Analysis of the interview transcripts of others provided additional details or refined understandings.

In answering Research Question 2, I analyzed the different perceptions from interview transcripts of groups of key personnel. Key personnel included science curriculum specialists, teachers, past and present school-based administrators, the Academy teachers, central office gifted and talented program supervisors, and teachers not part of the Academy but directly or indirectly affected by it. I focused on five areas:

1. The role of central office staff from early curriculum design;
2. The documentation of the Ailanthus STEM Academy curricula;
3. Opportunities for replicating the Ailanthus Academy curricula throughout Piedmont Public Schools;
4. Concerns for protecting the integrity of the Academy; and
5. Issues of diversity and equity in the creation and development of Academy.

Writing Processes as Analysis

The exploratory case study process was organic, and as the findings emerged, it became increasingly important to tell a comprehensive story rather than provide a list of individual findings. Organizing and reorganizing important discoveries was a regular part of the writing process. Interviews were transcribed from digital recordings and often revealed incomplete sentences, incomplete thoughts, and even misstatements. The processes for reviewing and organizing these transcriptions often required additional research and in some cases follow-up conversations. Key themes of access, elitism, equity, diversity, and conflict often overlapped.

Differing perceptions among key stakeholders required further reorganization and sometimes these reorganizations required new transitions and bridges between themes and perspectives that also required analysis and confirmation from the transcript data. It was often particularly difficult to separate the important distinguishing components of the Academy from the discussion of the differences in perceptions of those components. In not only the first draft but with each succeeding draft, the re-alignment of stakeholders' perceptions and key themes led to new headings, subheadings, and new transitions. These realignments further influenced the discussion, recommendations, and suggestions for further research in Chapter 5. The writing processes for the discussion and recommendations in Chapter 5 sometimes revealed assertions that required supporting analysis in Chapter 4 to be more explicit, or to refine the understandings, based on the available data.

Eliminating Research Question 3. A third research question was originally proposed: "RQ3. What perceptions were reported by teachers, administrators and other stakeholders as influential in the implementation of the Ailanthus STEM Academy?" In answering Research Question 3, I analyzed the interview transcripts for factors that influenced the perceptions of teachers, administrators and other stakeholders. I organized those factors in a manner that was thoroughly reiterative of how I answered the other two research questions:

RQ1. What distinguishing features of the creation, implementation and adaptation processes of the Ailanthus STEM Academy program were perceived as salient by interview participants?

RQ2. How did perceptions of the program differ among interview participants, and how did perceptions change over time?

The first two questions turned out to be very robust, and distinguishing how perceptions influenced implementation in a third context did not add a new dimension to the findings presented in the discussion of the first two questions. In the final phases of preparing Chapter 4, I integrated the findings relevant to the third research question into the findings for the first two questions, and improved the clarity of both.

Standpoint of the Researcher

The purpose of this section is to provide my standpoint as a STEM education researcher. Summarizing feminist standpoint theory research, Jessica Sprague-Jones and Joey Sprague provided the following perspective, which is a useful context for considering my standpoint as a researcher:

> A standpoint is not how people in a particular social location think—in fact, it cannot be because not all people in a particular location think alike... Rather, a standpoint is a place from which to begin an inquiry. Working from the standpoint of a particular social group entails grounding inquiry in their experiences and centering on their material interests (Sprague-Jones & Sprague, 2011).

I am employed as a science and STEM education specialist. I began promoting integrative science and technical curricula beginning in the 1999-2000 school year, teaching both Biology and in Career and Technical Education (CTE). In the following year I began mapping state CTE course curricula to laboratory science curricula statewide. At the same time I began a progression in my own teaching from using Project-Based Learning (PjBL) as a complementary teaching strategy to emphasizing it as a primary teaching strategy in 2002, promoting genuine inquiry, creativity, relevance and lifelong learning. As these strategies and desired outcomes became the foundations of my teaching philosophy, they similarly influenced how I perceived

the design and outcomes of other programs. As STEM and integrative STEM discussions grew between 2005 and 2007, I actively engaged at the local, state and national level due to my proximity to the U.S. Capital, and I regularly found opportunities to test and refine my perceptions, and became an advocate for integrative curricula through Project-Based Learning.

In this case study research project, I interviewed many key personnel who have or have had similar education backgrounds and career roles, and some personnel knew me professionally and personally from earlier projects conducted with the Piedmont School District. Others also knew that I have played a significant role in STEM education curriculum development, professional development, and business and community outreach regionally and nationally. In those roles I promoted many of the STEM components described in Chapter 2.

Participants who were aware of my involvement in STEM education and particularly integrative STEM education may have shaped their responses to this case study. However, no participant referenced any article I have written, professional development seminar I conducted, nor any public statement I've made. To the best of my knowledge, Ailanthus PTA parents did not know me by name but were aware that a STEM education evaluator was studying their school and Academy program.

In collecting these data and interviewing personnel, I was aware that the continuation of the Ailanthus Academy program was threatened due to concerns expressed by some Piedmont school board members representing parts of the school division that were not eligible to attend the Ailanthus Academy. All personnel interviewed, and presumably many Ailanthus PTA parents were likely also aware of these concerns.

While some participants in this case study may have speculated that I was influenced by the school board's concerns, others may have perceived, because of my role in STEM education,

that I was a strong advocate for special STEM programs. The Piedmont Assistant Superintendent for Instruction and a former Piedmont Science Education Specialist were also likely aware of my orientation toward equitable opportunities for all students and the benefits of STEM literacy for all students, I made no such pronouncements during this investigation except in the form of questions about student, parent or other stakeholder perceptions.

CHAPTER 4 - FINDINGS

This chapter describes the findings from data collection and analysis, including interviews with key personnel affiliated with the Ailanthus STEM Academy in Piedmont Public Schools. The findings from the Ailanthus Elementary parent survey questionnaire are also described. This chapter is organized to align with each research question guiding this case study:

RQ1. What distinguishing features of the creation, implementation and adaptation processes of the Ailanthus STEM Academy program were perceived as salient by interview participants?

RQ2. How did perceptions of the program differ among interview participants, and how did perceptions change over time?

In this context, I discuss the aggregated understandings, findings and interpretations in the following major sections:

1. Distinguishing Features of the STEM Academy Implementation; and
2. Differences in Perceptions among Stakeholders.

Throughout this chapter I draw heavily on quotations taken directly from interviews of key personnel. Directly quoted information is in quotations or indented (longer quotations) and cited. Transcripts of interviews are included in Appendices D through L.

Distinguishing Features of the STEM Academy Implementation

In addressing Research Question 1, I describe the creation of the Ailanthus STEM Academy and its early curriculum planning and influences, leading to the selected strategies for teacher teaming, subject-specific instructional time, learning activities, the use of classroom technology, and influence of engineering-based curriculum. I then describe the student

recruitment, application and selection processes that distinguish the Academy from other elementary schools and other science-focused programs.

Creation of the Ailanthus STEM Academy

In 2001, three highly motivated teachers, their principal, and a science curriculum specialist collaborated on a design and proposed a program created to benefit students identified as gifted in science and math and/or students recognized by teachers and parents as having strong interest and aptitude in science and mathematics. The students enrolled during the first year program were already among the Ailanthus Elementary School population.

Duana Clinton, a former Chrysalis Magnet School Science specialist in Piedmont County and Hands-on Math and Science (HOMS) trainer, described how the program was approved by the Piedmont School Board during the 2001-02 academic year. Additional funding had been requested but was denied by the School Board. However, an active parent group (PTA) provided extra funding to support the special programs involved. The costs borne by the PTA consisted largely of transportation expenses for the special experiences such as visits to the state arboretum and zoological museum, and field experiences to observe seasonal phenomena. Because the Academy did not receive anticipated funding support from the school board, teachers and their founding principal (Ms. Wise) perceived an implied autonomy in developing their learning activities (Interview with D. Clinton, October 7, 2012).

Early Curriculum Design

Summer 2001 training was facilitated by Ms. Clinton. Early Academy curriculum featured integration of two curriculum areas: math and science. The Ailanthus Elementary principal specifically solicited hands-on training for the Academy teachers (Cheyenne Ruskin, Benigna Kaia, and Meryl Winfield) consistent with HOMS training. HOMS learning activities

were mapped to state learning standards (Learning Benchmarks). The Academy teachers began using the 2001 third, fourth and fifth grade, state-aligned HOMS curriculum binders to guide their planning. Summer training at Ailanthus Elementary focused on inquiry and activities for life science, earth science, and physical science. Teachers continued with training throughout the school/academic year in State Learning Benchmarks and HOMS activities that integrated math and science instruction (Interview with D. Clinton, October 25, 2012).

Ms. Clinton reported that even with the influence of the HOMS curriculum, the Academy curriculum development was collaborative and strongly influenced by the three Academy teachers. Using informal curriculum mapping exercises, they matched their proposed learning activities to curriculum standards quarter by quarter. Ms. Clinton and the teachers used the two-week training in the summer to prepare for the first quarter. They used after school and professional time during their first quarter to prepare for the second academic quarter. They did this again in the second and third quarters, and again with less formal planning in the second year. For each quarter, teachers and Ms. Clinton began with the math curriculum, recognizing it as the most linear because of the progressive manner in which skills build upon earlier skills (Interview with D. Clinton, October 7, 2012). They used Piedmont mathematics pacing guides and the benchmark tests that existed at the time to create a sequence of learning activities for their students. Teachers next considered and integrated science standards and objectives, then social studies into their instructional plans. They finished their planning with considerations nonfiction and fiction texts for integrating reading of scientific content or descriptions of natural phenomena at the appropriate readings levels for their students. (Interview with D. Clinton, October 7, 2012).

Teacher Teams and Instructional Time

In Spring 2003, the school board provided funding for three additional teachers to expand the program in the 2003-2004 school year from 26 students in each grade 3 to 5, to 52 students in each grade, creating a magnet program for additional students who would come from six nearby schools. This funding also enabled each grade-level Academy math and science teacher to work with all Academy 52 students (typically two classes of 26) in their grade (Interview with P. Geary, October 1, 2012).

Each of the third, fourth and fifth grade Academy teachers taught integrated grade-level science and math, and each was paired with a grade-level teacher responsible for social studies, language arts, and reading. This model differed from the norm in Piedmont County, in which each elementary teacher taught math, social studies and science and was paired with a designated reading teacher. Throughout the last decade, these pairings have been phased out in the rest of Piedmont County in favor of a single teacher teaching all subjects (Interview with P. Geary, October 1, 2012).

The Piedmont Science Supervisor, Dr. Geary, described the daily time allocated for each subject area in the Ailanthus Elementary (representing the rest of Piedmont elementary schools) and Ailanthus Academy's instructional day (see Table 4). The emphasis on integrative curriculum strategies led STEM Academy teachers to further distinguish the Ailanthus Academy as a STEM-focused program by having the math/science teacher distinct from the social studies/English language arts teacher allocations in all three upper elementary grades. All Academy teachers spent approximately 135 minutes with each group of 26 Academy students each day.

Table 4. Piedmont and Ailanthus Scheduled Instruction Time by Subject Area

Subject Area	Ailanthus Elementary and Other Piedmont Elementary Schools		Ailanthus STEM Academy
	Grades K-3	**Grades 4-5**	**Grades 3-5**
Language Arts	140 minutes	120 minutes	120 minutes
Math	75 minutes	75 minutes	75 minutes
Science	25 minutes	35 minutes	35 minutes
Social Studies	25 minutes	35 minutes	35 minutes

The Academy teacher pairing relationships allowed all 52 Academy students in each grade to benefit from a specialized math and science teacher without any significant difference in dedicated instructional time from the Piedmont norm. In the STEM Academy's 3rd, 4th and 5th grades, teachers split their workload so that the Math/Science teacher had students for the same amount of time as the teacher responsible for Language Arts and Social Studies, but the Math/Science teacher integrated the Math and Science with content-related reading, writing, and presentations, and also social studies concepts (Interview with P. Geary, October 1, 2012).

Although Piedmont central office staff expressed concern for [the lack of] time spent on Language Arts in 3rd grade, the Ailanthus Academy teachers emphasized explicit integration with content-related language arts and the social studies curricula through the two-member teams at each grade level. Teams identified relevant novels and non-fiction reading aligned with the science and social studies curricula. Teams also mapped science and social studies curricula to demonstrate the connections between human society, nature and technology. Through their use

of contextual reading and writing activities, teachers and administrators asserted that the English language arts instruction was enhanced (Interview with D. Clinton, October 7, 2012).

Emphasis on Emerging Best Practices

Without constraint from Piedmont central office curriculum and instruction specialists, the teachers and the HOMS trainer identified learning activities and strategies that continue to be recognized as best practices ten years later (Ravitz, Hixson, English, & Mergendoller, 2012). These include project-based and problem-based learning, progressive and spiraling curricula from one grade to the next, authentic applications of technology, and an emphasis on design-based approaches.

Project-based learning. Academy teachers described the primary emphasis in their curriculum as project-based learning and problem-based learning with real world connections.

> So, we got the kids out there collecting data at the State Arboretum, at different places and now that is certainly, definitely more common. But I think we've been doing that for so long that now we have kind of branched out, even from there with adding the STEM projects and adding other things. (Interview with Academy teachers, October 8, 2012)

When asked to describe STEM projects, Academy teachers shared how in their attendance at recent regional and national conferences, they recognized great enthusiasm for activities they've been doing with their students from the beginning of the Academy program. The Academy teachers described a thorough, persistent integration of project-based learning.

> My kids aren't pretending to be scientists, my kids *are* scientists. We are working with real scientists, you know. My kids are working with real scientists at the Zoological Museum. Our kids are working with scientists at the State Arboretum. They're working with real robotics people, you know. They're working with, they're making those real-

> world connections. It's not in that [artificial] problem based learning module. It's not pretend. (Interview with Academy teachers, October 8, 2012)

Continuum or spiraling curricula. Academy teachers also reported that they strived for a Science continuum, beginning in 3rd grade, to get students familiar with the components of experimental design, so as they move forward to higher grades they could be increasingly comfortable designing their own experiments. They could understand what questions could be the basis for an experiment or suitable for research. Teachers also used a variety of research questions to help students understand scientific questions. They also helped students advance their writing to be increasingly technical as they moved through the continuum. Topics and projects were revisited each year for deeper exploration and understanding with new skills and strategies. For example, trips to the Arboretum might include observations and measurements in 3rd grade, measurements and comparisons in 4th grade, and measurements, analysis, documentation and presentations in 5th grade (Interview with Academy teachers, October 8, 2012).

Classroom technology. Academy teachers and their administrators also integrated classroom technologies such as interactive devices, webcams, and video conferencing. They described and demonstrated how the technologies are used, and how they integrated their use to expand teaching and learning beyond the classroom walls. They supported such efforts with special funding through a technology award in 2004. The award acknowledged the Academy's exceptional initiatives and provided for distance learning equipment (web cameras and communication) that allowed students to talk directly with scientists and engineers (Interview with D. Clinton, October 7, 2012). While observing the fifth grade science classroom, I saw a video chat with an astronaut. In third grade math I saw students leading and explaining problem-

solving demonstrations on interactive white boards. While these technologies had become commonplace in many Piedmont high schools and middle schools in the last decade, they had been less common in elementary schools.

Project Lead-the-Way. In the interview with the Academy teachers, I asked about engineering activities I witnessed in two of the science classes. The teachers described how they adopted *Project Lead the Way* (2014) activities after several years, thus infusing engineering into their integrated math and science program. The teachers highlighted the importance of distinguishing engineering from science. They used *Project Lead the Way* (PLTW) to replace some of the problem-based activities they had been doing. Engineering or problem-based science is an addition to a science curriculum, but student interest and the accelerated pace of the Academy program allowed for time to add extended learning activities (Interview with Academy teachers, October 8, 2012). With the infusion of engineering and problem-based design briefs into the Academy program, the elementary teachers may be described as early adopters or innovators. PLTW remains uncommon in elementary schools, but design-based engineering activities are newly emphasized in the Next Generation Science Standards (NGSS Lead States, 2013). PLTW is a design-based curriculum more commonly found in middle school Technology Education courses and high school Technology, Engineering, and applied science courses (Project Lead the Way, 2014). PLTW began its national high school programs in 1997, and offered its middle school *Gateway* program in 2000. It achieved significant attention in 2003 when recognized by a NASA partnership, followed by an exemplary program recommendation by the U.S. Department of Education in 2004. The PLTW elementary-focused *Launch* program did not begin until 2013. The Academy teachers adopted PLTW learning activities six years before PLTW launched its elementary program.

Parents' perceptions of curriculum and instructional best practices. In responding to the online survey questionnaire, parents were asked the combined questions, "Are you pleased with the curriculum in your child's classes? Is it increasingly rigorous and engaging?" Many Academy parents described the Academy curriculum in very supportive terms, such as rigorous, challenging, accelerated, and even including "very elite!"; but many respondents did not distinguish the curriculum or instruction from the other components of the Academy program. Parents regularly cited a challenging curriculum, exciting field trips, class projects and dedicated, knowledgeable and enthusiastic teachers who love math and science themselves.

In responding to a question concerning what attracts students and parents to the Ailanthus Academy, parent survey participants reported a wide array of factors. These were: students' strong orientation to a scientific and mathematical worldview; challenging curriculum; dedicated, knowledgeable and enthusiastic teachers; the Academy as a unique opportunity within their home school; its reputation; its uniqueness, accelerated curriculum for "like-minded" children; emphasis on creativity, imagination, leadership skills and problem solving; emphasis on subjects that Americans seem to be falling behind in, and likelihood of STEM career opportunities; teachers that are dedicated and have high expectations of the students; approaching curriculum through important themes; technical writing; field trips; and community connections.

I asked nearly all key personnel about their perception of what features attracted Piedmont parents and students to the STEM Academy. The responses of these stakeholders often provided insight. Educators' awareness of parent perceptions is strongest when parents are disgruntled and activated; when they are quiet it is much more difficult to gauge (Interview with S. Daniels, October 17, 2012).

Administrators, teachers and the curriculum specialist described the appeal of the Academy to students and parents in the context of a more intensive math and science experience. Students' perceptions are particularly difficult to distinguish from their parents' motivations because prospective students are identified in second grade. Many aspire to attend the Academy because of sibling experiences, stories of classroom experiences and field trips, and even classroom animals (Interview with M. Croft, October 25, 2012). Throughout the school there are also many displays of student work, which capture the attention of younger Ailanthus students, and particularly younger siblings and visiting parents (Interview with Academy Teachers, October 08, 2012).

Educators also described the appeal to some parents as an authentic interest in integrated, project-based experiences using community resources and real data. Many noted that the Academy has a reputation among parents for being community-centered and project-based. Educators also perceived parents' interest as based on a unique educational experience for their children (Interview with G. Fishman, October 8, 2012; Interview with M. Croft, October 25, 2012).

According to the Ailanthus Assistant Principal, Nevil Tyson, the Academy has a strong, supportive parent community, with an expected amount of word-of-mouth sharing about student experiences and the positive characteristics of the Academy. That larger interest creates a "positive kind of a feeling" that is shared among parents (Interview with T. Nevil, October 8, 2012). The Ailanthus Elementary PTA is not separated by program, so Academy parents and other Ailanthus parents work together on behalf of the whole school.

STEM Academy Application and Selection Process

As the program progressed, students and their families were required to apply to be considered for admission to the STEM academy. Only students who attended selected regional elementary schools were eligible to apply; these included Boxwood, Alder, Dogwood, Chestnut, Ailanthus, Tupelo, and Sycamore Elementary Schools. Each school had a building contact who was designated as the source of information and applications. The third grade class was comprised of 26 newly selected students from identified feeder schools and 26 from Ailanthus Elementary School (Discussion with Ginger Fishman, October 8, 2012).

Currently the application process involves a written application, a portfolio of student work, a face-to-face meeting with an Academy teacher or representative, and hands-on performance-based tests evaluated by classroom observers. In the early years of the academy, these performance-based activities included both a math-focused and science-focused activities but later activities were often more integrative (Interview with D. Clinton, 2012).

Application timeline and grade-level requirements. The application process for third grade enrollment starts near the end of second grade. Applicants are encouraged to demonstrate their achievements and interest in the Ailanthus Academy application process in specific ways (Piedmont Public Schools, 2012):

Third Grade

- Show academic evidence of math and science interest and aptitude in second grade (i.e.: grades, teacher's anecdotal notes); and
- Successfully complete an authentic assessment of aptitude, administered by Ailanthus Academy evaluators at the student's home school.

Fourth and Fifth Grades (for new applicants to Ailanthus Academy due to attrition)

- Achieve an average grade of C or better in third (or third and fourth) grade math and science;
- Show evidence of interest in mathematics and science and aptitude through teacher notes or student achievements; and
- Successfully complete an authentic assessment of aptitude, administered by Ailanthus Academy evaluators at the student's home school.

Ailanthus Academy teachers and administrators attempted to consider the "whole child" by using a full profile of the student (Interview with Academy Teachers, October 8, 2012). A selection committee typically included administrators from the feeder schools, curriculum and instruction specialists, and Piedmont administrators and teachers from schools throughout the division. There was a waiting list of students for each grade level to fill potential openings through the end of the first nine weeks of school. No lottery was used or planned (Interview with C. Moore, October 31, 2012).

Parent and teacher collaboration. In an interview with Dogwood Gifted Resources teacher, Madison Croft, she described how parents are expected and encouraged to indicate students' interest in attending the Ailanthus Academy. Even so, she reported that teachers often initiated discussion with parents of students who, in their view, have demonstrated interest and aptitude in math and science. Both parents and teachers use a rubric to assess and recommend interested students. In addition, they are asked to submit narratives in support of students who score high in the rubric. Gifted resource teachers reported that while scores from parents and teachers often vary for an individual student, wildly divergent scores are uncommon (Interview with M. Croft, October 25, 2012).

Sibling preference. In the Piedmont School Division, there has been no apparent sibling preference or consideration for the convenience of parents to have their kids in the same school. Due to the competitive application process, siblings of students enrolled in the Academy are not given special preference status in the process. Rather the process relies on students' performance on application assessment measures. To accommodate families of enrolled students from feeder schools, siblings of those students may ride the bus to attend Ailanthus Elementary (Interview with G. Fishman, October 8, 2012).

Parent perceptions of the application process. In the online survey of PTA members parents of Academy students generally held the application and selection process in high regard. Some suggested it reflects a level of commitment to their child's education. Many recognized it as an alternative for highly motivated students that are not identified as gifted.

One parent who applied but whose student was not enrolled in the Academy expressed concern for the process: "I'm not sure why [my son] wasn't accepted. He is a straight A student in the gifted cluster." Some parents reflected many educators' concern for the self-perceptions of students who, at a very young age, questioned their potential as scientists after not getting accepted, at a time in the U.S. when agencies are striving to recruit more students to STEM academic and career fields.

Some parents reported pressure from other parents to apply to the Academy. Some were concerned that 2nd grade student is too young for such a decision and that those not accepted may feel inferior at a very important time for young learners' self-perception. Some perceived the Academy as an opportunity to encourage their students in fields in which the student had not yet expressed a strong interest.

Eroding Distinctions from Other Piedmont Science Programs

Other Piedmont schools have implemented innovative science programs. Ms. Clinton described how a science emphasis developed at Piedmont County's Juniper Elementary during the early years of the Ailanthus STEM Academy. Juniper Elementary was outside the Ailanthus Academy regional attendance zone. The science initiative was facilitated by a PTA parent with a strong science background who trained other parents in hands-on science and developed a science laboratory, plus a special *Science Seat* was created on their PTA Board. As Juniper became recognized as a science-focused school, Piedmont curriculum and instruction leaders re-worked and revised the elementary science curriculum outside the Ailanthus Academy to make it more project-based and math-integrated (Interview with D. Clinton, October 7, 2012).

In the time since the Ailanthus STEM Academy started, Piedmont Schools made efforts to align best practices countywide with some Ailanthus Academy innovations. A revision of the countywide elementary science curriculum occurred that made it more project-based and more integrated with the math. Changes within the Piedmont elementary science and math curriculum have also paralleled many of the original components of the Ailanthus Academy that defined the Academy's uniqueness, including the hands-on science emphasis and integrated language arts (Interview with P. Geary, October 1, 2012).

Assistant Principal Mr. Tyson shared that even the Academy's innovative integration of social studies and English language arts is now required in all Piedmont Elementary schools, to promote self-contained teacher classrooms where a teacher teaches everything in the elementary level to her or his students. He explained that integration maximizes time for each subject and minimizes the burdens of teacher planning. Mr. Tyson agreed that it seems that others are learning from Academy successes and are able to reorient their curriculum much faster than the Academy teachers who have worked their way through each discovery.

> I see it because I have a passion for science; however, we have come to a point where the whole division is being exposed to the same things they are. The bottom line is that it served a purpose. Some things have come out of it that are real good, but I guess I'm a little tainted and biased because of what I've witnessed over the past year [as Assistant Principal]. (Interview with N. Tyson, October 8, 2012)

Differing Perceptions among Stakeholders

In addressing Research Question 2, interviews of key personnel were also the primary tool for discovering how perceptions of the STEM Academy program differed among stakeholders, and how perceptions changed over time. School personnel interviewed included Ailanthus program developers, Ailanthus Elementary and Piedmont central office administrators, teachers within the Ailanthus STEM Academy, non-Academy teachers from Ailanthus Elementary, and teachers from feeder schools. While school personnel provided insight on parent perceptions, parents who participated in an online survey questionnaire provided their views directly. Accordingly, in this section, I have aggregated the perceptions of key personnel in the following five categories as subheadings, informed by the data collected:

1. Exclusion of central office staff from early curriculum design;
2. Conflict in documentation of the Ailanthus STEM Academy curricula;
3. Replication of the Ailanthus Academy curricula throughout Piedmont Public Schools;
4. Concerns for protecting the integrity of the STEM academy status; and
5. Diversity and equity in the availability of Academy opportunities and Ailanthus resources.

Exclusion of Central Office Staff from Early Curriculum Design

At the beginning of the Academy, then-principal Roxanne Wise reached out to Ms. Duana Clinton, who was a Hands-on Math and Science (HOMS) instructional leader, science specialist and former teacher at Piedmont's Chrysalis Middle School, and also a resident of Piedmont County. Ms. Wise wanted summer training for the three math/science teachers representing grades 3-5 based on HOMS materials. These materials focused on inquiry in life science, earth science, and physical science that was aligned with state standards and provided activities that integrate math and science. Central office staff members were aware of the training but not directly involved. Ms. Wise also asked Ms. Clinton to support the proposal submitted to the school board to create a STEM Academy (Interview with D. Clinton, October 7, 2012).

The Piedmont school board approved the STEM Academy without additional funding in the first year, as there was concern that it would be difficult to implement the teachers' ideas county-wide. The very active parent group at Ailanthus Elementary provided funding through the PTA to enable special opportunities not possible with routine school board funding. Initial planning focused on a hands-on curriculum, mostly consistent with Piedmont constructivist approaches. There was support for integration with the English Language Arts and the Social Studies curricula through grade-level teacher teams. The teachers used novel studies and non-fiction reading that aligned with the Science and Social Studies curricula. They also looked at ways to integrate the Science and Social Studies so that students benefited from a social science perspective in their curriculum. Because each teacher team had just two motivated teachers, integration was easier than it might have been with larger teams. While it may seem that English language received less attention than in other schools, the teachers emphasized integration of reading, writing, and presentations in all curriculum areas. For example, the seasonal

observations at the Arboretum involved significant note-taking, descriptive writing and presentations (Interview with D. Clinton, October 7, 2012).

Ms. Clinton described her role with the Ailanthus teachers as collaborative, beginning with informal curriculum mapping to standards quarter by quarter. The training was also staggered quarter-by-quarter, with two weeks in the summer to prepare for the first quarter, in-service and after-school time during the first quarter to prepare for the second quarter, and so on throughout that year. All three of the Ailanthus Academy math/science teachers were involved in the curriculum design. All planning began with consulting the Piedmont curriculum pacing guides, specifically math because of the progressive sequence that was aligned with benchmark testing. They began the curriculum mapping by aligning the science with the math pacing guide, then locating places for non-fiction and fiction books from Social Studies, and then also places for reinforcing English Language Arts skills and learning activities.

Ms. Clinton described Roxanne Wise, the founding principal of the Academy, as a celebrated, strong leader with the competence and confidence to promote the Ailanthus STEM Academy without Piedmont central office support. When the School Board decided to deny additional funding to Ailanthus Elementary for the STEM Academy, Ms. Wise made it clear that Piedmont central office curriculum specialists would be kept at arm's length and would not have a leadership role in the STEM Academy. Ms. Wise took advantage of Piedmont policies that prohibited central office curriculum specialists from being involved in curriculum unless invited by school building administrators, and kept the central office staff from influencing the Academy curriculum design simply by withholding invitations. The next year, after the Academy program had already become a bright spot for the larger reputation of Piedmont, funding was provided by the school board for an extra teacher in each grade level and for feeder-school transportation.

This action raised the visibility of the Academy throughout the county; with that visibility concerns about perceptions of exclusivity emerged among various stakeholders. The barrier between the STEM Academy and central office administrators remained and intensified. Ms. Wise continued to insulate the Academy program from central office involvement until she retired in 2005 (Interview with D. Clinton, October 7, 2012).

Changes in School Leadership. The central office had new opportunities to become involved in the Academy after each of the Ailanthus Elementary school leadership changes, as listed below:

2000 - 2005	Ms. Roxanne Wise
2005-2011	Ms. Loretta Huddleston
January – July 2012	Ms. Shannon Daniels (interim for 6 months)
July 2012-2013	Ms. Ginger Fishman

Principal Loretta Huddleston came to Ailanthus Elementary in 2005 after the departure of Roxanne Wise and remained principal there until January 2012. When Ms. Wise retired, Piedmont central office Gifted and Talented curriculum leaders became involved in the Ailanthus STEM Academy curricula. While the new principal, Ms. Huddleston, remained strongly supportive of the STEM Academy, she recognized from her experience in applying for the position that changes to the Academy curriculum were coming and that the central office expected better alignment with other Piedmont curricula and improved documentation of the curriculum and pedagogy actualized at the Academy. HOMS trainer Ms. Clinton also highlighted Loretta Huddleston's efforts to "cross-pollinate" within the school to make sure the entire school benefited from the STEM Academy at Ailanthus Elementary, likely responding to local pressures or criticisms of elitism within the school. These shifts resulted in more sharing of

both ideas and resources between Academy teachers and non-Academy teachers at Ailanthus Elementary. At this time, Ms. Clinton remained involved only through her informal connection to the Academy teachers, while central office Gifted and Talented curriculum leaders stepped in to document and align the curriculum (Interview with D. Clinton, October 7, 2012).

At the time the STEM Academy was proposed and developed, Dr. Janette Oakley was the Elementary Science Coordinator. From 2004 until 2011 she served as a Gifted and Talented Programs Specialist. In the early years of the Academy, Dr. Oakley tried but was prevented by Ms. Wise from being involved in the design of the Academy curriculum. Dr. Oakley tried to ensure learning activities were aligned with best practices identified by Piedmont Public Schools: specifically that experimental, descriptive or historical research was integrated into the curriculum. When Ms. Huddleston became principal, Dr. Oakley gained considerable access and involvement. Dr. Oakley's new involvement began with a focus on documenting the Academy curriculum in collaboration with the teachers. (Interview with J. Oakley, October 2, 2012).

In our October 1, 2012 interview, the current Science Supervisor, Dr. Piper Geary, described how Dr. Oakley pushed for integrated STEM content elsewhere throughout Piedmont County, despite limited involvement in the Academy's initiatives. Simultaneously, the 5th grade Academy teacher, Cheyenne Ruskin - who Dr. Geary described as "a phenomenal teacher" - emerged as a leader and emphasized the integrated teaching and learning that is now part of prevailing STEM education philosophy. Yet efforts to distinguish the Academy from the rest of the Ailanthus school created a divide within the school building, exacerbated by the use of special colored t-shirts identifying Academy students and lab coats worn by the Academy teachers.

Conflict in Documentation of the Ailanthus STEM Academy Curricula

Documentation of the STEM Academy curriculum was a priority for Piedmont Gifted and Talented Programs Supervisor, Dr. Carolina Moore, and Gifted and Talented Programs Specialist, Dr. Janette Oakley. Documentation became a source of conflict between the central office and the Academy. The two entities differed in terms of their perceptions regarding the format, frequency and extent of documentation (Interview with P. Geary, October 1, 2012; Interview with D. Clinton, October 7, 2012; Interview with J. Oakley, October 5, 2012).

Academy teacher perceptions of curriculum documentation. In my October 8, 2012 interview with Academy teachers, they described how the evolution of the Ailanthus STEM Academy changed suddenly with the retirement of Principal Wise in 2005. The central office curriculum and instruction leaders, specifically the Gifted and Talented Programs leaders, were eager to document the existing curriculum with the Understanding by Design (UbD), backwards-design format. They also pushed for additional changes and documentation each year. The 5th grade teacher Ms. Ruskin explained,

> And you know we were writing curriculum over and over and over and over… you know, that was very difficult for us. And, you can imagine, we can teach. We're good teachers. We like to teach. We love our classrooms. And we would take classes here and there on how to write curriculum and we would spend all summer together writing curriculum and worked very well with our partners integrating the language arts. That's one of the beautiful things about, we do a lot of research writing, you know, my team member will do persuasion, of writing persuasively and then, I do the science. We bring it together.

The Academy teachers perceived that the new Piedmont administration saw academies as three or four-year pilots for developing strategies to be shared countywide. This understanding

was not part of the teachers' original STEM Academy proposal or early planning, so they had nothing documented for sharing. Instead, they had relied on the HOMS learning activities provided in state-specific binders, adapted them to their own ideas, ordered supplies, and developed functional plans. They maintained hand-written notes in the HOMS binders, photocopied handouts, and traditional hand-written curriculum planners, but they had developed nothing for sharing professionally. The teachers expressed their anxiety about meeting me because building administrators had described me as a curriculum auditor, so the teachers felt they would have nothing to share with me (Interview with Academy Teachers, October 8, 2012).

In our October 7, 2012 interview, HOMS trainer Ms. Clinton described how all of the Piedmont County school system followed the Understanding by Design approach to backwards-design curriculum development (Wiggins and McTighe, 1998). Early implementation of backwards design planning in Piedmont County Public Schools began with special programs, but Ailanthus Academy teachers resisted documentation in part because they perceived it would be disadvantageous to their program. Ms. Clinton explained that implementing UbD required teachers to tie their curricula to enduring understandings and big concepts, and was not challenging or troubling for the Academy teachers. But the effort to explain how some Academy curriculum strategies fit into the Piedmont curriculum became a point of conflict between Academy teachers and Piedmont curriculum specialists. The tensions were manifested through back-and-forth dialogue over the UbD process. Academy teachers felt very strongly about providing students with authentic experiences utilizing community resources for ongoing scientific observation. However, they were reluctant to document how these experiences related to the goals of the larger curriculum plan (Interview with D. Clinton, October 7, 2012).

Ms. Clinton also described that teachers explored project-based learning, and to a lesser extent, problem-based learning. They emphasized the use of real data, engaging students in thinking and acting like scientists thus developing those scientific habits of mind. The teachers also implemented pre-assessments to establish baseline information and check for student misconceptions. These pedagogical practices were not yet prevalent in Piedmont or elsewhere at that time the Academy curricula were developed. As early adopters/implementers of this integrative science and math pedagogy, these teachers eventually saw other elementary educators catch up over the last eight years. As their approach became acknowledged to be best practices and adopted by others, there was little stimulus to change, expand or advance their existing Academy curriculum. Instead the teachers made minor improvements year after year, but did not assert themselves as curriculum leaders. They overlooked or avoided opportunities to share their strategies or their rationale in countywide meetings, conferences, or elsewhere.

When the new Piedmont curriculum development initiatives began, the teachers made an effort to reformat their curricula and model what curriculum specialists were asking, but they clearly experienced difficulty in developing this documentation. This struggle to document their curriculum for sharing eroded their sense of professional autonomy. They described the central office feedback loop as rigid, rather than collaborative (Interview with D. Clinton, October 7, 2012).

Without the protections of Ms. Wise, the influence of the Piedmont central office grew, and the relationship between the STEM Academy and the central office became further strained rather than improved. Piedmont county policies promoting backwards-design UbD curriculum documentation were quickly reinforced by Dr. Oakley and Dr. Moore. The Academy teachers were not yet comfortable with the UbD model, but the biggest obstacle to documenting their

curricula was their reluctance to share the components of the perceived uniqueness of their curricula and their program (Interview with D. Clinton, October 7, 2012). They perceived the goal of the Piedmont Gifted and Talented Programs office was to spread their good ideas and strategies throughout the Piedmont School District, so the perceived unique status of the Ailanthus STEM Academy would be lost.

Ms. Clinton also described how the involvement of the Gifted and Talented Programs administrators after 2005 was perceived as "somewhat dictatorial" (Interview with D. Clinton, October 7, 2012). She described how teachers would eventually complete tasks or hit obstacles and would seek feedback but not get a response. The teachers then became frustrated when they were criticized for not being in full compliance despite trying. Otherwise however, Ms. Clinton emphasized that Dr. Oakley's early involvement and leadership in promoting inquiry-based science, describing her "at the forefront of pushing inquiry in elementary science," suggesting that there was congruence in curriculum and instruction strategy despite the interpersonal and professional obstacles to collaboration.

Principal Loretta Huddleston guided teachers through the transitions and struggles with the central office staff. In our October 30, 2012 interview, Ms. Huddleston described how she knew that the Piedmont elementary science curriculum had evolved significantly, enhanced by the Academy's examples. Ms. Huddleston acknowledged the challenge of the curriculum documentation, but noted that UbD has been promoted in Piedmont Public Schools, school-by-school, since around 2000, and participation by the Academy teachers was overdue. By the time the Academy teachers began their effort to document their curriculum, central office curriculum specialists were also pressuring them to use the documentation process to prepare the curriculum for replication in other parts of the county. She described how Dr. Oakley met with the teachers

every three or four months. While it was challenging for the teachers, the result was more integration, more English Language Arts, and writing across the curriculum, even if not professionally documented. "The 5th grade team, eventually the responsibility of Cheyenne Ruskin, did a very good job." (Interview with L. Huddleston, October 30, 2012)

Central office perceptions of a lack of documentation. The central office administrators explained that the Academy teachers resisted documenting their program and never truly developed a written curriculum. Gifted and Talented Specialist Dr. Oakley helped to develop the performance-based assessments and problem-based assessments, and helped to facilitate the portfolio review process, and wanted this to be reflected in the Academy curriculum documentation (Interview with J. Oakley, October 25, 2012). Otherwise, Dr. Oakley described her ongoing role as working with teachers to provide them feedback on their curriculum units to improve them. She reported that the Academy teachers implemented some of the changes she recommended, but not often. She said,

> "I struggled to get the buy-in of the teachers. You have good teachers that are comfortable doing what [they've] always done. When the written curriculum units were turned into Dr. Moore, a lot of the recommendations I made were not put in place. A lot of what was talked about in terms of integration never happened."

Dr. Oakley was only able to report the interactions to the Gifted and Talented Supervisor, Dr. Moore, and asked the teachers for the same changes again in the next quarter. She hoped the Academy teachers might lead the Piedmont division in creating inquiry-based activities in the UbD units, but she did not get the teacher cooperation. She reported that in most cases, teachers chose to stay with the curriculum binders of activities they purchased through their HOMS training, so the curriculum documentation was never completed. With no turnover in the

teachers, Dr. Oakley found no opportunities to significantly improve her relationship with the STEM Academy team (Interview with J. Oakley, October 25, 2012).

Dr. Moore supervised the work of Dr. Oakley from the time the Academy was created and agreed with her perspective regarding documentation. Dr. Moore had reviewed the status of the Academy curriculum in 2010, and shared the following.

> I can say that two years ago when I looked at the curriculum, the components of it being inquiry-based, conceptually-based, and integration of language arts skills, particularly student-driven research were not [represented] in the curriculum. Those things presently exist in the curriculum that's being developed at the division level.

She continued with emphasis,

> Well the point I'm making is that they never developed the curriculum, that's not to say that things were not going on instructionally, but in terms of actual curriculum units of study, they never developed fully the curriculum that was supposed to embed those things. We are developing that curriculum at a division level. (Interview with Dr. Carolina Moore, October 30, 2012)

Dr. Piper Geary, the current Elementary Science Supervisor, also reported a lack of shareable curriculum documentation. She once met with Academy teachers in 2011 in an effort to align their hands-on learning activities with the rest of Piedmont but, she explained, she had not seen any outcomes. In our interview on October 1, 2012, Dr. Geary also said she hoped that I had received STEM Academy Science curricula, because she was not aware of any. When I noted that (at the time of our interview), I was not aware to what degree anything has been documented, she nodded in understanding. Dr. Geary explained that the unwillingness to participate in curriculum documentation is one of the primary reasons no one in the central office

tried to help the Ailanthus STEM Academy overcome the public concerns about equity of the program (Interview with P. Geary, October 1, 2012).

Curriculum outside the Academy. Dr. Geary also explained the curriculum in the rest of Piedmont Public Schools. The science curriculum follows a state framework based on essential skills and knowledge, but the need for accountability-driven assessments led to a disassociation from the state framework. The 4th grade now prominently features earth science with life processes, and 5th grade features physical science and plants. Abstract concepts are emphasized according to the year they're tested in statewide standardized exams. There are no science coaches; all Piedmont elementary schools are supported by only the two central office staff: one coordinator and one specialist (Interview with P. Geary, October 1, 2012).

Dr. Geary highlighted the Electricity Units developed by Ailanthus 4th grade Gifted teacher Amy Harley explaining that Ms. Harley had become a countywide model for 4th grade science. Her success has partly diminished the negative feelings toward the STEM Academy from within Ailanthus Elementary (Interview with P. Geary, October 1, 2012). Dr. Geary also expressed hope that curriculum looping (sometimes called spiraling curriculum) will be considered at Ailanthus Elementary and in the STEM Academy. The new principal, Ginger Fishman, began on July 1, 2012 and came from a school in which this curriculum looping allows for teachers and students to revisit concepts with increased rigor and context as students progress through each grade (Interview with P. Geary, October 1, 2012).

Participation in recent district-wide curriculum implementation. Science Curriculum Supervisor, Dr. Piper Geary, joined Piedmont Public Schools in 2000. She initially served as a computer resource specialist and then assistant principal, then joined the curriculum and instruction staff in elementary science. She is now on the K-12 curriculum team. In our

face-to-face interview on October 1, 2012, Dr. Geary confirmed that the 2012-2013 academic year was the last year for *Everyday Math*,(Everyday Mathematics, 2015), and that all Piedmont Schools were moving away from textbook-driven curricula. Piedmont adopted *Everyday Math* in 1999-2000 and the Curriculum Department later adapted it to local goals and objectives. During the 2012-2013 academic year, Academy teachers participated in the Piedmont Mathematics Curriculum Pilot Project and adopted the Piedmont Science Curriculum sequence.

Piedmont has emphasized *performance-based* assessment to complement the state Learning Benchmarks exams. The resulting performance assessment tasks allow for curricula focused on students' ability to do things, not just know things. Inquiry-driven curricula have also been emphasized. The Academy teachers seem to have comfortably embraced both the new Math and Science curricula. The remaining curriculum distinctions at the Academy are due to teachers' expertise, community partnerships, and strategic enhancements to the curriculum to meet the interests and needs of students hand-picked for their aptitude in math and science. The Academy teachers' concerns now seem centered mostly on whether and how classes of highly engaged students mixed with reluctant learners could progress through the curriculum at a pace sufficient to allow time for the extended learning opportunities that have defined the Academy. (Interview with P. Geary, October 1, 2012).

Consideration of Ailanthus Academy Components for Replication

Several challenges impeded the district's hopes of replicating the Academy curricula throughout the Piedmont Public Schools. In this section I discuss some of these challenges, which are based on differing perceptions of Piedmont and Academy stakeholders.

Teacher quality and commitment. In our October 8, 2012 interview, Ailanthus Principal Ginger Fishman regarded all Academy teachers as very impressive in their classroom

instruction, noting that they had developed a strong approach to interdisciplinary teaching and learning. Even so, she wondered about how such instruction might benefit students outside the Academy program.

> I think a lot of that work was done here before I got here. With the smart boards and all that is really strong, but it is different when you have these hand-picked kids. And what I'm saying is what you're wondering, which is that what you're doing is good for everybody…but [Academy teacher Ms. Kaia] doesn't believe that it can be done with everybody, the other two do. And I do, you know I think it's the same thing it's just different kids. (Interview with G. Fishman, October 8, 2012)

I described how when I observed in Ms. Kaia's classroom there were times when she would intentionally make mistakes just to keep students alert and other times she would make genuine mistakes. The students caught both her fake mistakes and her genuine mistakes. She demonstrated that she had the right personality to manage that situation that might be challenging or embarrassing for other teachers. Ms. Fishman commented,

> [Ms. Kaia] is also very engaged, involved in everything, and extremely reliable; but she is also the most emotional out of these guys, really emotional. And you know, [she] wants [the Academy] to stay as is. She really likes the program and cares deeply about it. I think the other two are flexible and believe in the program just as much, but are willing to consider other options. (Interview with G. Fishman, October 8, 2012)

Despite the tensions with the STEM Academy teachers, Dr. Oakley, the Gifted and Talented Specialist, emphasized her praise for the teachers' efforts at integration of subject areas and implementing research-based components: descriptive, historical, and certainly the experimental research. She shared that she typically sees elementary teachers teaching research

in science by involving students in reading about scientists and writing book reports about the scientists' discoveries. Instead, she explained,

> The Academy teachers demonstrated that kids can do the research. They would have students generate a question and begin surveying people about Albert Einstein. They led students to have what they read become a catalyst for developing their own questions. (Interview with J. Oakley, October 25, 2012)

Mr. Tyson affirmed others' respect for the individual teachers' skill and motivation as teachers and how difficult it may be for them to share openly.

> You know, these teachers put a lot of blood, sweat and tears into this [program] and to start it. They have ownership, it's their baby. With any parent and their child's being threatened, the emotions come out that "I want to protect my child." They're wonderful teachers, they're great with kids. But to speak with a bias, I think everyone should be exposed to what they are having; however, and I think we've caught up to that…Even related to gardening, bringing their greenhouse programs and botany to all students would be good for these teachers. I would hate to see the teachers go away because I don't think their heart would be into it anymore. (Interview with N. Tyson, October 8, 2012)

HOMS leader and science specialist, Duana Clinton, had described how teachers at the Ailanthus STEM Academy are known as "dedicated teachers who have put a lot of skin in the game" and they became anxious that all they've built and defined was really special and unique, and they suddenly became vulnerable. "When Mrs. Wise left, they were beaten down," Clinton added, "...she really was like a mother bear protecting them." The teachers felt like the central office staff resentment against Ms. Wise was suddenly directed at them. "It was a hard time. I

can remember at end of the year school being over and being invited to join them for dinner and they had been beaten down pretty hard." (Interview with D. Clinton, October 7, 2012).

The Academy teachers reinforced the concern about sharing their strategies and community connections, worrying that access to these special resources would be compromised and the learning activity itself would be implemented less rigorously elsewhere. Ms. Ruskin, a 5th grade teacher, elaborated,

> Different opportunities that we have gone out and created, making these connections; and that's not something you can do countywide, you know. You can't have 4000 children talking to a nanotechnology science lab at a university. That's not something that can happen just because of the volume. That's where the STEM Academy is different. That's because we set out to find these people and I guess we keep it small. It's a small-scale type of thing and it's not that we aren't willing to share. It's just that it can't be done. My kids travel to monitor the Bog turtles. They are very careful that you can't expose the Bog Turtles to too many germs. All the fifth graders in Piedmont cannot tiptoe through behind the scenes. My whole class can't even go at the same time. So, those types of real-world experiences just cannot be replicated throughout the county (Interview with Academy teachers, October 8, 2014).

Limitations of non-Academy teachers. Academy teachers also perceived limitations on the expertise and resourcefulness of other elementary teachers that they argued would make it unlikely the STEM Academy could be replicated elsewhere in the county. Not only did they believe that their activities and strategies would not be delivered with the same rigor, but they feared that lesser implementations elsewhere would diminish the reputation of the Ailanthus Academy. Third-grade Academy teacher Ms. Kaia provided the following:

> You know, I have to speak only from my own experience. I think this experience, I have grown into it and it has grown with me. So, you take a regular third grade teacher, that hasn't had the opportunity to do this. My room is my classroom. My animals are getting ready to be the biggest part of what I teach. When I start teaching I've got food chains right there for them to see. The kids are participating and you've got to be, and it didn't just happen. It started with just using cockroaches. And now it's anoles. And now it's a leopard gecko. And now it's those slider turtles, you know. But they all play a part in helping the children actually see and experience the science concepts and that was something that happened…But I don't know that every teacher has the opportunity, you know, to concentrate on this. And not every teacher has the audience that's interested in what you're doing, you know. The children, for me, have truly been what has driven what I've learned and been able to do for them and I don't [know] how that could even be [done elsewhere].

Perceptions of the Academy feeder schools personnel on academy innovations. Feeder school Gifted Resource teacher Madison Croft is also the recognized Dogwood Elementary liaison to the Ailanthus STEM Academy. She described her rising scholars program in K-1. She also serves as the resource teacher for the gifted clusters in grades 2 through 5. At Dogwood, gifted students learn in heterogeneous classes, so she collaborates with teachers in those classes to differentiate instruction to meet learners' needs. Periodically she also conducts *Socratic seminars* (questions and discussions to promote critical thinking) based on class pre-assessment and formative assessment data.

In consideration of how Academy programs could be expanded to all schools, Ms. Croft described how through professional development she would emphasize differentiated curriculum

and the characteristics of gifted learners. She suggested beginning with an emphasis on teachers' mastery of the curriculum and then knowing where to use specific models and strategies within the curriculum. Teachers would then be expected to utilize student data, opportunities for placement, acceleration, and remediation. She is concerned that STEM-focused programs can have many great features, but overlook some core curriculum standards. She would also expect teachers to have the training to allow for a balance of student autonomy and structure, to let advancing learners construct their own understandings of important concepts.

Integration and Collaboration. In Piedmont Public Schools, the team-based approach perceived to work so well at the Ailanthus Academy has been phased out in favor of having one teacher for these subjects. This change was intended to promote better integration and reduce time burdens of team coordination. Ms. Croft described how at Dogwood, the gifted resources teacher facilitates collaboration and sharing throughout the school, thereby accomplishing the same integration of Social Studies and English Language Arts with Science and Math featured in the Ailanthus STEM Academy. Moreover, the Dogwood teachers manage this in heterogeneous classes through their emphasis on differentiation. She provided an example:

> …we discussed that they were working on the new weather unit, so I go over and service those students also in language/arts, so I found a piece of literature that aligns with their science and where they are right now. It's called *In the Eye of the Tornado*. So I came in, Dogwood just got new iPads, took my new iPad in, showed them a tornado on the iPad, small flex screen. Now these are students who have an accelerated DRA and really need to have an enriched piece of reading. I could have pulled in any piece of literature but determined that it would be best to pull in something that's related to science with what they're learning right now. So I pulled in this great story called "In the Eye of the

> Tornado," so we got engagement at a much higher reading level, brought in science so we did a pre-reading, and I had them use their Kaplan icons. (Interview with M. Croft, October 25, 2012)

Socratic seminars. Ms. Croft also emphasized the role of Dogwood Elementary's Socratic seminars in her collaboration with teachers in their classrooms. While she previously indicated that she used these seminars to summarize concepts, make connections, and draw conclusions, the seminars are also an important tool for promoting interpersonal communication. "I think it's an emphasis here, I will say that it has been my emphasis because I really believe that students need to know how to look eye to eye, speak to one another."

During a 2nd grade classroom observation at Dogwood Elementary I witnessed how such one-to-one communications and larger student discussions seemed comfortably routine for students. There was no announcement or declaration of a special activity. Instead, the teachers simply encouraged students to talk with a partner and then invited larger classroom discussion in a typical think-pair-share approach to student collaboration (Lyman, 1992).

Curriculum mapping. Because I witnessed an intentional integration of curriculum in the Dogwood classroom observations, I asked Ms. Croft about professional development in integrative teaching and learning, and curriculum mapping. She described how professional development varied in the school districts in which she's worked. New curriculum objectives are often introduced with opportunities for planning and realigning curriculum.

During the last few years, elementary education specialist Piper Geary has visited Dogwood several times. The division hired substitutes to enable regular classroom teachers to meet during the school day to map their curriculum with their teams. That opportunity was not available in 2011-2012.

> I think they greatly miss that…they were actually taking time with the curriculum specialist to go in and look at the curriculum and actually map it out as a team. And that's a beautiful thing. (Interview with M. Croft, October 25, 2012)

Transportation to STEM Academy magnet programs. Ms. Croft explained that travel time is a concern for parents who apply to special programs. Dogwood staff are explicit about that concern during open houses and information sessions. Some kids thrive on that, getting their homework done, enjoying friends on the bus, and some even have wireless Internet access on the bus. While Dogwood sends between 12 to 15 students (four to five per grade) to the Ailanthus STEM Academy each year, Ms. Croft emphasized there are clearly many effective parallel, highly engaging academic opportunities for high achieving students at Dogwood. She described that while many discuss the Ailanthus STEM Academy model based on finance and logistics, particularly concerning the expense of busing students and the impact of long bus rides for some (45 minutes to an hour for some), she and other educators remain focused on the student impacts. But she concluded that it would be a "beautiful thing" if curriculum and instruction strategies could be shared and aligned with the specific needs of students at the existing feeder schools, and money spent on busing was instead spent on teacher training (Interview with M. Croft, October 25, 2012).

Parent perceptions on STEM academy components considered for replication. In answering a survey question specific to identifying components of the STEM Academy for replication, many parents recommended replicating the entire program throughout Piedmont. Some described this as a matter of equity for all Piedmont County students. Several Academy parents suggested that nothing about the program should be replicated, and only one feeder school Academy parent recommended a similar magnet alignment with feeder schools for

possible STEM academies in other regions of Piedmont. In support of the status quo, one parent explained,

> Please do not water down the existing program to create the "perception" of parity across the district. The success of this program for our kids is a byproduct of their willingness to learn and their merit based selection into the program. Not every student has a strong interest in math/science just like not every student could be identified as "gifted"...this should be considered in any decision to replicate the program.

Several Academy parents recognized that grouping similarly motivated or "like-minded" students with demonstrated interest and abilities allows for an accelerated curriculum. While many parents recommended the accelerated curriculum for replication, only a few explicitly recommended this approach to student grouping for replication.

Many parents recommended expanding to all students the opportunities for the unusual field trips, their frequency, and those trips that revisited the same study locations over time to promote observation skills. None mentioned the Academy teachers' concern that replicating field trips and special relationships with the facilities that support them would overwhelm those partners and make it impossible or at least much less likely to sustain those opportunities for students. Several Academy parents and many non-Academy parents stated that the special trips should be available to all 4th and 5th grade Ailanthus Elementary students, recognizing these trips are symbolic of the inequity of the Academy program.

Many parents identified the teachers as the distinguishing feature of the programs and some feeder school Academy parents explicitly asked whether or how their skills, motivation and passion could be replicated. An Ailanthus parent not associated with the Academy added, "The program is no longer *ahead of the curve* in its offerings. It has exceptionally dedicated teachers

who love what they do. Ailanthus has a large number of highly invested teachers that are not Academy teachers."

Concern for Protecting the Integrity of the STEM Academy Status

Academy teachers recognized the importance of community involvement and collaborative partnerships in creating unique experiences for students. Although the Piedmont elementary curriculum had evolved to adopt many of the same pedagogical approaches used by the Academy, the teachers continued to perceive these community resource connections and relationships were important and distinguishing characteristics of the Academy curriculum. They used their unique Academy status to make important connections to nearby or regional institutions. Academy teachers perceived their identity as an Academy had been important in establishing and maintaining these relationships. They perceived that these important connections could be lost or compromised if the Academy changed. Similarly, they expressed concern that if Academy programs are replicated throughout Piedmont, these Academy partners would be saturated with requests for similar relationships elsewhere and opportunities for Ailanthus Academy students would be diluted as partners become overwhelmed.

Concerns Related to Exclusivity, Diversity and Equity

I interviewed current Principal Ginger Fishman on October 8, 2012. Ms. Fishman has been an educator in Piedmont Public Schools since 2001, as a Special Education teacher and coordinator and as an assistant principal. Earlier, in Highland County, she had worked as a math coach. Her role in Ailanthus Elementary began in July 2012, and equity and diversity were primary concerns for Ms. Fishman.

Enrollment in the Academy. Enrollment in the Ailanthus STEM Academy is not lottery based. Ms. Fishman described how diversity and equity are influenced by parents in the more

affluent areas of Piedmont, who strive to have their kids at the Ailanthus STEM Academy. She perceived the parents' second preference is participation in the Ailanthus gifted cluster, and third preference would be enrollment in a regular class. She anticipated highly engaged parents would steer their child away from an inclusion class, which combine students of widely varying abilities.

In less affluent areas of the county, where less affluent families live, special programs such as the Academy remain less accessible. Ms. Fishman described how regardless of student ability, it is difficult for less established families to participate in school choice programs. Ms. Fishman described how a boundary change after the 2012-2013 school year began led to sudden overcrowding and six new portable classrooms. That led to complaints that 5th grade Academy kids (many from feeder schools) were being taught inside the school building classrooms while local Ailanthus students were reassigned to portable classrooms, perceived as less advantageous for students.

Ailanthus Assistant Principal Nevil Tyson reported that enrollment in the Academy is regularly uneven among the feeder schools, with schools enrolling more high SES students providing more applicants. While Boxwood, Chestnut, and Sycamore elementary schools regularly provide 14 to 15 applications, there are significantly fewer from Alder, Tupelo and Dogwood. Of these schools, Alder and Tupelo are Title I schools, and Dogwood Elementary was a Title I school until recently (Interview with N. Tyson, October 15, 2012).

Many educators interviewed described that recruitment from these Title I schools as vigorous (Interview with Academy Teachers, October 8, 2012). However, parents from some other feeder schools, from which applications were plentiful, reported they learned of the

Academy program only through other parents whereas information about other countywide special programs' application process was abundant (Parent Survey, October 29, 2012).

In consideration of the application process, I asked Assistant Principal Tyson whether he thought there is a way to distinguish students' genuine interest (as second graders) from the parents' interest in applying to a special program. Mr. Tyson replied,

> I find that hard to imagine that. Because every kid coming out of the second grade, the majority of them would be fascinated by the things in science, and typically that piques kids' interest. The study of what the moon, the sun, and hands-on things; however, I don't know if [interest in the Academy] is able to be conveyed by a student.

When asked about a lottery-based approach to selection to remove some of the perceptions of exclusivity, Mr. Tyson added,

> It would certainly take some of the elements out of the neighborhood prestige part, but here again, would it be feasible for everyone to be exposed to that curriculum?... I guess I haven't thought that far down the road yet about the benefit of, I guess you would call it a charter school, if there was someone to start one. I'm sure that would be possible in Piedmont. (Interview with N. Tyson, October 8, 2012)

Diversity within the Academy was a concern for past administrators. Former Principal Ms. Huddleston described how when she first went to Ailanthus Elementary, the selection process for the STEM Academy was flawed. When she reviewed the selection process with central office staff, they concluded that the Academy "was only taking smartest and brightest, not every kid with a strong interest." (Interview with L. Huddleston, October 30, 2012).

To improve the process, Ms. Huddleston encouraged use of a portfolio process. Because the performance tasks for the application process required families to travel on a Saturday, she

arranged for the Ailanthus representatives to go to the feeder schools beforehand. The Ailanthus representatives were instructed to ask school principals for permission to talk to students for 3-5 minutes, specifically encouraging applications from African American students and girls.

Ms. Huddleston highlighted the important role of Dr. Carolina Moore, the Gifted and Talented Curriculum Supervisor, in improving diversity by being a "cheerleader for all kids." Ms. Huddleston described Dr. Moore's concern for "little kids who think they might not be smart enough and don't apply"; and for the others who applied and weren't selected. She supported consideration of a lottery, specifically to increase the enrollment of African Americans and girls. She worried that Academy teachers were overly concerned about the types of kids they'd get, particularly those with behavioral challenges (Interview with L. Huddleston, October 30, 2012).

Two of the Academy lead teachers, Benigna Kaia and Cheyenne Ruskin, both Caucasian, had teaching experience in minority-majority settings in large cities. Both were explicit in their concern that the diversity of the Academy mirrored the diversity of Piedmont county schools. They were encouraged by a professor to go to the churches to tell families about the Academy opportunities, which they did. They also held information dinners at some of the Title I feeder schools to attract diverse students and they attended nearly all of the feeder schools' open houses. Teachers from Dogwood Elementary, a Title I school, were invited to the Academy to see students in classes. In my question about students' self-perceptions as scientists when not accepted into the program, one teacher explained her view:

> … you certainly [sic] wouldn't want any child to feel they didn't have the ability or the potential to do something…you know instead of saying, 'I'm sorry you didn't get in', we should have been able to say, 'You know there are other opportunities. We're going to be doing great things in your class too.' But I don't think as a building from the top

> down we handled some of those disappointments. (Interview with Academy teachers, October 8, 2012)

In contrast to these views, when I asked feeder school Gifted and Talented teacher Ms. Croft about the Academy application process, she was upbeat in her assessment:

> Actually it's really exciting, Piedmont has a great system with that because students can be referred by a parent, they can be referred by anyone who works within the school system who notices. Say for instance, an art teacher comes to me and says, 'You know Ms. Croft, Johnny was just expressing this amazing vocabulary during our art lesson, have you noticed this?' And I may not be in his cluster class, but when I hear that, I'll go visit that classroom and have a conversation with the teacher, call the parents and see if they would be interested in referring the child. A classroom teacher may say to me, 'Mrs. Croft, there's a student in my classroom that's really showing a potential in mathematics. I think we need to look at this child to see if this child really needs a differentiated curriculum.' Classroom teacher, anyone who works in the building, a parent. I receive phone calls all the time from parents that see this potential within their children.

Feeder schools had complementary processes for identifying students. According to Ms. Croft, teachers at Dogwood Elementary take notes on students' behaviors in their Rising Scholars Program and K-1 classrooms. So when it's time to refer first grade students to the gifted cluster there's a pattern of student behavior that supports an effective referral.

Ms. Croft reported that she is especially interested in providing opportunities in math and science for students with demonstrated abilities in these subjects, and that she is concerned there are so few opportunities. She described her mantra is that *all students should have access to opportunity*, and expressed her wish for more such opportunities.

> I would like to see something like [the Ailanthus STEM Academy] offered to not just one group of students who live in a particular zone, but to students who may have that propensity who live over on the other side of our area of Piedmont.

Commenting further along these lines, Ms. Croft expressed her concern for unsuccessful program applicants.

> I've seen children who are disappointed, obviously because they are not in the program and that leaves you wondering, okay well they don't get into the program, they go back into a regular class, so they're probably wondering in their mind: 'Am I really aligned to be someone who can be a mathematician or not? Or am I going to be a scientist one day?' So I wonder what influence that does have on students. There was a pattern before I came here. Evidently there were large numbers who applied to the program. Over the course of years, our numbers have declined. I don't know why that is. (Interview with M. Croft, October 25, 2012)

Distribution of resources. Ailanthus Principal, Ginger Fishman, expressed several concerns about the use of resources. Ms. Fishman described how the Academy field trips are not in her view equitably distributed, despite being funded through shared school-wide resources. Further, because field trips do not necessarily align with the Piedmont science curriculum, she is pressured by central office leaders to pay for them from other budgets, including PTA funds. Ms. Fishman has occasionally reallocated funding from other programs to extend some Academy field trips to non-Academy students so the whole grade can participate.

> What I did do...there's a cave field trip coming up for 5th grade. In the past it's only been Academy 5th graders, so I took summer camp money and all the 5th grade is going. I just can't sleep at night knowing that these kids who have probably been to this cave five

> times are going again and these kids who have never had the opportunity would be left behind... it's a [long] drive. And they study for [state exams] on the way up there, they all have iPads, and it's a great field trip. It's very expensive, and you know it's funny because [Academy teachers] say most kids outside the STEM Academy won't be able to afford it. So the implication there is that kids in the STEM academy can afford to go on more field trips than kids outside the STEM academy. (Interview with G. Fishman, October 8, 2012)

HOMS leader Ms. Clinton described how the Academy teachers were adamant about giving kids authentic experiences and community connections within a unique exploratory science curriculum. The curriculum provided for experiences such as the regular visits to the State Arboretum to see and document the same things over all seasons. *Science notebooking* (in which students collect all of their explorations, experiments, findings, and reflections in a single place) was a foundation for these experiences in this approach to learning. Students also regularly participated in project-based learning and sometimes problem-based learning, with an emphasis on using real data, thinking and acting like scientists and developing the habits of scientists. STEM Academy teachers also used pre-assessments to check for student misconceptions. Ms. Clinton emphasized that while these terms and strategies - mostly now ubiquitous throughout Piedmont County and elsewhere - were used in the original planning discussions in 2004, they were not common at that time, particularly in elementary schools, and were limited to the Academy students within Ailanthus Elementary.

When asked about the influence of the STEM Academy on the other Ailanthus Elementary classes, former Principal Ms. Huddleston described that it was a real challenge to have that school within a school, without any real boundaries. "The [STEM Academy] wanted

to be so unique; they had technology before others…It required a lot of transparent conversations." She described how Academy teachers received grants to become the first in Piedmont schools to have three SMART boards; and by making them available to the whole school they began fostering more sharing and more collegiality (Interview with L. Huddleston, October 30, 2012).

The Academy's 3rd grade Math teacher, Benigna Kaia, shared a rationale for the use of resources for the STEM Academy students:

> I just feel for the children we have been able to touch and I like that I can touch 52 children and I just feel like it's been important. That they have not sat and listened to something three or four times being retaught… And I don't know how you would adapt if you had a multi-ability classes, how would this work. Well, it may work beautifully. We haven't done that. But I know that not only do we plan the activities, but what they get from each other by being with people who care about school - you know, who want to learn more, who maybe haven't had the experience to share more - that it's really positive…But not all kids are ready for all things. They're all at different places at different times. Some kids need to be in 17-person classrooms and some can be in our 26-person classroom. (Interview with Academy teachers, October 8, 2012)

The school-within-a-school relationship and visibility of unequal treatment.

According to HOMS trainer Duana Clinton, the dichotomy created by the Ailanthus Academy within the larger school has been an irritant for teachers, parents, perhaps some students, and administrators. All principals worked hard to foster cross-pollination between the Academy and the rest of the school, so that the entire school benefited from the Academy, its resources, and thoughtful approaches to instruction. Meanwhile the many other highly engaged

teachers at Ailanthus Elementary, and particularly some in the Ailanthus Gifted Program (distinct from the Academy), developed their own outstanding approaches to teaching science and math (Interview with D. Clinton, October 25, 2014). All teachers acknowledged this concern, but the Gifted and Talented Science teacher described how she was motivated by this distinct identity to create a special non-Academy program, affirmed by both Administrators and current and past Piedmont Science specialists.

In interviews with key personnel, there were four manifestations of the school-within-a-school relationship that created concerns among many stakeholders: use of a specially designated Academy lab space, Academy teacher lab coats, Academy students' red t-shirts, and field trips. To mitigate two of these concerns, administrators successfully expanded laboratory facilities to provide equity and provided lab coats for any teacher that requested a lab coat.

The special t-shirt worn by Academy students on scheduled days remained an irritant to many teachers, perhaps as a reflection of how the teachers imagined the impact on students and perceptions of parents. Academy teachers recognized the sensitivities the t-shirts might create but noted the importance of being able to distinguish their students, who were regularly outside the school building collecting samples and traveling throughout the school while other school students were on the playground and in the hallways.

When I asked teachers how they imagined a non-Academy student, who might be interested in STEM but had never been encouraged to apply might perceive his or her own future as a scientist or STEM professional, when he or she sees a large number of red t-shirts pass by on the way to explore the school yard, the third-grade teacher, Ms. Kaia paused, and then began with, "I never thought about that." She wiped tears from her face and continued, "I don't want

that; I never realized that might be how we're thought of" (Interview with Academy Teachers, October 8, 2012).

Academy teachers explained their field trips as a product of many years of hard work, partnership building, outreach, outcomes, and shared public relations. They were comfortable extending these opportunities to all Ailanthus students, but stated they would resist any effort to make the opportunities available to other schools. "This would diminish all that our partners and parents believe is special about our program" (Interview with Academy Teachers, October 8, 2012).

I asked Mr. Tyson (Ailanthus Assistant Principal) about the extensive differentiation efforts I witnessed in a non-Academy, gifted math classroom, and what additional differentiation would be necessary if the Academy teachers classrooms were mixed with Ailanthus students and without students from the feeder schools. He described how the non-Academy teachers have taken a lead on differentiation, and contrasted this effort with the exclusive Academy trips to the state arboretum, zoological museum, and the state capital. The Academy teachers had their students share their projects and presentations with the rest of the school, which he described as a "trickle-down" learning philosophy that made perceptions of elitism and exclusivity seem only worse. Mr. Tyson perceived that science curriculum elsewhere in Ailanthus Elementary and the rest of Piedmont County has caught up. He was concerned that innovation at the Academy has stalled, and the distinctions are now based on exclusivity, again highlighting the extra field trips,

> I think it maybe has plateaued at this point. An interesting thing is they participate in more field trips than anyone else, and life experiences through field trips is wonderful in my opinion, but that's not reaching everyone who is in the school who could be doing that also. (Interview with N. Tyson, October 8, 2012)

Parent perceptions of equity and access. In the online parent survey, several parents recognized that where curriculum may be similar or identical, it is the makeup of the class that accelerates the learning. Many reported that students' intellectual and motivational homogeneity facilitates deeper learning, peer mentoring, and student-led experiential learning (inquiry). Several parents reflected the Academy teachers' comments that the concentration of high-achieving students significantly reduces classroom management ("discipline") challenges and how this is an important factor in creating a faster pace and a broader and deeper investigation of the curriculum.

Parents also cited the relevance of using real-world data, or real-world or science fiction-based problems and challenges, teleconferencing with scientists, and role playing, which all contribute to an enhanced learning experience, and that these are possible because of the accelerated pace facilitated by student interest, motivation, and reduced classroom management challenges.

Other parents praised Academy teachers for homework involving application or applied learning, rather than practice. Teachers and some parents questioned whether these instructional practices would be successful with groups of students needing more supportive instruction. Many parents focused their comments on describing the benefits for students with high interest and high aptitude, learning among others with a shared work ethic, interest and initiative, and proficiency that allows for greater challenge, motivation, and a faster pace. Several expressed a common desire for a better education for their children based on these widely perceived characteristics of the STEM Academy's learning environment. Several parents described how it made their child feel special and provided confidence in pursuing their academic interests, or simply in recognizing interests.

Academy Parents from feeder schools also described the cohort of similarly oriented students, hands-on activities and unique field trips, groupwork, and more in-depth, faster paced study in the fields of STEM. Many perceived the teachers to be hand-picked, perhaps not realizing it was those teachers who created the Academy. Feeder school parents also described characteristics of the highly regarded teachers reported by others: highly organized, dedicated, and a willingness to individualize instruction for accelerated learners.

Some parents described the described the Academy as a "private school in the public school", and some cited other parents "desire to push their children to excel at an early age"; the desire to be part of an exclusive "club" where 'my child is better than yours'". Other parents expressed their admiration of the Academy as a school that "...puts their children in classes with 'like' children from other schools" and "being surrounded by good kids" and "(from) nice families with interest in education "to perceptions of "...the feeling that the Math Science Academy students are from better families and have a more academic focus...and maybe more stable home environments." Others used descriptors of the Academy students such as *like-minded,* and *similarly proficient*, or *similarly motivated.*

Several parents suggested having more applicants than available spaces validates the purpose of the Academy, but others added that this has created a negative perception of all Piedmont elementary programs among disappointed families whose children were not selected for a special learning environment. One parent described how some parents began a movement to challenge the equity of the program when their students were not accepted, but became supportive when younger siblings were enrolled. A parent from a feeder school described misperceptions of their child's feeder school peers, who widely assumed their child's enrollment in the Academy was because of disappointment with the feeder school.

Academy parents attributed nearly all negativity concerning the Academy to parents of students who were not accepted, but many acknowledged the impact on their "home" (feeder) school, believing (incorrectly) that test scores of those feeder-school Academy students are assigned to Ailanthus Elementary rather than the feeder school. Many acknowledged the cost of some of the field trips but none stated that it was a barrier to their family's participation.

Parent perceptions of Academy impacts on other Ailanthus elementary programs. Some Academy parents described how the STEM Academy has divided the school, particularly concerning field trips and access to the science lab. One Academy parent stated, "Honestly the great teachers in the program would still be there if the academy went away and my younger (student) might have a better chance of getting those teachers, but I still think she would be better off applying for the program and hopefully getting in than if it were 'random' (via a lottery) who got those teachers."

Several parents of students from other Ailanthus classes (not enrolled in the Academy) were positive and supportive of the STEM Academy, and some expressed a desire for their student's younger siblings to have an opportunity to attend.

Others offered cautionary statements concerning self-perceptions of students that are not accepted, or are put on the waiting list. Many commented on perceptions of exclusivity, fairness to all and disadvantages to some, a recognizable lack of ethnic and socioeconomic diversity, and divisiveness in the school's community. Field trips and STEM Academy t-shirts were the most frequently cited examples, but others described negative behaviors reflected by Academy students in gym classes, the cafeteria, and even among parents.

Many applauded specific administrative decisions, such as a former principal's decision to change the science fair competition to a participation-recognition event, largely because of the presumptions of or actual impact on students who were not part of the academy.

The findings presented in this Chapter described the distinguishing features of the Ailanthus STEM Academy implementation, how key personnel and parents perceived the program over time, and factors that were influential in perceptions of the program implementation. In the next chapter (Chapter 5) I will discuss these findings in the context of the research literature, and provide discussion and recommendations concerning STEM-focused, school-within-a-school magnet programs. I will also propose several directions for further research.

CHAPTER 5 - DISCUSSION AND IMPLICATIONS

Overview

In this Chapter I begin with a summary of the STEM Academy program implementation; and then in the context of the research literature, I describe how the STEM Academy program implementation was influenced by perceptions of exclusivity and equity of resources and opportunity, and also how these factors influenced the sustainability of the program. Based on the findings presented in Chapter 4, I provide a discussion concerning the implementation of best practices, the challenges due to incomplete communication and documentation, how the program implementation created perceptions of exclusivity and inequity, and how the lack of planning and documentation influenced program evaluation and replicability. Based on this discussion, I provide six recommendations for STEM program implementation and evaluation. Finally, I provide suggestions for areas of further research in school-within-a-school and magnet programs, STEM academies as pilot projects for replication, and team-based interdisciplinary planning.

Summary of the Academy Program Implementation

The Ailanthus STEM Academy program began with highly motivated teachers wanting to provide special opportunities for students interested in science, math, technology, and the processes of engineering. They were also interested in creating a special program in which they could invest themselves professionally and personally. When they met initial resistance from central office administrators and were refused extra resources, they relied on a highly skilled and strong-willed building principal who rallied PTA parents and nearby building leaders to create the special Academy program on their own. The initial adversarial position with Piedmont school district curriculum leaders was never overcome, even as those leaders moved on to other

roles, and the Academy program was implemented without documentation of long-term goals, an evaluation plan, or consideration for replicability.

As the Ailanthus Elementary leadership changed, Gifted and Talented program leaders recognized the successes and reputation that was developing at the Ailanthus Academy and these central office leaders offered conditional support. That enabled the Ailanthus Academy team to build a solid foundation for a sustainable program, but the teachers did not succeed in documenting their curriculum according to school division policies, a goal that might have facilitated program replication across other Piedmont County schools. The Academy teachers' resistance to documentation exacerbated tensions with Gifted Services staff in the central office, and fed concerns related to inequity and elitism of the Academy program.

Discussion

Academy Implementation was Perceived Consistent with STEM Education Best Practices

The Ailanthus program was developed with Hands-On Math and Science (HOMS) resources consistent with the National Science Teachers' Association (NSTA) position statement on elementary science, seven key principles (NSTA, 2002). Students were engaged in problem-solving tasks in a scientific and technology-integrated context, and enjoyed access to real-world resources and data. Teachers developed learning activities with a primary emphasis on science and math, and indirectly technology and engineering. They enjoyed the support of parents, businesses, and community members.

Discussions with school leaders, teacher interviews and supporting classroom observations revealed that Ailanthus Academy teachers provided all the important components reflecting inquiry-based classrooms described by Martin and Hand (2009): active investigations; dialogs between teachers and students; collaboration among students; and also the authentic

explorations of students' own questions. These features reflect recommendations of the AAAS Benchmarks for Science Literacy (1993), and they remain challenging for most elementary classroom teachers today. The teachers were well-trained and confident in their content mastery and pedagogy, and dedicated to making their program exceptional.

Project-based learning and *problem-based learning* were apparent throughout the curriculum, and their strategies reflected the recommendations of advocates for inquiry-driven investigations including Savery and Duffy (1995), Thomas (2000), and Pearson, et al. (2010). Learning activities were based on real data and student data collection. Teachers promoted design processes that involved students in building models and testing them, with opportunities and time for re-design, even though an accelerated pace and expanded curriculum were hallmarks of the program. While project-based and problem-based teaching and learning strategies in elementary school are understandably less student-centered than in upper grades, the Ailanthus Academy teachers were proficient in creating both autonomy and cooperative learning, opportunities for self-assessment, and the use of technology and community resources. These technologies were used to connect to scientists and engineers, nonprofit leaders, politicians, and others to explore citizen science and service learning opportunities. For elementary teachers and others, these opportunities are limited by teachers' access to the community resources and limitations with their facility with inquiry processes.

Even before the concepts of integrative STEM had evolved in the research literature (Sanders, 2009), the Piedmont HOMS trainer and the Ailanthus Academy teachers had implemented cross-curricular strategies throughout their learning activities. The Academy program benefited from the ongoing participation of the same highly engaged teachers during the first decade of implementation. Science and math teachers made the socio-political, historical or

geographical connections with scientific understandings explicit. Teachers of English language arts and social studies integrated scientific themes and non-fiction with reading, writing and presentation skills, with the support of and planning with their grade-level colleagues. There was also coordination across grade levels. Integration was not only intentional but also assessed through applied learning, projects, and cross-curricular items on formative and summative assessments. These features made cross-curricular connections explicit for students, added context to everyday learning, and exemplified the learning experiences that became better known today as integrative STEM (Sanders, 2009, Pearson et al., 2010).

Incomplete Communication and Documentation Compromised Sustainability

Despite the success in implementing strategies consistent with emerging best practices in STEM pedagogy, there were two areas in the implementation in which the Academy leaders struggled: communication and documentation.

A protective principal supported teachers who had the aptitude, motivation and opportunity to innovate. In supporting the teachers, the principal refused the involvement of central office curriculum and instruction leaders. Instead, both Ailanthus Academy teachers and central office leaders seemed to pursue similar ideas independently, so suspicion and frustration became prevalent and animosity and defensive postures compromised the Academy's sustainability. Communication was incomplete and typically minimal. Autonomy granted to Piedmont school building leaders may have provided many advantages in promoting innovation and responsive actions to individual school needs, but it also limited the effective visioning, goal-setting, planning, strategizing, and assessing necessary for the larger school system. If communication and cooperation had been achieved, the central office leaders might have refined

the Academy's image enough to avoid or overcome perceptions and misconceptions of elitism and exclusiveness.

The teachers also resisted efforts to document and share their curriculum and strategies, fearing their community partnerships and exceptional learning activities would be readily adopted or mimicked, thereby diluting their program's uniqueness and its integrity. Had these approaches and strategies been documented and shared with other teachers in the school and school division, collaboration with central office leaders would have been more likely and the Academy may have been better received by those who felt excluded from the school or the curriculum. Ironically, the teachers' behavior mimicked older engineering design processes, in which successful outcomes were shared only with the patent office, rather than newer design processes where successful tools are shared as *open source* tools.

The Academy's cross-curricular integration initiatives and successes were also deserving of replication but were not shared with the rest of the Piedmont school district, and initially not even the rest of Ailanthus Elementary School. The teachers may have believed their collaboration was unique and the strategies were not transferable or they may have found so much satisfaction in their instructional role that there was little motivation for seeking professional growth through presenting good ideas through teacher conferences. Similarly, they did not recognize or exercise the important role of documenting and sharing their learning activities and strategies, and thereby alienated themselves from resources that could have enhanced their program's sustainability.

With ongoing curriculum support, documentation, alignment with other Piedmont initiatives, and frequent sharing of best practices, the STEM Academy could have served as a pilot and laboratory for evaluating program implementation for replication throughout the school

division, without diluting the special flavor or integrity of the Academy. Indeed, as a laboratory for best practices, the Academy teachers and their Ailanthus Elementary colleagues may have been rewarded with continuing resources for professional development and expanding partnerships.

Of all stakeholders, the only perceptions that remained positive throughout were those of the STEM Academy parents. Parent perceptions are a major concern for administrators in all schools, but particularly in elementary schools where students do not commonly exercise self-advocacy. The parents' consistent support and promotion kept interest high, resources flowing, and community connections rich and engaging. The perceptions of other Ailanthus and Piedmont parents, however, created challenges for the program that were particularly problematic for elected school board members: elitism, exclusivity, and lack of diversity.

The Academy Program Design Created Perceptions of Exclusivity and Inequity

The Ailanthus STEM Academy operated as a school-within-a-school and served as a magnet program attracting a total of 52 students in each grade 3 through 5. For each grade, 26 students were recruited from the larger Ailanthus Elementary school, and an additional 26 students were recruited from among six feeder schools nearby.

School-within-a-school programs and perceptions of exclusivity. The school-within-a-school program at Ailanthus Elementary was highly regarded and highly promoted by Academy teachers, participating parents, and by some community partners. The explicitly recognizable distinctions between the STEM Academy students and the remainder of the Ailanthus Elementary school may have elicited interest from parents, but it also brought problems. The perceptions of the Academy within the Ailanthus Elementary community would likely have been more positive if there was equity in access to resources, shared or aligned

curricula, and less celebration of its distinctness through special t-shirts, special Academy-only field trips, and less branding overall. Also, because the Ailanthus STEM Academy shared the same administrators, hallways, budgets, and other features of Ailanthus Elementary, it did not fully achieve the smaller-school environment that is a primary goal of school-within-a-school programs (Raywid, 1995), and the lack of separation likely compromised its success in school satisfaction, teacher morale and the larger community (Dewees, 2007).

Concerns for equity and exclusivity of the Ailanthus STEM Academy might have been reduced by more separateness from Ailanthus Elementary, a district-level reporting relationship, and a separate budget. Of course, these features also require administrative support and additional costs. Interviews and observations suggest that the Ailanthus STEM Academy suffered from challenges in all of the concerns recognized by Matthews and Kitchens (2007) when providing exceptional learners with a differentiated content and pace while coexisting without antagonism or perceptions of elitism:

- transparency and communication;
- flexible access to Gifted and Talented Programs;
- equitable access to equipment, facilities and field trips;
- awareness of misconceptions and stereotypes; and
- recognition of diverse pathways to excellence and achievement.

Magnet school programs and diversity, equity and outcomes. Many useful data about Ailanthus Academy diversity and outcomes were not available because they were not recorded or maintained separately for participating Academy students. Instead, these data were aggregated with the students' home schools of attendance (feeder schools) rather than the Academy. For example, the scores for a top achieving Ailanthus Academy student recruited

from Dogwood Elementary were included in state reports for Dogwood Elementary, not Ailanthus Elementary or the Ailanthus STEM Academy.

This aggregation of data compromised my opportunities to compare the Ailanthus Academy with the results from other schools based on overall performance and self-selection, and findings of Adcock and Phillips (2000) that magnet program students did not fare as well as students with similar ability in non-magnet programs. The Adcock and Phillips study was particularly relevant in considering outcomes of non-Academy gifted classes in Ailanthus Elementary and the other schools. Although the Academy program was distinct from other academic programs and curricula early in its implementation period, highly engaged teachers in non-Academy Ailanthus Elementary and other schools quickly and comfortably adopted successful and engaging learning activities. As such convergent evolution happens elsewhere, school division leaders and parents questioned whether this magnet program should continue to deserve special status, exemptions from some school division requirements and extra resources.

This aggregation of Ailanthus Academy and non-Academy data may have also reduced attention to concerns for diversity at the Ailanthus Academy, and may have been very important in securing continued participation from the feeder schools. If gifted students have higher levels of achievement in the Academy program, but the scores and demographic data are reported to the state Department of Education through the feeder school, this advantages the feeder school and encourages continued administrative support for sending their students to the Ailanthus Academy. The alternative - including the high achieving, less diverse students in the Ailanthus Academy or Ailanthus Elementary scores - would likely be disadvantageous to all. Likely the scores for feeder schools would be lower and the diversity metrics for Ailanthus Elementary would also be lower.

Nevertheless, perceptions of an elite, less-diverse academy persisted, and we must imagine how young people of color see the Academy and themselves when underrepresented in a magnet-program academy. Moreover, when any subgroup is identified and segregated for their proficiency or ability, we must consider whether those not included perceive limits to their future access to opportunities and aptitude for success. As we consider the future STEM workforce, in both technical skills jobs and scientific and technical leadership careers, it is extremely important to promote inclusiveness in access and expectations.

Incomplete Documentation Compromised Evaluation and Replicability

The Ailanthus Academy was created without a formal evaluation plan, and there was no evidence or documentation of informal evaluation plans. There were missed opportunities to study how teacher preparation, and content-based or pedagogy-based professional development informed implementation. Frykolm and Glasson (2005) described how these variables can inform evaluation of integrative curricula, but at the time of this implementation there was no plan for replicability or transferability, and the program was not even studied as an evolving implementation of Hands-on Math and Science curricula. Further, the implementation of backwards-design models such as Understanding by Design (UbD) was well underway in Piedmont County, providing for established desired outcomes, goals, and thorough documentation; but the Ailanthus Academy was developed without this central office support and guidance. Without those central office resources, the program was left to evolve each year through informal and collaborative reflection rather than formal evaluation and analysis of student outcomes.

Support from the HOMS trainer provided sufficient resources and strategies for continued success and progress, tangibly measured only by parent and student interest in the

program, while central office staff remained at arms-length. Had the program been implemented with an evaluation plan based on a two-part analysis of professional development on teacher practices and teacher practice on student outcomes, the program data might have provided a very effective pilot for county-wide replication. Further, if the evaluation plan had been informed by analysis of Academy teacher behavior and ongoing training, and changes in perceptions that measure adaptability during cycles of change, opportunities for replicability and transferability might have been significantly enhanced (Frykolm & Glasson, 2005; Peterson, 2013).

Program documentation and planning as critical to fidelity of implementation. Because the Ailanthus STEM Academy was developed with limited school district guidance, program documentation and evaluation were not part of early planning and no explicit goals were established nor metrics considered for measuring success in long-term outcomes. As the program received accolades from parents and the community, interest from nearby schools contributed to further program changes from sending small numbers of students (typically 3-5) from feeder schools each year. Academy leaders added three staff positions and made internal adjustments, and simply adapted to the additional students. However, there is no evidence that any further short-term planning or goal setting took place.

If such planning, documentation and evaluation had been considered, the fidelity of design could have established the Academy as a model for replication, demonstrated successes could have quieted critics, and stakeholders and others may have suggested solutions to concerns for equity and diversity rather than create challenges to the Academy's existence. The University of Chicago Center for Elementary and Mathematics Education (CEMSE) framework (Century et al., 2008, 2010) recognized that context and conditions influence implementation and that such contextual factors should be considered in comparing outcomes to the initial plans and

goals. Therefore, in order to measure the extent to which an implemented program is consistent with the intended program model, program designers should not only have considered evaluation in their implementation planning, but also should have provided documentation of all standard planning components such as mission, vision, goals, timelines, collaborations, communications, staff and leadership changes, and interim and long-term metrics.

In their study of the 4E learning cycle (Engage, Explore, Explain, Evaluate), Bodzin et al (2003) described the important influence of teacher burdens on fidelity of implementation. The STEM Academy teachers were a driving force in implementing the closely related BSCS (Bybee, et al, 2006) 5E learning cycle (Engage, Explore, Explain, Elaborate, Evaluate), and only in documenting their curriculum did teachers or key personnel describe the influence of teacher burdens. The Understanding by Design (UbD) curriculum planning strategies (Whiggins and McTyghe, 1995) were never fully adopted or utilized by the teachers, so there was no documentation of the desired outcomes, big concepts, essential questions, or alignment of other metrics with the selected learning activities that could have facilitated an evaluation consistent with the CEMSE framework described above. The teachers' resistance to the UbD burdens created additional conflict with central office staff, which in turn created additional professional and personal stress for the teachers.

In considering the scope of the implementation, the Academy developers may have intuitively considered considers factors of success, such as the nine characteristics identified by Ruiz-Promo (2006) and described in more detail in Chapter 2 in guiding program implementers:

- *Complexity of the program* - more complex programs have lower fidelity;
- *Time required* - longer timelines have lower fidelity;
- *Materials and resources required* - unplanned resources lower fidelity;

- *Number of providers* – more contributors lower fidelity;
- *Available implementation manuals* – poor guidelines lower fidelity;
- *Training* – poorly trained implementers lower fidelity;
- *Sites and context* - variations lower fidelity;
- *Staff experience or commitment* – effects of experience vary, reduced commitment lowers fidelity; and
- *Theoretical agreement* – lack of alignment lowers fidelity.

The Ailanthus STEM Academy implementation benefited from a minimally complex program, a small number of providers, intensive training, a narrow context (at least initially), and high staff commitment. Although not formally established, the short timeline and narrow scope of required resources probably also advantaged the Academy implementers. However, the long-term success and sustainability of the Academy implementation suffered from the lack of an implementation plan and lack of explicit theoretical agreement with central office leaders and perceptions.

Also, all of the early curriculum design and mapping was for the purposeful implementation of the Academy's first year, which meant the teachers often worked just a few months ahead. They worked with printed materials and traditional planning books rather than using technology more suitable for formal documentation and archiving. Increased planning, documentation and collaboration with the central office may have prepared implementers for the challenges of a school-within-a-school challenges of perceived elitism, lack of diversity, and expectations of cooperation and sharing.

Case study approach to STEM program post-implementation analysis. The case study approach, and particularly an exploratory case study approach, was important for analyzing

the Academy implementation in the absence of an evaluation plan and comparative student outcome data. In all sciences, we strive to begin any exploration by determining what questions we want to answer. Choosing those questions is influenced by, and in turn influences, the story we can tell. How do we choose which variables to study, which to control for, and which can be ignored? How do we distinguish confounding variables from important variables, and how do we distinguish the "signals" from the "noise"?

In promoting strategies for differentiated instruction and individualized learning, we are quick to point out that every student's combination of perceptions, learning styles, and physical and emotional needs are different. In creating and designing professional development we discover the same is true for our participating teachers. This case study approach reinforced how each school and school division also provides a unique context, and how important it is to examine all unique features and perspectives in evaluating the factors of successful program implementation, rather than attempting to isolate the outcomes that can be correlated to a single variable.

Reflecting back on Fitzpatrick et al. (2004) and Yin (1994), a case study analysis of a special school program would ideally include quantitative measures of student outcomes, student demographics, and sufficiently illustrative, qualitative descriptions of program adoption. It would also include early preparation for implementation, problems and frustrations, surprises and successes, staff adaptations, and environmental influences. It is necessary to hear the voices and perspectives of many different stakeholders that give context to the quantitative measures of student outcomes.

Fitzpatrick et al. emphasized data collection from different sources, but focusing on qualitative methods such as observations, interviews, and the study of existing documents.

Patton (2002) provided the emphasis on units of analysis that are usually determined during the design stage and become the basis for purposeful, qualitative sampling. The lack of clear, establish goals, desired outcomes, and Academy-specific data collection strategies compromised administrators from using the Ailanthus Academy curriculum and strategies for replication throughout Piedmont County Schools. However, this exploratory case study revealed that many other professional and inter-personal factors influenced the perceived successes and opportunities for collaboration. Based on these findings, future investigations with sufficient planning and outcomes data could be more explanatory or descriptive in design (Griffis, 2014).

Perception data as important in case studies of special programs. The emphasis on perception data encouraged by my committee and affirmed by the research literature proved to be most revealing in this case study, particularly considering the conflict between central office staff and Academy leaders. Experienced program designers and implementers know from personal examples that others' perceptions are the *reality* in which they must operate. Many have been credited for a relevant saying, promoted most recently by Steven Covey, "We see the 67world not as it is, but as we are."[3] With the best of intentions and planning, a program implemented without consideration of others' perceptions is vulnerable to misconception, and perhaps most vulnerable to the perceptions of those who feel excluded. Regardless of the merit of a program's design, the implementation of the program will likely always be limited by the perceptions of its stakeholders. Programs supported by public funding, under the control of elected officials may be especially vulnerable. Accordingly, researchers and evaluators must acknowledge these perceptions in their sampling, interviews, and field observations.

---

[3] The oldest references are attributed to an interpretation of the Talmud, but in the context of interpreting dreams. But others cited include Immanuel Kant, Anais Nin, H.M. Tomlinson, and most prominently by Steven Covey.

Specifically concerning teachers, we must recognize that the burdens of teaching careers lead most teachers to seek and adopt efficiencies, find a "groove" in which they can establish efficacy, and that administrative changes that interrupt such efficiencies are very disruptive. The processes for ongoing exploration of teacher perceptions like those established by Guskey (1988) and the CBAM Stages of Concern (Hall & Hord, 2006) were not available to these teachers through normal channels because of the ongoing challenges and alienation from central office leaders. There was no structured reflection, exploration or documentation of teachers' feelings and perceptions. Therefore, perceptions were neither challenged nor validated, and grew toward polarization. As central office staff members grew concerned and frustrated, the Academy teachers grew defiant and defensive.

The Ailanthus Academy case study findings affirm all six of the CBAM model assertions for implementing change (Hord, et al., 1987):

1. change is a process rather than an event;
2. change is accomplished by individuals, and influences them;
3. change is a highly personal experience, and paying attention to individual's responses enhances outcomes;
4. change involves developmental growth, and individuals express or demonstrate their growth through both feelings and skills, evolving with experience with the change;
5. change is best understood by teachers in terms of what it will mean to them and their practice, and what changes in their (or their students') beliefs and behaviors are necessary; and

6. facilitators should focus on individuals, innovations and context, as even small innovations have widespread effects.

Without opportunities during the early implementation to explore and understand changes in perceptions of the teachers, there was no opportunity for aligning useful resources or interventions. Moreover, there were no structured opportunities to authentically measure the perceptions of community stakeholders except through anecdotal evidence, which may have been obscured by sustained interest and demand for the program by parents. The ongoing struggle between the central office and the Academy leaders supported the assertion by Ornstein and Hunkins (2004) that for influenced individuals (in this case, the teachers) to embrace change they must have ownership of both the concern and the processes of the change.

Recommendations

I offer the following seven recommendations for implementing Elementary STEM programs and evaluating their implementation.

1. ***Special programs within an elementary school must be inclusive and equitable in sharing resources.*** Unlike secondary special programs that can be established based on student self-selection and longer-term evidence of aptitude and interests, elementary programs must avoid all factors contributing to exclusivity. In this case study, perceptions of inequity eroded school, school board, and school-district personnel support for the program. Particularly at the elementary level, parents, the community, and the students themselves perceive and should be encouraged to perceive that all doors to all possibilities remain open, and the community will support all students with engaging, stimulating, challenging learning environments. Like race or religion, unequal or inequitable celebration of any subgroup fosters perceptions of exclusivity and ineligibility, and nurtures harmful attitudes of resentment and resistance. Even small

investments like special t-shirts can be perceived by young children as exclusive. Bigger things like special laboratory spaces, special field trips, and special classroom technologies not only demonstrate inequity, they also contribute to achievement gaps and other undesirable long-term outcomes.

2. ***Lottery-based enrollment is a useful selection tool for elementary STEM programs.*** When interest among parents and students is greater than available opportunities within existing attendance-zone policies, opportunities should be determined by double-blind lotteries. Magnet programs based on STEM education should include targeted outreach that facilitates interest and participation that matches community demographics for race, ethnicity and gender, and a double-blind lottery is likely to be a better approach to ensuring equitable access than other strategies for determining access. When multiple feeder schools are involved, the total available seats within a lottery can be divided among these schools evenly, thereby representing the entire attendance zone.

3. ***School-within-a-school programs should be reconsidered at the elementary level.*** The requirements for successful school-within-a-school are typically not feasible within an elementary school setting. Relevant research (Matthews & Kitchen, 2007) suggests that at the secondary level, school-within-a-school programs are best implemented with separate administration, budgets, teachers, and spaces. These attributes are nearly always too expensive and complicated in elementary schools, which have smaller budgets and smaller facilities. When such school-within-a-school programs provide for special opportunities and resources, they have been shown to cause resentment from the larger school populations even in high schools. When a school-within-a-school program is considered (e.g., an optional language immersion program), equity in resources and opportunities must be emphasized.

4. ***All stakeholder perceptions must be considered throughout a STEM program implementation cycle.*** Beginning with early program visioning processes, stakeholders should be invited to participate and to share their perspective of innovative programs. This can include involving representatives of parents, teachers, businesses, non-profit groups and other community members on writing teams during the visioning process. An advisory committee with similar representation should be considered throughout the implementation cycle. In addition to the benefit of having these representative perspectives during planning, the same stakeholders can become disciples, advocates, and supporters in meeting the programs' special financial needs. In this case study, some stakeholder perspectives influenced STEM Academy decisions, but there was no evidence that stakeholder perspectives were ever solicited, collected or addressed in a transparent, formal manner.

5. ***Ongoing evaluation must be part of STEM program planning.*** Evaluators should be part of the planning and leadership teams. Early planning should describe desired outcomes, methods and metrics of assessment, with the anticipation of measuring the fidelity of implementation. Evaluation teams can be qualified internal or district-based personnel, or provided by community or university partners. Having evaluation teams, particularly if guided by research questions or evaluation questions aligned with the program's goals or larger goals (e.g., school board or state or federal education goals), may also be more attractive to funders interested in supporting innovative pilot programs. Evaluation plans should include quantitative measures of student outcomes, student demographics, and qualitative descriptions of the processes of program adoption, early preparation for implementation, personnel involved, problems and frustrations encountered, surprises and successes, staff adaptations and rationales, and evolving environmental influences.

6. ***Documentation of program goals, curriculum, and changes is critical for sustainability and replicability.*** Documenting all components of a program implementation vision allows for reflective practice, re-orientation or redirection when necessary, and data collection that supports consideration for expanding or replicating such programs. This documentation can be challenging for elementary schools without sufficient staff, but coordination and collaboration with central office curriculum specialists will likely allow for extensive support, templates, and advocacy when changes are needed. Also, highly engaged parents or community supporters may provide necessary skills. While the STEM Academy in this case study was strongly influenced by a highly regarded curriculum-based teacher development program, there was insufficient documentation of the curriculum, no documentation of alignment with school-district goals and policies, and little or no communication with central office curriculum leaders. Without documentation, central office leaders had no established way to measure outcomes, provide for replicability and transferability, demonstrate alignment with countywide priorities and policy changes, and solicit support to sustain the program. Such documentation also becomes critical as the program matures, partners or collaborators change, funding sources change, and especially when leadership changes.

Suggestions for Further Research

This Ailanthus Academy case study suggests several opportunities for further research in the implementation of other magnet and school-within-a-school programs. These suggestions are provided without investigation of the associated costs.

Comparing of in-school STEM programs with STEM magnet schools. Research projects might explore how perceptions and outcomes vary among different STEM education structures. How do equity, access and exclusivity differ between in-school programs limited to

only students within the host school's attendance boundary, from magnet programs that draw participants from other areas but exclude students from the host school? If in-school programs integrate with the host school better than magnet programs, do in-school programs provide a more equitable approach to engaging every student, overall improved achievement and reduced achievement gaps (all were Piedmont strategic goals)? Can in-school participation be based on student and parent interest, be fluid from year to year, and be expanded or contracted as necessary based on enrollment? What are the benefits and opportunity costs when curriculum strategies are consistent across the whole school, enhanced with different pacing or with an emphasis on individualized learning?

Examining ways to improve equity and access in STEM programs. How can designations of "pilot project" be used to address or minimize concerns for equity and exclusivity? Can the anticipation of replicability or scalability expand support for programs among stakeholders who do not yet have access? Similarly, can expectations of sharing new innovations provide administrators and teachers with new flexibility in programs, partnerships, and community resources? Can highly engaging and often geographically unique and relevant community partnerships be developed as models for other schools to approach similar partners? How flexibility for innovation be matched with expectations for providing professional development or workshops for sharing strategies and resources?

Examining facilitation of communication, collaboration and trust of programs within and across school boundaries. How can developers and implementers expand school-wide and district-wide support for special programs and minimize perceptions of exclusivity? Can special programs faculty be shared with the larger host schools to promote equity? How can team-based interdisciplinary planning be encouraged across traditional content areas (e.g., Science,

Social Studies, Reading, Math, Art and Music) and program boundaries in all elementary schools? Are integrative, interdisciplinary teaching and learning within teams reinvigorating for all practicing teachers, as they were for Ailanthus Academy teachers? Is the planning time necessary for team-based interdisciplinary teaching efficient, or better spent on sharing strategies and ideas by individual instructors focused on their own students? How can schools foster teachers' professionalism and provide regular opportunities to refresh the curriculum while expanding all participants' breadth and depth of experience and professional practice? How do elementary STEM specialists or teams complement classroom teachers' or reading specialists' curriculum connections in each grade? Can a well-trained elementary teacher integrate interdisciplinary connections as effectively, but more efficiently, than teacher pairs?

Investigations of longitudinal student outcomes of STEM-focused education programs. How can increasingly available longitudinal data be used to measure outcomes of special programs? What factors of special programs are most influential in developing student and parent interest and engagement? How are parents perceptions of desired outcomes for participation special STEM programs aligned with school leaders' perceptions? What factors of elementary school special programs are most strongly correlated with outcomes that address concerns for a STEM-ready or STEM-literate workforce? How do elementary STEM programs affect students' long-term interest, motivation and resilience in pursuing STEM education and careers?

REFERENCES

Adcock, E. P., & Phillips, G. W. (2000). Accountability evaluation of magnet school programs: A value-added model approach. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

AIMS Center (2014). AIMS Math and Science Professional Development. Retrieved from www.aimsedu.org/tag/hands-on-math-and-science/ on November 20, 2014.

Alexander, B. (2006). Web 2.0: A new wave of innovation for teaching and learning?. *Educause Review*, 41(2), 32.

American Association for the Advancement of Science (AAAS). (1993). *Benchmarks for Scientific Literacy*. New York: Oxford University Press.

Appleton, K. (2007). Elementary science teaching. In S. K. Abell & N. G. Lederman (Eds.), *The handbook of research on science education* (pp. 493–535). NJ: Lawrence Erlbaum.

Barro, R. J., & Lee, J. (2001). International data on educational attainment: updates and implications. *Oxford Economic Papers*, *53*(3), 541-563.

Beaton, A. E., Mullis, I. V., Martin, M. O., Gonzales, E. J., Kelly, D. L., & Smith, T. A. (1996). *Mathematics achievement in the middle school years: IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: TIMSS International Study Center, Boston College.

Biological Sciences Curriculum Study (1993). Developing Biological Literacy: A Guide to Developing Secondary and Post-secondary Biology and Post-secondary Biology Curricula. Colorado Springs, CO: Biological Sciences Curriculum Study.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist*, 26(3-4), 369-398.

Bodzin, A., Cates, W., & Price, B. (2003). Formative evaluation of the exploring life curriculum: Two-year implementation fidelity findings. Annual meeting of the National Association for Research in Science Teaching, Philadelphia, PA.

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., et al. (2006). The BSCS 5E instructional model: Origins and effectiveness. Colorado Springs, CO: BSCS.

Century, J., Freeman, C., & Rudnick, M. (2008). A framework for measuring and accumulating knowledge about fidelity of implementation (FOI) of science instructional materials. annual meeting of the National Association for Research in Science Teaching.

Century, J., Rudnick, M., & Freeman, C. (2010). A framework for measuring fidelity of implementation: A foundation for shared language and accumulation of knowledge. *American Journal of Evaluation*, 31(2), 199-218.

Crawford, B. A. (2000). Embracing the essence of inquiry: New roles for science teachers. *Journal of Research in Science Teaching*, 37, 916–937.

Dewees, S. (2007).The school-within-a-school model. Retrieved from http://www.txechs.com/downloads/24_school_within_school.pdf

Drake, S. M. (2007). Creating Standards-Based Integrated Curriculum: Aligning Curriculum, Content, Assessment, and Instruction. Thousand Oaks, CA: Corwin Press.

Egenrieder, J. A. (2010). Facilitating student autonomy in project-based learning to foster interest and resilience in STEM Education and STEM Careers. *Journal of the Washington Academy of Sciences*, 96(4), 35-45.

Everyday Mathematics (2015). Resource and Information Center. University of Chicago. http://everydaymath.uchicago.edu/parents/.

Fitzpatrick, J. Sanders, J., & Worthen, B.(2004). *Program evaluation: Alternative approaches and practical guidelines*. Boston: Allyn and Bacon.

Frykholm, J., & Glasson, G. (2005) Connecting science and mathematics instruction: Pedagogical context knowledge for teachers. *School Science and Mathematics* 105.3: 127-141.

Ghaith, G., & Yaghi, H. (1997). Relationships among experience, teacher efficacy, and attitudes toward the implementation of instructional innovation. *Teaching and Teacher Education, 13*(4), 451-458.

Goldring, E., & Smrekar, C. (2000). Magnet Schools and the Pursuit of Racial Balance. *Education and Urban Society*, 33(1), 17-35.

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational evaluation and policy analysis*, *11*(3), 255-274.

Griffis, M.R. (2014). Bricks, mortar, and control: A multicase examination of the public library as organization space, in Williams, D.E.and Golden, J. (ed.) *Advances in Library Administration and Organization* (Advances in Library Administration and Organization, Volume 32) Emerald Group Publishing Limited, pp.1 - 106

Guskey, T. R. (1988). Teacher efficacy, self-concept, and attitudes toward the implementation of instructional innovation. *Teaching and Teacher Education*, 4(1), 63-69.

Hailey, C., Erekson, T., Becker, K., & Thomas, M. (2005). National center for engineering and technology education. *The Technology Teacher, 64*(5), 23.

Hall, G. E., & Hord, S. M. (2006). Implementing change: Patterns, principles, and potholes.

Hord, S. M., Rutherford, W. L., Healing-Austin, L. & Hall, G. E. (1987). Taking charge of change. Alexandria, VA: ASCD.

Horwitt, D. (2004) Farewell to Hippie High. Washington Post. June 13, 2004, Page W28. Retrieved from http://www.hbwoodlawn.org/postarticle.pdf on September 30, 2013.

Johansson, F. (2004). The Medici effect: *Breakthrough insights at the intersection of ideas, concepts, and cultures*. Harvard Business Press.

Lewis, L. K., & Seibold, D. R. (1993). Innovation modification during intraorganizational adoption. *Academy of Management Review*, 18(2), 322-354.

Lewis, L. K., & Seibold, D. R. (1996). Communication during intraorganizational innovation adoption: Predicting users' behavioral coping responses to innovations in organizations. 63(2), 131-157.

Lyman, F. (1992). Think-pair-share, Thinktrix, Thinklinks, and weird facts: An interactive system for cooperative thinking. In N. Davidson & T. Worsham (Eds.), Enhancing thinking through co-operative learning, (pp. 169-181). New York: Teachers College Press, Columbia University.

Martin, A. M., & Hand, B. (2009). Factors affecting the implementation of argument in the elementary science classroom. A longitudinal case study. *Research in Science Education*, 39(1), 17-38.

Matthews, D., & Kitchen, J. (2007). School-within-a-school Gifted and Talented Programs: Perceptions of students and teachers in public secondary schools. *Gifted Child Quarterly*, 51(3), 256-271.

McCabe, J. G., & Oxley, D. (1989). Making big high schools smaller: A review of the implementation of the house plan in New York City's most troubled high schools. New York: Public Education Association; Bank Street College of Education.

McMahon, C., Lowe, A., & Culley, S. (2004). Knowledge management in engineering design: personalization and codification. *Journal of Engineering Design*, 15(4), 307-325.

McMullan, B. J., Sipe, C. L., & Wolfe, W. C. (1994). Charter and student achievement: Early evidence from school restructuring in Philadelphia. Philadelphia: Center for Assessment and Policy Development.

Morrison, J. A. (2012). Exploring exemplary elementary teachers' conceptions and implementation of inquiry science. *Journal of Science Teacher Education*, 1-16.

Mullis, I. V., Martin, M. O., Gonzalez, E. J., & Chrostowski, S. J. (2004). TIMSS 2003 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades.TIMSS & PIRLS

International Study Center. TIMSS & PIRLS International Study Center. Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA 02467.

Muncey, D. E., & McQuillan, P. J. (1991). School-within-a-school restructuring and faculty divisiveness: Examples from a study of the coalition of essential schools. Working Paper #6. Providence, RI: School Ethnography Project, Brown University.

National Research Council. (1996). *National Science Education Standards*. Washington, DC: National Academy Press.

National Science Teachers Association (NSTA). (2002). An NSTA position statement: Elementary school science. Arlington: NSTA.

NGSS Lead States (2013). *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

Ornstein, A. and Hunkins, F. (2004). *Curriculum foundations, principles and issues* (4th ed.). Boston: Pearson.

Patton, M. Q. (2002). Qualitative interviewing. *Qualitative research and evaluation methods, 3*. Sage.

Pearson, D., Sawyer, J., Park, T., Santamaria, L., van der Mandele, E., Keene, B., et al. (2010). Capitalizing on Context: Curriculum Integration in Career and Technical Education. A Joint Report of the NRCCTE Curriculum Integration Workgroup. National Research Center for Career and Technical Education.

Peterson, S. (2013). *Readiness to change: Effective implementation processes for meeting people where they are.* In T. Halle, A. Metz, & I. Martinez-Beck (Eds.), Applying implementation science in early childhood programs and systems (pp. 43-64). Baltimore: Paul H. Brookes.

Piedmont School District. (2005). Ailanthus STEM academy for Grades 3, 4, and 5.

Project Lead the Way (PLTW). (2014). Milestones. Retrieved from https://www.pltw.org/about-us/history/pltw-milestones on December 20, 2014.

Railsback, J. (2002). *Project-Based Instruction: Creating Excitement for Learning*. By Request Series.

Ravitz, J., Hixson, N., English, M., & Mergendoller, J. (2012). Using project based learning to teach 21st century skills: Findings from a statewide initiative. American Educational Research Association Conference, Vancouver, Canada.

Raywid, M. A. (1995). The subschools/small schools movement--taking stock. Madison, WI: Center on Organization and Restructuring of Schools. (ERIC Document Reproduction Service No. ED 397 490)

Raywid, M. A. (1996a). Taking stock: The movement to create mini-schools, schools-within-schools, and separate small schools. Urban Diversity Series No. 108. New York: ERIC Clearinghouse on Urban Education. Madison, WI: Center on Organization and Restructuring of Schools. (ERIC Document Reproduction Service No. ED 396 045)

Raywid, M. A. (1996b). The Wadleigh complex: A dream that soured. In W. Boyd, R. Crowson, & H. Mawhinney (Eds.), *The politics of education and the new institutionalism: Reinventing the American school*. Philadelphia: Falmer.

Ruiz-Primo, M. A. (2006). A multi-method and multi-source approach for studying fidelity of implementation. Regents of the University of California. Retrieved from http://www.gwu.edu/~scale-up/documents/AERA-Implementation-Ruiz-Primo.pdf on October 12, 2013.

Sanders, M. (2009). STEM, STEM Education, STEMmania - Washington ESD STEM. Retrieved from http://esdstem.pbworks.com/f/TTT%2BSTEM%2BArticle_1.pdf on November 18, 2013.

Savery, J. R., & Duffy, T. M. (1995). *Problem based learning: An instructional model and its constructivist framework. Educational technology*, 35(5), 31-38.

Schneider, R. M., Krajick, J., & Blumenfeld, P. (2005). Enacting reform-based science materials: The range of teacher enactments in reform classrooms. *Journal of Research in Science Teaching*, 42(3), 283-312.

Sprague-Jones, J., & Sprague, J. (2011). The standpoint of Art/Criticism: Cindy Sherman as feminist artist? *Sociological Inquiry*,81(4), 404-430.

Stake, R. E. (2005). *The art of case study research*. Thousand Oaks, CA: Sage publications.

Thomas, J. W. (2000). A review of research on project-based learning. Autodesk Foundation. http://www.bie.org/index.php/site/RE/pbl_research/29

Tsupros, N., Kohler, R., & Hallinen, J. (2009). STEM education: A project to identify the missing components. Intermediate Unit, 1 and Carnegie Mellon, Pennsylvania.

U.S. Department of Education. (2002). No Child Left Behind Act of 2001. U.S. Public Law 107-110, January 8, 2002. http://www2.ed.gov/policy/elsec/leg/esea02/107-110.pdf

U.S. Department of Education. (2008). NCLB Choices for Parents: Helping Families By Supporting and Expanding School Choice. http://www2.ed.gov/nclb/choice/schools/choicefacts.html

Virginia Tech University Libraries (2013). What is Summon? Retrieved from http://www.lib.vt.edu/help/summon/what-is-summon.html on November20, 2013.

Weiss, I., Pasley, J., Smith, P., Banilower, E., & Heck, D. (2003). *Looking inside the classroom: A study of K-12 mathematics and science education in the United States*. Chapel Hill, NC: Horizon Research.

Wiggins, G. P., McTighe, J., Kiernan, L. J., & Frost, F. (1998, October). *Understanding by design* (pp. 0-87120). Alexandria, VA: Association for Supervision and Curriculum Development.

Wiggins, G., & McTighe, J. (2006). Examining the Teaching Life. *Educational Leadership*, 63(6), 26-29.

Yin, R. K. (1994). *Case study research: design and methods*. 1994. Thousand Oaks, CA: Sage publications.

Yin, R. K. (2003). Case study research design and methods third edition. *Applied Social Research Methods Series*, 5.

APPENDICES

List of Appendices

Appendix A. List of Piedmont Personnel Described in the Case Study (Alphabetical)

Marylou Carlisle	Ailanthus – Math/Science /Social Studies teacher (5th)
Rowanne Chamberlain	Ailanthus – Math/Science /Social Studies teacher (3rd)
Holly Christensen	Ailanthus Academy – ELA/Social Studies teacher (4th)
Duana Clinton	Former Science Specialist
Madison Croft	Dogwood - Gifted Resources
Shannon Daniels	Piedmont Asst. Superintendent of Curriculum, Ailanthus Principal
Kenny Dennell	Piedmont Asst. Superintendent of Instruction
Ginger Fishman	Ailanthus Principal
Dr. Piper Geary	Piedmont - Science Supervisor
Amy Harley	Ailanthus - Gifted Science teacher (4th)
Loretta Huddleston	Ailanthus - Retired Principal
Benigna Kaia	Ailanthus Academy – Math/Science teacher (3rd)
Minerva Kay	Ailanthus – Math Coach
Dr. Carolina Moore	Piedmont - Gifted Supervisor
Dr. Janette Oakley	Piedmont - Gifted Specialist, Consultant
Chelsea Ortiz	Piedmont Gifted and Talented Programs
Cheyenne Ruskin	Ailanthus Academy – Math/Science teacher (5th)
Krystal Saunders	Dogwood – all subjects teacher (1st)
Nevil Tyson	Ailanthus Asst. Principal
Cameron Weber	Dogwood – all subjects teacher (4th)
Roxanne Wise	Original Ailanthus Principal
Meryl Winfield	Ailanthus Academy – Math/Science teacher (4th)
Ruth Woodhams	Dogwood – all subjects teacher (2nd)

Appendix B. List of Piedmont Personnel Interviewed (Alphabetical)

Holly Christensen	Ailanthus Academy – ELA/Social Studies teacher (4th)
Duana Clinton	Former Chrysalis Science Specialist, HOMS Instructor
Madison Croft	Dogwood - Gifted Resources
Kenny Dennell	Piedmont Asst. Superintendent Instruction
Ginger Fishman	Ailanthus - Principal
Dr. Piper Geary	Piedmont - Science Supervisor
Amy Harley	Ailanthus - Gifted Science teacher (4th)
Loretta Huddleston	Ailanthus - Retired Principal
Benigna Kaia	Ailanthus Academy – Math/Science teacher (3rd)
Minerva Kay	Ailanthus – Math Coach
Dr. Carolina Moore	Piedmont Gifted Supervisor
Dr. Janette Oakley	Piedmont Gifted Specialist
Cheyenne Ruskin	Ailanthus Academy – Math/Science teacher (5th)
Nevil Tyson	Ailanthus Asst. Principal
Meryl Winfield	Ailanthus Academy – Math/Science teacher (4th)

Appendix C. List of Institutions Referenced in the STEM Academy Case Study

School or Institution	Relationship to Ailanthus STEM Academy
Ailanthus Elementary	STEM Academy Feeder/Host School
Alder Elementary	STEM Academy Feeder School
Boxwood Elementary	STEM Academy Feeder School
Chestnut Elementary	STEM Academy Feeder School
Chrysalis Middle	Ailanthus Middle School
Cyprus Elementary	Piedmont Elementary Languages magnet
Dogwood Elementary	STEM Academy Feeder School
Foothills Public Schools	Other school district
Highland County Public Schools	Other school district
HOMS (Hands-On Math and Science)	Nationally recognized math/science curriculum
Honeylocust Arts Program	Piedmont Elementary Arts Magnet
Juniper Elementary	Piedmont Science Focus School
Mountain View Public Schools	Other school district
Piedmont County Public Schools	School district for Ailanthus Elementary
River County Public Schools	Other school district
State Arboretum	STEM Academy field trip site
Sycamore Elementary	STEM Academy Feeder School
Target 2015	Strategic Plan
Tupelo Elementary	STEM Academy Feeder School
Willow Elementary	Suggested site for Academy replication
Zoological Museum	STEM Academy field trip site

Appendix D. Transcript of Interview with Academy Teachers

October 08, 2012, 4pm.
Participants included the following Academy teachers:

- Ms. Cheyenne Ruskin, 5th grade Math and Science
- Ms. Meryl Winfield, 4th grade Math and Science
- Ms. Benigna Kaia, 3th grade Math and Science
- Ms. Minerva Kay, Math Coach
- Ms. Holly Christenson, 3rd grade English Language Arts

Interviewer: Ok good let's see, I don't, still cannot get access to the internet here. Except sometimes I'm able to connect by creating a hub for myself but it doesn't seem to be able to work now. So, here's what I'd like to do is ask you the kinds of questions I'm asking everybody. And I don't mean at all to confine the topics you want to talk about, and in almost every way your opinion is the most valuable to me because I at least know that three of you have been part of this from the beginning. Is that correct?

Multiple teachers: Yes.

Interviewer: Even Duana Clinton, she was there from the beginning, but isn't able tell me anything that has been going on for the last few years and nobody really has the enduring experiences that you all have. So, there were even some questions only you all can answer well. So, the first thing I'd like, and you can answer collectively and complement each other, is give me a feel for how the curriculum came to be. Did you sit down as a group or did you individually bring ideas and then somehow find a synergistic way to assemble them? Or how do you describe this to others when people ask you how this academy came to be?

Teacher: We started off with doing training with Duana Clinton. She, you know, got our topics and kind of came together. And we kind of planned out well how could we arrange the science so it really goes with the math, so that the math enhances the science and they kind of work together. So, we looked at the pacing for the math for the year and kind of aligned the science with it. And she just brought us a bunch of ideas that we can try out that went along with the topics and aligning the objectives between math and science so that's where it originated.

Interviewer: Okay and this was back in 2004? Do I have that?

Teacher: 2000, this is my tenth year, so this is 2002 probably.

Interviewer: Oh, okay.

Teacher: 2002-2003, were as the pilot year, 2003-2004, was our first regional year.

Interviewer: Okay, so was she still with the school division then or was she already with the science leadership group?

Teacher: She was also there for our first...

Teacher: That's hard to say where she was still.

Teacher: She actually worked with us through just about our first...

Teachers: Four years.

Interviewer: Oh okay, so she was probably still outstanding?

Teacher: But she was still an employee of the city of Piedmont so she's still...

Interviewer and Teacher: [Indiscernible cross talk]

Interviewer: Okay and then she...

Teacher: She actually started. She actually helped us write the proposal.

Interviewer: And...

Teacher: So even as far back as '99, I believe, when our proposal was being written.

Interviewer: And tell me, who else was involved with that proposal? Was the principal at that time involved in that proposal as well? Okay.

Teachers: Yes, yes.

Interviewer: Okay and I'm really interested in something that no one has been able to answer. The transition, forgive me for suddenly forgetting the former principals, name...

Teacher: Loretta Huddleston.

Teacher: The first one or the second one?

Interviewer: The first one.

Teacher: Oh, Roxanne Wise.

Teacher: Wise.

Interviewer: Wise, thank you. When Ms. Wise departed I think it was at the time there was an emphasis on understanding by design and how did that influence the way you had been doing your integration and curriculum development and other things?

Teacher: Duana Clinton actually brought Understanding by Design to us as a template.

Interviewer: Oh, okay.

Teacher: Before Loretta Huddleston came and said, “This is a new understanding about how curriculum goes, I think you should look at some of these ideas and concepts...”

Interviewer: Okay, so that wasn't a challenge necessarily? It was...

Teacher: No, no.

Interviewer: Okay, and how would you, did it, changed that way that you all planned when you started looking at enduring understanding and big concepts and then figure out how to assess it and then figure out how to do your learning assessments or was that pretty consistent with how you had been operating?

Teacher: I think we had already done that. I, the change was in spending a lot of our time in writing, you know, writing it as a curriculum...

Interviewer: Okay.

Teacher: Was what really changed.

Interviewer: Well that raises a question. I was so impressed with what I witnessed in your classrooms. I wondered to what degree that curriculum is written or published. I think of most teachers’ lesson planning as an enhanced agenda, except when they are developing something to be shared with others or published or maybe some special observation. But tell me about what I saw today?

Teacher: I was well, I guess in the fourth grade is where we started out. That’s something additional that we have taken on to kind of promote STEM a little bit more than just the science and math connection we tried to promote engineering a little bit more. So we, what I was doing was Project Lead the Way. Which is, so, in addition to, we have time to go through the regular unit. So, we just finished studying the solar system. And well, this was a great connection because they had to research the planets and all then decide which colony to build, or which planet to build a colony on. So, this was an additional kind of engineering specific discipline that we bring in that connects to the sciences as well.

Teacher: Project Lead the Way was brought to us last year through ASCS and it’s a new element that we decided to take on in the third, fourth and fifth grade. And it was in addition to our science curriculum.

Teacher: Everything that we have heard about engineering, it should be its own discipline not necessarily put into science but standalone so we treat it differently.

Interviewer: Yeah, I have mixed feelings about that. I don't know, I’m a, I run a research farm on the weekends and every time I have to design my own tool, whether it’s to measure something or do something I’m engineering. It seems like in the grand scheme of things, I’m probably 90% engineer and only when I’m isolating variables and making assertions and inferences, am I actually a scientist, pure and simple.

Teacher: So, it's a different process, and that's why we teach it differently.

Interviewer: Yeah

Teacher: Why we added Project Lead the Way as an element. Because we do, we are, able to move faster through curriculum, it's just the nature of the beast. So, we figured we had opportunities to add Project Lead the Way to our curriculum.

Interviewer: Yeah, and I, based on what I observed, it really does seem like you added it to your curriculum, rather than replaced anything with Project Lead the Way. Is that right?

Teacher: I would say it, yeah, it depends. We were able to replace some of the activities that are done. I guess, in stage three is really where we differ, I guess. Because we, you don't replace the objectives. You don't replace sometimes how you're assessing, but you might change three with how you do it so. The engineering is in addition to, but there are some times where we are allowed to compact a little bit because the kids have such an interest in science they might not need to do some, an activity, that the other classes are doing. And then, it kind of gives us the time to do some extensions that the kids are really interested in.

Interviewer: And I'm curious, oh were you going to say something?

Teacher: I was just going to say, the idea when we started was to be kind of on a continuum in the third grade, to get them familiar with experimental design and the components of experimental design; so as they move forward they could design experiments. They could understand what questions could be, you know, an experiment could be done or it had to be researched. So, we tried to take those different kinds of questions to help them understand those and for their writing to be a little bit more technical in some ways as they moved up the continuum.

Interviewer: Well, I was really thrilled with how much integration I saw, even with social studies, but everything just seemed inquiry driven, whether it was project based or problem based, and all these things that I tried to describe to others and they don't seem to be able to address and in a better than superficial way. I saw a lot of really good stuff today. So, let me ask how do you perceive what you do to be different than what exist in the rest of the schools? And then, maybe, in the rest of Piedmont Public Schools? And you may even want to answer that longitudinally, because, it seems like from what I learned, most of the things you have been doing for quite a long time are now recognized as best practices. So, you are sort of out there cutting edge and found affirmation and I imagine as all the ideas you have been implementing for quite a while showing up in journals and in STA journals. You start to see everybody else doing similar things. So, I'm kind of curious how you seen your curriculum. Do you start to see some convergence or do you ever see divergence? Resistance? <laughing>

Teacher: I would say, I would say, yeah, it really started with our curriculum to do more of the project based learning and real world connections. So, we got the kids out there collecting data at the State Arboretum, at different places and now that it's certainly, definitely more common. But

I think we've been doing that for so long that now we have kind of branched out, even from there with adding the STEM projects and adding other things

Interviewer: Oh good, so when you say the STEM projects, that is in part referencing the Project Lead the Way activities? But are there other things that have evolved more recently? Because that, I mentioned earlier, there, many people couldn't really describe what's happened in the last few years, and I was looking forward to asking you about that.

Teacher: You know, I think it was, to me, it was interesting because I don't really think in the specifics like you're talking. But we went to a children's and engineering conference last February in the capital and there are a lot of people really excited about some of the things that we're doing. Say, focusing on STEM, my thought is: we're doing that. We're just not, maybe, we're just not classifying or looking at that. I mean doing simple machines, the kids will build what's called a puff-mobile. They're given, you know...

Teacher: We've been doing that for years.

Teacher: For years, and we went to a STEM conference at the university and a girl's STEM conference, and almost every activity they pulled out for the girls, and now I'm a little bit blank, but I'm thinking: We did that. And I'm looking at the girls we took, "Do you remember doing that in the third grade? Do you remember we did that in the third grade?" And they're like, "Oh yeah, we did do that in the third grade." But what the turn about it now, for me, after the conference was that we don't do it once. We learn from doing it. Now, we do it again and we see if we can do it better, you know, so that you can really see that science is not a one time thing or engineering is not a one time thing. You may have a great idea but sometimes if you learn from that great idea to develop another idea. So, I think some of those things have just been interjected just by the ability. Duana Clinton is phenomenal. These two are phenomenal. You can talk and say, I'm doing this, and the fact that we have had the ability to go to regional conferences for NSTA for NSTM and have some of that kind of exposure and where you might necessarily take their idea as they're doing it. But it gives you that springboard to do things. So, I don't look at things in isolation, as much as thinking it just has it, has evolved.

Teacher: I think too, that something is, how we, what I'm afraid of is that we do make a lot of real-world connections, you know. My kids aren't pretending to be scientists, my kids are scientist. I never, we're not, we are working with real scientists, you know. My kids are working with real scientists at the Zoological Museum. Our kids are working with scientists at the State Arboretum. They're working with real robotics people, you know. They're working with, they're making those real-world connections. It's not in that problem based learning module. It's not pretend.

Interviewer: Right.

Teacher: You know, we have the opportunity. We make connections with people at [the university] and when their nano science technology lab. We have connections there that the kids are excited about talking with the [professor-researcher], you know. Different opportunities that we have gone out and created, making these connections; and that's not something you can do

countywide, you know. You can't have 4000 children talking to nanotechnology science lab at a university. That's not something that can happen just because of the volume. That's where the STEM Academy is different. That's because we set out to find these people and I guess we keep it small. It's a small-scale type of thing and it's not that we aren't willing to share. It's just that it can't be done. My kids travel to monitor the Bog turtles. They are very careful that you can't expose the Bog Turtles to too many germs. All the fifth graders in Piedmont cannot tiptoe through behind the scenes. My whole class can't even go at the same time. So, those types of real-world experiences just cannot be replicated throughout the county.

Interviewer: Another question I want to ask you all is, what do you perceive to be the big challenges for say the next five years of the Academy? What sorts of challenges would you see? These examples are very important to me. The idea that some of the things that you have created, the connections that you have created, simply can't be duplicated. They're just only so many miles of Bog Turtle breeding Lakes.

Teacher: Or they could, I mean they could be replicated, but they can't be duplicated throughout the county.

Interviewer: Right, right.

Teacher: You know, if you were going to have another STEM Academy in this part of the city, but you can't take what we're doing and repeat it in every elementary classroom throughout the city which I know is what, you know, what has been talked about. If it's good enough for that class, it's good enough for everyone in the city of Piedmont.

Interviewer: Yeah, I wonder what you think about the options there. I see a couple of things going on. One is you folks are doing those components, and have been doing those components, that are recognized as best practices and many of those best practices could be replicated elsewhere. But I think there's something else I'm seeing, which is much, much harder to replicate. And that is sort of a holistic view when you do everything sort of in that integrative, thoughtful, coordinated kind of way; and I don't imagine that happening countywide or division wide. So, I wonder how you would identify the things that can be replicated or if there were things that could be replicated, how could that happen without pulling folks like you out of classrooms where you're tremendously effective to go you know preach your gospel across the city? Could there be things you did where people did videotapes of you teaching and or you talked about your planning? Do you present when you go to these conferences? Or do you..

Teachers: We have.

Teacher: You know, I have to speak only from my own experience. I think this experience, I have grown into it and it has grown with me. So, you take a regular third grade teacher, that hasn't had the opportunity to do this. My room is my classroom. My animals are getting ready to be the biggest part of what I teach. When I start teaching I've got food chains right there for them to see. The kids are participating and you've got to be, and it didn't just happen. It started with just using cockroaches. And now it's anoles. And now it's a leopard gecko. And now it's those slider turtles, you know. But they all play a part in helping the children actually see and

experience the science concepts and that was something that happened. And you said where do you see you going in five years...

Interviewer: That's not what I asked, but that's okay if you want to answer that.

Teacher: No, but well, no, but at one point you said, "What do you see as your challenges in five years?"

Interviewer: Right.

Teacher: But I don't know that every teacher has the opportunity, you know, to concentrate on this. And not every teacher has the audience that's interested in what you're doing, you know. The children, for me, have truly been what has driven what I've learned and been able to do for them and I don't how that could even be done.

Interviewer: I would even argue that I don't think many teachers have the capacity to accomplish what you folks continually try to accomplish. So, that's what I'm trying to really try to explore. Like how, if at all, can you carve out bits and pieces and replicate it?

Teacher: Yeah we're fortunate to have a passion for science and math.

Teacher: Can I, back to your question about what could be replicated and what could not. Replication could happen on a small basis as it is here. Like you wouldn't have a whole school, I don't think, doing what we do, but you might have classes.

Interviewer: Schools within a school maybe? Or programs within a school?

Teacher: That could do what we do because, you know, we have the starting point where all we've learned in the past 10 years. So there's a lot that could be replicated and brought to a school, but you do need the core of teachers that are like, "Yeah, wow, I want to do this."

Teacher: And that's truly where we started. We started with a principal who had a vision and the three of us and, you know, I was the [inaudible] resource teacher at the time. And I had the pleasure of like knowing Duana Clinton outside of school, and just knew she was a visionary as well and pulling her into this project. And well, and working I think we spent about four years doing research and coming up with a plan, developing a plan, proposing it to the school board.

Teacher: Right, and then we were told no, but we could do it inside school.

Interviewer: And I heard without funding.

Teacher: And well it was approved without funding and that's when we did it as a pilot. And the following year it was funded and we started the third and the fourth and then we could not find teachers to teach it. We had Benigna who would teach it at the third grade with her partner. We could not find anyone at the fourth grade level to teach.

Teacher: Meryl was a new teacher to Wayne Court and we convinced her to teach the fourth grade. She was, she was naive. <laughing>

Teacher: I thought I was recruited. <laughing>

Teacher: She was tricked. <laughing> And, you know, at the fifth grade again, we could not find anyone to teach fifth grade. So I left the GRT position. But, you know, Benigna at the time, we started this research, she had a fifth grader here and I had a two year old or three year old at the time.

Teacher: It was so long ago.

Teacher: And you know, I think Benigna and I set out to develop a program that was appropriate for our children. And the first year of implementation, Alex was in middle school and jack was a first grader. And was going to be, you know, I've had three kids, two of which have gone through this program, and you know, we truly designed a program that would be suitable for our own children

Interviewer: Well, let me talk about or ask about the level.

Teacher: And that's where our passion is. That's where our passion is.

Interviewer: Oh, I can tell. Let me ask about the level of instruction which, from what I observed, is very high. And I, by the way, if you didn't notice, I got to observe classes outside of your academy too. And I still saw you exercising differentiation even within your high achieving students that certainly there are a lot of folks in there who need things differently or need different things than the person sitting next to them. If you even imagined doing some of the things you did, and let's just put aside that issue of there's only so much lake and only so many Bog Turtles and things like that, what differentiation challenges would there be if you started working with a group of kids that was broader than this? Then, the way your students are selected and I also want to know what you think about the way your students are selected.

Teacher: Well, that did change.

Interviewer: Oh, it did?

Teacher: Yes, in 2007 or in 2006-2007. That did change originally. It was, we worked more on a matrix where everything had a value, a point value and all aspects, all the pieces, five components were still the same. Teachers recommendation, student recommendation, I mean parent recommendation, student performance; we also had a testing component at that time. Students had a quarterly test scored.

Teacher: There was also a report card.

Interviewer: And was there a portfolio or was that a new component of it?

Teacher: Well, they also did the assessment. The performance assessment, but it was given a numeric score and that numeric score was added and then the top 25 kids, I would say the top 20, were clear. The last 10 might have tied, and that's when it went to a committee, to well. The committee evaluated all of them, but the top 20 were clear cut and the last 5 slots were discussed and evaluated.

Interviewer: Okay, so then what changed in '06-'07?

Teacher: In '06, it was more of, it was more of a profile approach where they looked at in the whole profile and gave it a 1,2,3,4,5. And three people read each profile, and then if you gave it a five, and you gave it a four, and I gave it a five, it was a 5-5-4 became the score.

Interviewer: Okay.

Teacher: So, it was more of just an impression score, I guess, is what you would call it.

Teacher: And the profile was observation, there were observers, notes and they determined what they want to put in the profile that the selection committee could look at.

Interviewer: So, was this the newer approach from parent pressure, or things like that, to have some more visibility...

Teacher: No, it was determined to replicate how our gifted program, to replicate how it would be selected, how it would be a selection.

Interviewer: Oh, I see. Tell me [indistinguishable cross talk], tell me what you think about the idea of lotteries for special programs? So, I guess that would mean a student, or in this case a student and his or her parents, demonstrate an interest and then it becomes a double blind lottery kind of thing.

Teacher: I know that's been talked about the last few years, a lottery.

Interviewer: I taught in a school like that.

Teacher: Certainly the interest is probably one of the biggest things that helps us do what we do with the kids because they're so interested in science that you can really pull a lot of it together. So, I think interest is important. Certainly, a lot of them do have a propensity toward math and they have a lot of knowledge in science. But I think interest is pretty much one of the key things. My thing I'm not so sure of, is how do you determine if it's a parent's interest or a child's interest at this level for application purposes.

Interviewer: Yea, and I see three big categories. One is a demonstrated student interest. And then, a second would be that parent's hunch or observation or gut reactions suggesting, this is what my student really needs. And then of course there is the third, undesirable one, which the parent who just wants their kid to be in some place special that they can talk about and I imagine you still suffer from.

Teacher: Oh, absolutely.

Interviewer: And parents are surprisingly good at creating these kinds of scenarios that look good when they're evaluated by a five person category in five panels. So,

Teacher: What is beautiful about our program is science is such an innate interest in children anyway. You know, they come to school loving animals, you know, loving outdoors and nature. To find a child that's not interested in science would be more difficult to find than children that are interested in science. So, I, that propensity for math is, or the demonstrated aptitude for math, is would be, much more difficult. And that really helps propel our ability to, or helps to compact, go faster, you know. I'm sure in Benigna's class you could see just that love and passion. I think she was the only math [Aside: you taught science too?], that love and that passion for math that you see in a STEM Academy, that you may not necessarily see all the time in other classrooms.

Interviewer: What is that indicator of some predisposition to where they could be very successful in a program. What do you think about the notion? And I'm sure you recognize this yourself, that the things you do would be good for every student. I mean that's got to be your biggest challenges, is recognizing the things that you do, would be good for every student and you only get to do it with however many there are.

Teacher: We've had kids that are...

Interviewer: Is it 25?

Teachers: 26.

Teacher: We started out at 24 and through mistakes our numbers kept going up. Yeah, we have had kids that have been unsuccessful, you know, have been unsuccessful in other schools come to us and just flourish here. So, you know, we understand that.

Teacher: I think of Kenny. I think of [name]. I think of all the kids that have, you know, other schools do a happy dance when we take them.

Interviewer: Can you, I understand there's a thing going on with math now that pretty much makes math uniform in terms of the scope and the sequences of the curriculum. How it's taught is still up to the professionals in the classroom, but and correct me if that's an incorrect assertion.

Teacher: No, I, no, we are field testing this new program that everybody is, you know, is supposed to be doing the same things.

Interviewer: Okay, but how do you all distinguish your science curriculum from the science curriculum in the rest of the school versus the science curriculum in the rest of the division? Are there specific units that you do or the sequence in which you do them? Or is it mostly just when, I would hope this is a comfortable term for you, but I like to think of the examples you gave as curriculum extensions. Is that how you distinguish?

Teacher: Yeah, this year. This year we've been told that we will teach the same units and the same sequence as the rest of city and the rest of the... So you will see same things in stage one and stage two that is the same that... We are allowed to extend and change our stage three's.

Interviewer: Oh, ok.

Teacher: Whereas, up until this year we did teach science in a different sequence like I told you in the beginning. We laid it out to make those connections with math so...

Interviewer: Right, right.

Teacher: And better sequencing for the science. Now the city has, in third grade, has made some of the changes we had made before and they're building the concepts like we had done in the past.

Teacher: I think Piper Geary had a very good conversation with us and understood why we had taught in the sequence we had and I think she took that conversation to heart.

Interviewer: Can you help me with some of that history? It sounds like you had lots of autonomy early on because of your principal's endorsement of you as a team and just her own persona that you really got to interject your personal and professional selves into your curriculum and then when she left, I guess it coincided with other things going on. And sounds to me like they, like some of your independence was eroded. And then I guess it's, I guess, I don't know how it's continued to evolve from there but how do you characterize it?

Teacher: You go that right. <laughing>

Teacher: Nothing beyond that.

Interviewer: But do you know what some of the motivations were that did change your curriculum from, I've heard the term outside, but I've also heard the term downtown? I guess they mean the same thing.

Teacher: Yeah.

Interviewer: Okay, do you know what their motivations were? Was it really just to say we are one school division or do you think it was folks that thought that they had a better than you were doing, or why did they clamp down? Or how've you categorized it?

Interviewer: Hello.

Teacher: Hello. I have to go because I have to be back for PTA.

Interviewer: Okay, well oh, this is what we were talking about earlier.

Teacher: Yeah, this is the student characteristics.

Interviewer: Okay, thanks again.

Teacher: Okay, so call be if you need me. Bye ladies.

Interviewer: Okay, thanks.

[Cross talk]

Interviewer: And tell me, are you on a tight timeline?

Teacher: [mumble no]

Interviewer: Okay, just say so.

Teacher: Well, I have to pop back to my... volunteer's running my Lego meeting so.

Interviewer: Back to how you categorized the way the way things changed. I really wonder what those motivations might have been.

Teacher: I don't think we can comment on other people's motivations.

Interviewer: Okay, no speculations?

Teacher: Yeah, I don't think we had any, I mean we have an inkling of why.

Teacher: We felt very encouraged, you know, under our former leadership and...

Teacher: It was like the whole, like a new leadership and a different focus. I remember our excitement to share with the incoming president. Remember? We made boards, we had a presentation, we had all these things to say, "We're doing this. This is what we've developed and this what we've done and this is how we've done this." And just, don't you remember, how excited we were to sit and say, "These are the things that, you know, we've been able to do and here are some of the other people we've made contact with and some of the directions we hope we can go in and what we want to do." And then was all of a sudden...

Teacher: We had people from Kansas coming to visit our school. They had heard about our school. We had people from Okinawa coming to visit our schools. We had just won the Interscholastic Schools of Distinction for Science, $10,000. We had, we had people from EVMS coming with human lungs, you know, I remember our new principal coming and our kids are holding human lungs. That had been children with smokers lungs versus healthy lungs, you know. We just had all sorts of those sorts of exciting projects and our focus at that time, we were out in the community. We were networking out and then our focus in the last five years, six years had been writing this curriculum. We are not curriculum specialist. I don't know about you guys,

but I can say I don't have a degree in curriculum writing. And it seems as though every year it was a new focus on the curriculum. New changes to the curriculum. New. And it was the same curriculum person that we were working with. And you know we were writing curriculum over and over and over and over.

Interviewer: Well, I did a master's and doctorate in curriculum and I still don't think of myself as a curriculum writer <laughing> I considered myself a teacher.

Teacher: And it was the same with us writing curriculum and, you know, that was very difficult for us. And, you can imagine, we can teach. We're good teachers. We like to teach. We love our classrooms. And we would take classes here and there on how to write curriculum and we would spend all summer together writing curriculum and worked very well with our partners integrating the language arts. That's one of the beautiful things about, we do a lot of research writing, you know, my team member will do persuasion, of writing persuasive and then, I do the science. We bring it together.

Unidentified man: Sorry to interrupt. They've run out of the activity to do.

Teacher: Alright, I'm off.

Teacher: So, we do that very well. But putting it down is a way to better read it in a curriculum document.

Interviewer: Yeah, get a consultant or someone to come in and check over

[Cross talk]

Teacher: So, that was our biggest challenge in the last five years. Is this curriculum and it was like every time we knew we had a deadline we would just panic. And then...

Interviewer: Why was that so...

Teacher: It never seemed good enough. It never seemed anything we wrote was good enough.

Teacher: It was never good enough.

Interviewer: Why was that assigned to you, though? I mean other teachers aren't called upon to write and rewrite their curriculum.

Teacher: Well, I think originally, and this is also a change of superintendents too so, you know you see, you know you see changes. Besides building leadership, we also saw a superintendent change. And the previous superintendent was about academies and, you know, opportunities. And I don't think the current superintendent that is, was something, you know, that he looked at. So, initially it was that it would be replicated in another part of the city and after three or four years they're like, well we've got nothing to give somebody to replicate. So, that's where he said you've got to start writing what it is you're doing. And...

Interviewer: But when you started out was it suggested that you were going to be a pilot for testing an idea that would be division wide or..

Teacher: Well, it was not really. Well we were one of the first academies. I mean when academies first came on board, you know, there were, I sat there, I sat in a meeting at the school board with all of the beginning academies. So...

Interviewer: So, there were, this is, there are only three in the elementary level if you include the gifted and talented...

Teacher: Yeah, but that was old. We were there when the high school, we were there for the high school academies. I mean we were one of the first blush of academies. So, I don't know if there was necessarily a plan for academies. I know a lot of people since had proposed different academies, but it was never necessarily part of, you know, they never said do this so that it can be replicated. Writing a curriculum was never something we thought of. I mean, we knew we had to have a plan written down and we had to have ideas written down and we purchased, at the time HOMS had just written a bunch of modules specifically for the state, so we purchased a bunch of them.

Interviewer: And so, did you go take that or was that just Duana Clinton going and doing it and coming back?

Teacher: Duana Clinton was just

Teacher: Yeah, she trained, we spent a lot, that's how we spent some of our budget is on, in training, you know and we, and she actually trained all of our teachers when the HOMS.

Interviewer: Oh, the whole elementary school?

Teacher: The whole third fourth and fifth grade...

Teacher: Had the opportunity to do all the training.

Teacher: To do the training so....

Interviewer: Now, I did notice something the school within a school thing can lead to all sorts of feelings of elitism and this or that. But I also noticed that many of you had leadership roles schoolwide. I don't know, I can't remember what they were though. I just remember seeing a list of maybe one of you as a third grade representative and one of you as a fourth grade representative. Do I have that right?

Teacher: Right, I'm a third grade level chairman and school academic coordinator. And Cheyanne is the fifth grade level chairman.

Interviewer: So, obviously it's not like you insulate yourself and withhold your ideas or anything like that.

Teacher: Oh, no.

Interviewer: You're advancing the mission of the whole school.

Teacher: You know, I've worked with Benigna, not as her teammate, but this is my first year as her teammate, but I've worked with her, this is my seventh year and we always shared stuff. Always planned together since the beginning. So it's never been a question of not sharing because we've always bounced ideas and planned together and it's never been...

Teacher: You know how it is, you get excited this worked you got to try it you know either way, this. My kids loved this lesson you got to try it so you got to share that within your grade level.

Interviewer: My challenge was always when you extract DNA with, from strawberries and then the next thing you know the seventh graders are doing it and now I see they're doing it in the third grade and by the time they come to you in ninth grade, you don't dare extract DNA.

Teacher: And even when, we made her have the lizards. You got to have the lizards.

Teacher: No, I'm not a critter person.

Teacher: Right, and I say to people come up to me and are like, "Do you want this," and I'm like, "No. No, nope." <laughing> "Got enough, nope. Nope, don't want any more."

Interviewer: We just have a lab technician who can carry it away.

Teacher: The kids take care of them. So, that's the only reason I can do them. If I had to take care of them... And the parents bring the food in for them now because the food has got be almost $20 a week. By the time you buy the crickets and the rosy reds and the... And really initially the turtles were only eating turtle sticks. And now it's like wow this is really cool. We should really show how the rosy reds, and they eat those. And as I said it just kind of... I...

Teacher: And it started out as pickle jars and beta fish.

Teacher: Right and we still have pickle jars.

Teachers: Yeah.

Teacher: That's how it started.

Teacher: So..

Teacher: Because that wasn't the exact activity. <laughing>

Teacher: And they're going to you in the pickle jars.

Interviewer: Well, let me ask you this, if called upon to do something other than write curriculum that you had to people in three-ring binders or DVDs or what have you, can you imagine yourselves training other teachers? And how would you pick those teachers? Or what would be your, what would you, getting back to, you were talking about earlier about that sort of co-evolution of the curriculum and the teacher. What would you even say to a teacher to have them self select to do some of the things you folks have accomplished as a professional learning community?

Teacher: Gosh, that's hard. That's hard because I don't, I don't even know within our own building that there would be other people. Holly, you know, joining me this year jumped at the chance to be a part of it and she would have probably jumped at the chance to do the math and science part of it. But I don't know, I don't know what, they're out there, all those people are out there. But I don't, how would you, I don't know?

Teacher: I, like I said, it was tough to find. Nobody would take the fourth grade. We had pull out Meryl from second. There wasn't but there were, you do find, you know you do find people out there. We brought, you know, Ms. Rogers in from another school to do what I do, fifth grade. And then she quit mid-year. That's how I left the gifted department. We couldn't find anybody to do fifth grade.

Interviewer: Did you all begin teaching right out of college or did...

Teacher: This is my 23rd year.

Teacher: This is my 2nd career. I taught high school real estate.

Interviewer: Oh, you did?

Teacher: Yeah, for 15 years.

Interviewer: And how about you?

Teacher: Straight out of college.

Interviewer: See, I come from mostly secondary to, especially in technical education, where it's almost impossible to have had a career in your field and to teaching that way and so we recruit very differently than you would. You actually have to find someone who doesn't just love teaching, but you have create, teaching learning activities that are just different.

Teacher: But I think where I came from, I taught at Holland before this, and it was a different, a completely different community and we had a different pilot program. I seem to be a, I seem to be the queen of pilot programs. We did a multi-age pilot program over there.

Teacher: She's a really good salesman. Let Cheyanne recruit people too.

Teacher: And, you know, over there was no shortage of people wanting to do something different. So, I think it's just, this was a, this was a different staff. It was a very established staff. Very, you know comfortable, and I don't want to say set in their ways because as the gifted resource teacher they were also willing to try something new and explore new things. But the math science piece was not strong at this point. This was a very strong reading school. A very strong language arts school.

Interviewer: Well, I think by the way, by what I see is that social studies integration and the English art integration that's a necessary part of promoting STEM because so many people see STEM and they say, that's not me. That's not my courses.

Teacher: And our music teacher is a mathematician.

Interviewer: Oh

Teacher: That's her degree.

Interviewer: And the physics of music is amazing to explore.

Teacher: I, I'm just saying, the curriculum is my biggest disappointment because June of this, this was June of 2011, we were tasked with, you know, rewriting the curriculum again with differentiation built in. That was our latest task. And our team was taken down from six down to two. And, we started in September and we met in September, I think it was September or October. We skipped November because Meryl had an emergency. And met December and that's when we were told there's no more STEM Academy. And we shortly then, thereafter told no more writing. So what ever you saw as far as curriculum is not finished. And so, and then whatever other curriculum there is that you've seen.. they're relics.

Interviewer: By the way, I've seen very little, do you post it...

Teacher: Well, some of it was posted, and then, the recent, but the recent curriculum, the curriculum we were tasked to write with the new SOLs we were tasked to write last year, we've only met four times to write, which is ridiculous.

Interviewer: Alright.

Teacher: And then, we had only met four times, and were told not to write any more curriculum that we were to write, that we were going to teach the city curriculum.

Teacher: So, there's no curriculum to write, and then we were told this summer that they were, that there's no curriculum written and then we were told there was a curriculum audit which scared me a little bit because the curriculum is not written. So that's my story.

Interviewer: I, I

Teacher: So, I don't know what you're seeing. I don't know what you know what your perspective is because there's really no curriculum written.

Interviewer: Well, I still

Teacher: And we didn't even know you existed until we...

Teacher: Came to school

Interviewer: Until when?

Teacher: Until September.

Interviewer: Oh, okay I thought you said this morning. <laughing>

Teacher: Till September, it's October. We just heard of your existence this September.

Interviewer: Oh, okay, okay. Well, that's, this doesn't officially start until September. So, yeah, and I think it was really just to explore what and how things could be replicable. And, I pretty much shared my perspective so far. That, that, you were the first to do some things and you got a lot of affirmation and probably hadn't had much stimulus to fix any problems so your evolution has been, has been a lot of polishing and refining that that most people don't visibly see and then enhancing those curriculum extensions we were talking about.

Teacher: Well, when you say curriculum auditor, we're just like a little nervous.

Interviewer: Wait, is that what they call me?

Teacher: [mumble yes]

Interviewer: Oh, that's not how I like to define myself.

Teacher: Oh, okay curriculum and auditor sounds like curriculum accountability. And there's no curriculum for you to audit so, <laughing>

Interviewer: No, no.

Teacher: We were just a little nervous.

Interviewer: No, technically, I think I would have said I'm just evaluating an elementary STEM program. That's actually what I've been telling them.. Okay, interesting. I think that was, that was, I'm hoping that was a mistake. It might have been just someone's quick and dirty definition of who was coming but...

Teacher: It wasn't a friendly euphemism. <laughing>

Interviewer: Yeah, no. My job is to write an evaluation of what I see, how it's distinguishable and what could be replicated and how if anything it's replicated and if it should be replicated. Anything you want to share is going to be welcome can't think of anyone except you folks you have been a part of this for the duration.

Teacher: No, just [indiscernible], not for the duration

Teacher: And really just the two of us. Meryl came on a couple of years later. I, I think just here for support. But I think you're seeing some differences from what we've done in that past and where we want it. From a mother and from an educator I love what we've been able to do with these kids and this are not all gifted and talented kids. And there are behavior problems in the class. And there are quirky problems in the class. You know when you have 26, you've got too many boys and girls. But what I have loved is the fact that they love coming to school. They can't wait to talk about, they love what we're going to talk about. Even when I have trouble with class talking, it's not that they're talking about their soccer game, it's not that they're talking about their video game. They're talking about what they're learning in school, about what they're going to do with it. And I know what we're doing is good for all kids. But at this age they're not all at the same maturity level, they're not all, there's just so many variables at an elementary school. And I just feel a passion, and my neck's probably getting red because I do, I just feel for the children we have been able to touch and I like that I can touch 52 children and I just feel like it's been important. That they have not sat and listened to something three or four times being retaught. And I don't know how you would adapt if you had a multi-ability classes, how would this work. Well, it may work beautifully. We haven't done that. But I know that not only do we plan the activities, but what they get from each other by being with people who care about school - you know, who want to learn more, who maybe haven't had the experience to share more - that it's really positive. You know I would love to have the opportunity to continue, replicate this and do this. But I wish my boys had had the chance. You know, because I've got a gifted kid who went to high school and said, "Why do I have to do this? I could go in and I could pass the test," because he never got the opportunity to do anything. Then, I have a high achieving student, who also is ADD/ADHD, who only got told to sit down, sit down, sit down, sit down. And if he had had more hands-on activities like we are able to do. You know, so I just think there's a place for this. I mean all kids? Sure, sure. But not all kids are ready for all things. They're all at different places at different times. Some kids need to be in 17-person classrooms and some can be in our 26-person classroom. So I don't know, but this has been a good thing for a lot of kids.

Interviewer: When Kristen came in, I was reminded of something that I didn't think to explore early on, but what do think about the diversity in your program?

Teacher: We wish it was more, and we tried to make it more. Heck, we've got some hot, you know, African American girls this year that as soon as we saw them test we were like, "Oh my gosh I cannot wait to have these kids in my class." But, you know, maybe a lottery brings them to us where an application didn't. But I am just, you know, loving the finally these girls and we have an opportunity to, you know, work with them but we haven't been diverse. We've been primarily boys and we haven't had really a lot of ethnicities by shear, by, but that's what the

application process tells you too. We've been in the schools. We've gone and we've asked to try and get other people you know involved but I don't know what the answer is. We were told in Richmond, we need to go church. And we went to the church on Sunday.

Teacher: And we offered them dinner for them. We asked. We sat in with an engineer from ODU because his whole thing was on diversity and we said, hey we have this program and we're trying to pull in a more diverse. And he said go into the churches, talk to the ministers and their churches and...

Interviewer: I'm so glad I asked you because I love hearing that you've been concerned and trying. Because I...

Teacher: Like you said, we'd have dinner for them. But we have gone to their open houses, we have presented at open houses in...

Interviewer: Meaning the feeder schools?

Teacher: Yes.

Teacher: To the feeder schools and...

Interviewer: Is that the term you use for your schools?

Teachers: Yes.

Teacher: Teachers from Dogwood Elementary had a title one school or...

Teacher: Came in and observed last year, so they could see maybe what we're doing

Teacher: And my homeroom is actually more diverse. I've talked kids in cluster for four years now. This is one of the most diverse homerooms I've had. Even here teaching this gifted cluster with Ailanthus students. So,

Teacher: Yeah, this has been one of our most successful years. In pulling in a more diverse...

Teacher: And not just averaging in female, and socioeconomic status of the room is also..

Teachers: A little bit different

Teacher: But you know I taught at Miami where I was the only white person in the classroom and I taught, and I'm from Oakland, so you know, I can comment on the fact that a lot of times just that is not, that is not something they identify with. That is not something a person of diverse culture identifies with. Kids feel like they have to make a choice. Am I smart or am I black? You know, and unfortunately we've lost many, we've lost Pearla, we've lost, you can name them all we've lost many of our African American children they choose to go back to their home school.

Interviewer: Let me throw out an assertion, and just react to what I say. I've been concerned about science fairs. For many, I think they are wonderful things for about 10% of the kids. And I perceive that science fairs result in one, two, or three winners and everyone else thinks of themselves as a loser. It's not like, oh I'll be a better scientist or engineer next year. They say I guess I'm not a scientist or engineer. And I wonder hearing that, because that happens in middle school, where kids are at a very tender identity building time at their lives. But I think the roots of where they get that notion that they could be headed toward a technical profession, a STEM profession happens much much earlier. And I wonder about a couple of things: the kids that apply and don't get in to this academy, do they think of themselves as less than scientists or engineers. Or the kids who are in other science and math classes here do they discount their aptitude because they're not part of an academy or wearing the red t-shirts. What do you think about that?

Teacher: I never thought about that. I don't want that; I never realized that might be how we're thought of.

Teacher: Well, I can kind of speak to that because being gifted cluster a lot of the kids that didn't get into academy from Ailanthus, their parents wanted them in the next best thing. So, I got a lot of that for the past three years. "My child didn't get into the academy so what can you do for my kid?" But I never had a child not love science. Because I love science, I have a passion for science and math. And I, and social studies, but I always did these experiments that Benigna was talking about doing. Or I would always try to seek ways to foster that science and creativity. And I never heard a kid say, "I'm not good at science, because I'm not in the academy." But what I heard, a lot of times, is my friends aren't in the academy. That's what I heard from the parents. Their friends, they can't identify with these children in this room because all their friends from the country club aren't with them. That's what I heard. That's that mentality. But I never heard a child say, "I'm not good at science, because I'm not in the academy." Not that it wasn't said, but I never felt that from a child.

Teacher: You know, I think what you said is this saddest part of doing this because you certainly, you certainly wouldn't want any child to feel they didn't have the ability or the potential to do something. And, you know, that's why we have 26 and not 24 in our classes. And this is the only year that they have not had the ability to retest. But that that is sad, but my perspective is we weren't prepared for it. And from top down we handled, we did not step forth and do what we could have done from the top down when that happened; you know instead of saying, 'I'm sorry you didn't get in', and 'I'm sorry you didn't get in,' we should have been able to say, 'You know there are other opportunities. We're going to be doing great things in your class too.' But I don't think as a building from the top down we handled some of those disappointments.

Interviewer: To be sure, there isn't a great way to do this.

Teacher: And I don't know either.

Interviewer: How do you imagine a non-Academy student, who might be be interested in STEM but had never been encouraged to apply might perceive his own future as a scientist or STEM

professional when he or she sees a large number of red –tshirts pass by on the way to explore the school yard?

Teacher: I never thought about that. <Emotional> I don't want that; I never realized that might be how we're thought of.

Teacher: Well, we, I think, we're more cowardly. I don't think we... I don't know what we did. I just feel some of it, and in some ways I think it got fed instead of I don't know. But that is sad. That is truly sad.

Interviewer: Yeah, I know, that is a challenge we all face as educators and

Teacher: But you can't not give opportunity because people don't have it.

Teacher: And we all face disappointments. My son didn't make the division, or the division AAU team. I mean you know they deal with those things it's not just STEM Academy. You know so, it's incredibly that we deal with those types of things in sports situations so beautifully and we handle it but when it comes to academics we feel the need to coddle them or insult them.

Interviewer: Can you folks remind me of your colleagues name here earlier?

Teacher: Holly Christensen.

Interviewer: And you said she's working with you as just your grade level collaborator?

Teacher: She teaches language arts and writing, because I just teach math and sciences and social studies. And she teaches the language arts, writing component. And the integration of the social studies and science, is what she does.

Interviewer: Good. Okay, and again please if you think of other things you wish you said, please, just reach out at anytime. I promised them I would get them an initial draft together that it may an enhanced outline by mid-October. And then be working toward a final draft by the end of October. And I'm sure when I aim for that initial event there will be gaps revealed that I would like to reach out to you. But I am going to try to come back again. And if there is a particular thing you want me to see, if I can align that with my schedule that would be fun to do.

Teacher: Now, what do you do with Duana Clinton? How do you know Duana Clinton?

Interviewer: There are many things I've seen in her teaching in you today. And I know exactly where some of those ideas may have come from. Or at least been nurtured.

Teacher: Yeah, she just, she's just phenomenal. Like I said, we would have never gotten as far as we are without her. And we wanted to keep working with and that wasn't an option for us.

Teacher: That's who we wanted when we started writing this curriculum we were like, please give this to Duana Clinton. We begged for her.

Teacher: I know. And you know what is there. I know when I first got stuck, oh not stuck, had the ability to write the curriculum. I would send my beginning stages to Duana Clinton and she would quickly give me good ideas and. So it was always interesting with the good stuff that she helped me with came back critiqued by the other person totally just I don't know. It's been a real great ten years. It has been a great ten years.

Interviewer: Well, thanks for everything. I kept you here twice as long as I intended to.

Teacher: Well, thank you for the opportunity to talk, though. You're the first person whose let us talk. Which is nice.

Interviewer: Well, very nice talking with you all.

Teachers: (Collective thank-you's).

==========

Appendix E. Transcript of Interview with Duana Clinton
October 7, 2012

Duana Clinton was the Chrysalis Middle School Science Specialist and a HOMS Professional Development Trainer.

Interviewer: Okay, so this is Duana Clinton on October 7th, and it's 7:51pm on a Sunday evening. She's the only person I can ever imagine doing this with me on a Sunday evening. Okay, so the first question I wanted to ask you is: what do you believe attracts students and parents to the Ailanthus Academy?

Duana: The students that are attracted and the parents that would help support their children are interested in a more intensive math and science experience, they're interested in an integrated experience as well, and there's a reputation with the academy that it's very project-based that it does reach into the community and uses a lot of community resources, too.

Interviewer: Do you believe many parents know that those things are going on or the reputation is consistent with what actually goes on, or do you think they're happy to believe that's the case?

Duana: There's a pretty strong parent community of support, so I think from word of mouth there's a lot of sharing from parent-to-parent as to what experiences students have been having who've already gone through the academy. And that positive kind of a feeling is shared with other parents, too.

Interviewer: You may not know this -- is there a distinct parent-teacher organization for the academy from the rest of the elementary school?

Duana: I don't know if there is or not. I know that traditionally the academy classrooms have had pretty strong support for field trips, for hands-on experiences, whenever they need materials there seems to be a readiness to supply those extra resources, too. They're pulling from just a few schools as well, so it's not as though it's pulling across the whole city. It's still somewhat geographically-centered too.

Interviewer: And do you know anything about students' perceptions even though it's at a very young age. Do you believe that there are second graders who aspire to go to the academy?

Duana: I know that several of the teachers work hard to have a lot of animals in the classroom, which is real motivating and exciting. There's a display of a lot of work, so it's kinds of engaging kinds of things in the hallway. So there are younger siblings who might see their brothers or sisters are involved, and those would be siblings who might just come in with moms and dads. So the hissing cockroach is a big draw, or whatever kind of critters there might be.

Interviewer: Do you know if there are any sibling preference programs just because of the convenience for parents to have their kids in the same school?

Duana: I don't know whether or not. And I think it was a competitive piece that there were performance tests and tested that students had to complete to be chosen, so I don't think there would be a preference layered on top of that.

Interviewer: Let me follow-up on that -- there's a combination of things I understand that would lead to a student's selection -- do you know what they are?

Duana: I haven't been involved in a couple of years. I know that there had been an application involved, and then there was some face-to-face hands-on performance-based tests going on, too. And there were observers in the classroom when the students were working through those, too. And at that time when I was last involved, there was kind of a focused math experience and a focused science experience. I'm not sure really what they have going on right now.

Interviewer: Was there anything about a student's portfolio of work that might be reviewed or analyzed? And when would that happen, as I imagine that would be at the end of second grade.

Duana: At the end of second grade, it would be in the spring. We always ran the testing and looked at student performance and student work. The end of second grade in preparation for them coming in in third grade. And I believe they also then, if there was space, they would consider bringing somebody in at the fourth grade level. I don't know if they brought them in the fifth grade level or not, but for any attrition, they would try to fill those spaces too.

Interviewer: So you mentioned just a few things in answering the previous question, but what does distinguish the academy program from the traditional Ailanthus elementary program?

Duana: All of this is based on, I haven't had recent experience with them, so just what I know was originally put into place...

Interviewer: And when was that, by the way?

Duana: Oh my gosh... I honestly don't remember, I'd have to go back and look. I helped when they were initially trying to get their proposal in front of the school board, and the school board had then approved the academy without funding, and there was some concern then that there would be no way to run it. But they had such a strong parent group, that there was funding from the PTA to be able to run it separate from the school board. So that kind of gives you a clue as to what parent groups are involved too. Initial planning really focused hard on having it be very constructionist, hands-on, a lot of kind of following the Piedmont constructionist model. There was integration with the language arts and the social studies so that at that point there were two member teams. There was the science/math teacher, social studies, and then the language/arts/reading teacher was a separate person, but they looked for novel studies and non-fiction reading that they could be doing at the same time that would match with the science and social studies. They looked at ways to pair the science and social studies so that they would make sense like a social science kind of look at things. So it was really trying very hard to integrate all that was going on between the two teachers. And with only having two teachers working together, it was easier to do some of that.

Interviewer: Has that pairing remained consistent? Is it still math paired with social studies, meaning that teacher teaches those two subjects or does it alternate based on teacher's certifications or what?

Duana: If there's the same teachers involved that were there from the start, I think they're still doing science/math/social studies and language/arts/reading as a separate person. That was how they had paired it originally. Traditionally in an elementary setting, the science is the opposite of social studies, but they've worked hard to try to merge all of that in together too. And so it doesn't sound like it's an even balance, but it seems to, when you think about the writing and it goes in with the reading and the writing part of it all too.

Interviewer: Now recognizing that the only other academy in Piedmont Public Schools is the language immersion academy, are there other Piedmont Public Schools that might have some of those characteristics you just mentioned about the Ailanthus Academy?

Duana: Some other schools have done some innovative things wrapped around science. I think it was at Juniper, they had a science laboratory that was actually managed by a PTA person. They actually even put it as a seat on their PTA board that there was somebody that was going to be the science lab support. It was a parent with a science background, who then did training with other parents to come in and do hands-on kind of pieces, and they would plan labs in the science lab and the teachers would all kind of run their kids through that. That wasn't as integrated a piece, but they wanted to be sure there was a real emphasis on science in their school. I know that there's been re-work and revisions of the elementary science curriculum to make it more project-based and more integrated with the math. So in the time since Ailanthus started, there's been more curriculum design that may parallel some of the things that were there originally.

Interviewer: I should have asked this earlier, what was your role at the time you were doing this on behalf of the academy?

Duana: I may have been still at Chrysalis or it may have been when I first went to NASA, they call me the NASA teacher, and I was kind of brought in from the outside to actually then run summer training. The principal at the time, Roxanne Wise, wanted some hands-on training with their teachers and because of my HOMS background, we ran HOMS training for the teachers. And that was when HOMS had just come out with focused the state SOL activities, and so we got the third, fourth and fifth HOMS binders for the teachers. And we ran some summer training focusing on inquiry and we then looked at the binders; we had got the binders that went with life science, earth science, and physical science so they had training for the year-round the state SOLs and HOMS' activities that integrate math and science.

Interviewer: And did they provide that for other states in addition to the state?

Duana: HOMS has binders for some other states, not all of them, but they have done initiatives in different states and for those states they develop binders that have the state specific activities. The state has third, fourth, fifth and sixth grade, I believe. Similar, they have Texas, they have North Carolina, but they've been brought in, different states have asked them to do kind of a focused approach. They left the generic kind of HOMS training to go into the standards specific training.

Interviewer: And where did you do the HOMS training?

Duana: At Ailanthus.

Interviewer: Oh, I meant where did you become certified?

Duana: In California as an HOMS trainer. When I was in Foothills Public Schools, Foothills Public Schools used to bring HOMS trainers to do training in the city, and then they determined

it would be a better use of funds to train some people within the city, and so they sent me and another person out for three summers to be trained.

Interviewer: I see. Okay, so you've largely answered the next question, which was how was the Ailanthus Academy program and curriculum developed. But I wondered about the role that you played with the teachers. It sounds like it was a collaborative thing.

Duana: It was collaborative. We did some curriculum mapping. so we laid out what their standards were kind of quarter by quarter. We did the training in a staggered session, some in the summer to prep for the first quarter, and the first quarter to prep for the second and kind of rolled it out over the year. We tried to, by laying out the math and science, we could also then overlay what was the logical time for non-fiction reading, for fiction reading, what books we could bring in that would make sense. So we kind of mapped out math and science first, then the social studies over top of it, and then language/arts to see how we could support it. And all of the teachers were involved in the curriculum design at that point.

Interviewer: All of the academy teachers?

Duana: All of the academy teachers.

Interviewer: And did you adhere to one, and they may not have existed at the time, but did you adhere to one particular planning guide that focused as what would be the foundation for what was taught when and then you built the rest on top of it, or was did folks say, "normally in math I teach this, or normally in science I teach this."

Duana: They looked at the pacing guide for Piedmont, so they started with that piece.

Interviewer: For one of the four subjects?

Duana: They pretty much tried to look at, I don't remember which one laid first, probably math is what actually laid it out first. And at that time there were benchmark tests, and so they were trying to make sure they could adhere to those pieces but they were given some freedoms around that too.

Interviewer: So the benchmark tests, were they specific to Piedmont Public Schools?

Duana: Mhm.

Interviewer: And at the time, were they provided for all three of those grades or just grades three and five when the SOLs are provided, or did they use it as an alternative?

Duana: I think they had benchmarks for all of the grades, and Piedmont has come in and out of doing that more heavily and they're probably out of doing it as heavily as they were at that time.

Interviewer: So this is an interesting one for me -- How have you perceived the Ailanthus Academy program and curriculum change since it began?

Duana: I haven't been involved in the last four or five years, so initially, the teachers that were involved had probably more flexibility and more freedom in choosing what they wanted to include, and each of them was looking for particular community involvement. They got heavily involved in the State Arboretum, some with the marine science center. With changes in administration, there was some changes with the focus of that too.

Interviewer: And you mentioned Roxanne Wise...

Duana: Roxanne Wise was the principal when the academy first came about.

Interviewer: Do you know who followed her?

Duana: Loretta was her first name, I don't remember her last name but I'm sure that will come up. And I honestly don't know if there have been people between Loretta and Ginger with what's going on. Kind of casually when I started doing more and more work with NASA, I would bring NASA resources to them so that they could see where those might fit in, but the curriculum design, once Mrs. Wise left, there was kind of like redesign and rethinking about the academy. And that's when Carolina Moore and Janette Oakley became more heavily involved with what was going on.

Interviewer: So did you function as almost the singular curriculum specialist at the beginning and then the elementary coordinator and Carolina Moore was ...

Duana: She was in charge. Carolina at that time was, I think, the gifted resource specialist and then she became in charge of the gifted and academy programs. I'm not sure the whole interim piece of that. The initial piece when Mrs. Wise was in place, in some ways she refused help from downtown, and the structure for Piedmont is such that the curriculum folks need to be invited into a school to be able to make change and function within a school. And Mrs. Wise chose not to invite them in.

Interviewer: I see. I imagine that facilitated what might have been perceived to be necessary autonomy for a new academy that was supposed to be distinct.

Duana: I think at the start, when there wasn't the funding then the downtown folks may have perceived that this was just not going to be happening, and Mrs. Wise was kind of a force to reckon with. She just kind of moved right ahead and she was kind of noted for getting things done with or without approval from other places. So while she was the principal, she could kind of do this arms length with downtown. When she retired, then downtown had a change to jump in.

Interviewer: I see. I wondered, did the funding model change if there was no initial funding, I also imagine Mrs. Wise said, well if you're not giving us any funding, why would you imagine that you could give us opinions. But did that funding model change?

Duana: Then there was some funding, I don't know how it all turned over at that point. The biggest change when Mrs. Wise retired was that kind of with both feet downtown jumped in.

Interviewer: Interesting. I don't know if you know anything about the new principal, do you know if she was selected in any way reflected the academy?

Duana: I don't know. I don't know what's happened recently with the reputation with the academy. For the longest time with Mrs. Wise it was really one of the jewels in the crown, and it kind of became not as important when the next group came through.

Interviewer: What do you know about ongoing work that may have influenced the evolution of the academy? In other words, do you know if the teachers, who largely remain the same, have continued to pursue new initiatives or new professional development, or have they remained steadfast in some of the ideas that they were very proud of?

Duana: I don't know exactly where they've gone. I know that they were involved in a lot of curriculum development, and that Janette was overseeing the curriculum design. All of the school system follows Understanding by Design so that was the model that was being used in the development of the curriculum. I know personally they were feeling very strong about giving kids authentic experiences and that's where the community-based part was really important to them, and ongoing science. So they would go in repeated times to the State Arboretum to see the same thing over time and make sure that they could record that information. I know notebooking was a big piece of the work that they were doing too. But I haven't really been involved to see what's going on right now.

Interviewer: So in addition, you mentioned notebooking, we talked about different types of experimentation and there was one other thing that you mentioned were significant components, Understanding by Design and...

Duana: Project-based, sometimes problem based, and then the real emphasis in real data, trying to think and act like scientists and developing those habits of mind. We actually used those phrases when we were first designing their work, you know, what were the habits of mind in mathematicians and scientists.

Interviewer: Many of the things you see reflected more commonly today you were advancing those back then.

Duana: And those weren't as prevalent at that time. And in fact, an emphasis on Science wasn't very prevalent at that time. That was still when that might have been the stepchild in elementary.

Interviewer: So, it's understandable that by implementing things that were then cutting edge but it turned out to have some traction and have become or actually continue to be state of the art, that there probably wasn't a strong impetus for those teachers to continue evolving especially when they see in the research literature and trade journals all these ideas that they've been using since early in the last decade.

Duana: And they would implement pre-assessments to check for student misconception, so a lot of the basic tenets that we know are important for good elementary science education. They were doing probably at an early stage, and for the teachers also kind of being in the trenches with it, they would work year after year to try to make improvements on what they thought were good starts. And when the new curriculum development piece came in, I think they sincerely tried to model what was being asked of them with that too.

Interviewer: Help me understand that when you say the new curriculum piece came in. This is under the influence of Carolina Moore and Janette Oakley?

Duana: That's with Janette, mhm --

Interviewer: Do you know what they were promoting in there?

Duana: That was with the emphasis of Understanding by Design.

Interviewer: Okay, I see. So you're saying the teachers really did --

Duana: They were trying to make and modify and to follow the training that they were given by Janette and Carolina to do that.

Interviewer: Do you think that it was a comfortable integration of those new ideas, was it sometimes challenging, did teachers have the where with all to sometimes say no or select?

Duana: It was somewhat dictatorial. And there was some frustration at times because they would seek feedback and not get feedback, and then feel as though they were criticized if they didn't comply when I think they had sincerely tried to comply and didn't know what to do.

Interviewer: And meanwhile the rest of Ailanthus Elementary was going through the same --

Duana: -- it was going through curriculum development, too.

Interviewer: Okay. Do you know how the curriculum at other Ailanthus Elementary classes has changed since the academy began?

Duana: This I don't. I do know that after Roxanne left, the new principal was working hard to cross-pollinate a little bit so that some of the things that were going on in the academy then were being used in the rest of the school. She wanted to make sure that everybody was benefiting from that.

Interviewer: Do you know whether there was any similar cross pollination with the other feeder schools?

Duana: I don't know. That's a good thing to find out. But no I don't.

Interviewer: I can only imagine that the principals of those other feeders schools would reflect on what makes that academy special -- why do I lose students, and of course those things that come up with "brain drain" concerns -- and I can imagine that there was some interest but I'd be curious to know, and I'll ask others.

Interviewer: And what about the curriculum and the math and science curriculum specifically throughout the rest of the school division -- do you know how it has evolved over the last eight or so years?

Duana: I know that there was much more of a push for trying to integrate there, and everybody has been doing an Understanding by Design so that has been the focus, which is much more performance based. I know that across the division they've also been developing performance assessments, so that in addition to worrying about SOL testing, The Piedmont Superintendent really considers those kind of low level that he has encouraged the development in the department of accountability that's been coming up with performance assessment tasks --

Interviewer: -- so students will be able to do things, not just know things.

Duana: Mhm.

Interviewer: Okay, and what inquiry-based teaching and learning?

Duana: Inquiry has been emphasized too and when Janette was elementary science, inquiry was a real push that she was really kind of at the forefront of pushing inquiry in elementary science too.

Interviewer: Is there anything I didn't ask you about the role you played in designing developing or modifying the academy curriculum?

Duana: No I think after the initial development the teachers still thought of me as a resource, so if they would start a new unit they would often say, do you have any resources that you would suggest. If they would get stuck when they were trying to write some curriculum and come up with essential questions, you know I would get emails that said can you help us brainstorm some ideas, and that continued on for maybe the next three or four years after I was involved. The last probably four years or so I've not heard from them much. I think they were just pretty overwhelmed with what they were working on.

Interviewer: Did you get similar opportunities directly or indirectly with the rest of Piedmont County public schools in terms of providing resources or outreach. I imagine it was more indirect.

Duana: In other pockets, secondary math asked for help when we started doing work with space math through the Da Vinci project. When teachers know that I'm involved with other stuff they'll ask for help through that. Chrysalis folks will know what I'm doing, so sometimes folks know what I'm working on and then I'll get emails to get some help with that too.

Interviewer: And balance sometimes even more from outside Ailanthus than from obviously in the last three or four years probably more from those?

Duana: And now mostly what Piedmont sees me...and the math folks know that I'm doing a bunch of stuff. Sometimes just with general science I'll run professional development just as an open professional opportunity wrapped around NASA resources and 21st century things. And that's across the board. Often those are more middle and high school based too.

Interviewer: Do you have any feeling how the academy is perceived by others within Ailanthus Elementary, and I'm thinking of things like the lab coats and the special shirts and the special labs or anything like that?

Duana: I didn't see how those kinds of things happened after I left. And I think they were trying to find a way to define the students a little bit and give them a sense of identity. I can only imagine that it may backfire too that it's perceived as elitist sometimes too.

Interviewer: Sure. Do you have any gut feeling on the challenges that the Ailanthus Academy will face in the next five years?

Duana: I think as Target 2015 starts to come to fruition, then Ailanthus is gonna need to define itself very differently or there's not going to be the need for it.

Interviewer: Is there enough about Target 2015 that, duplicates isn't the right word, but compliments or overlaps with the original academy model?

Duana: Some of the big overarching pieces, not necessarily some of the specific ways they've implemented it. But the emphasis on collaboration and teamwork and the emphasis on creative and critical thinking and the emphasis on using emerging technology and connecting outside of the classrooms walls. And so as more and more are understanding and implementing that, some of those bigger tenets of Ailanthus are happening in other places too. And it might have been more narrowly defined within Ailanthus but it's kind of like the world's been opened up to everybody too.

Interviewer: So it sounds like there are many components of Ailanthus Academy that have been replicated elsewhere in Piedmont Public Schools not necessarily because they were part of the academy, but because they came to be recognized much more widely as best practices. Can you think of anything that remains part of the academy that could or should be replicated throughout the rest of Piedmont Public Schools?

Duana: If it's not being done, the community connections I think should be replicated and using whatever unique community resources. I mean Piedmont has such a range of across the city, but wherever you might be there's some strong resources that could be brought in and also could help the students build an identity with their community too. I know that Ailanthus was identified as...when you talk with them, they were seen as a special kind of classroom where in essence they were given some funding and then they brought in distance learning like all the camera ware and all of that piece into the lab. So they were working hard to try to then connect

with other locations. They connected back to NASA a couple of times through DLN. That kind of technology is now available in most of the middle and high schools, not so much in the elementary schools, but more and more some of the elementary are starting to see that they can go to some of the middle and high schools and do that. So breaking down the walls of the classroom, the getting the kids involved with real scientists and engineers and mathematicians, or you know with elected officials. Just having kids realize that they can be more proactive and more involved. They did some things that kind of border on service learning and some of that's happening in other schools too.

Interviewer: And what about citizen science with that community outreach where they were looking for real community problems. Do you know if there was ever any effort to engage the community in actually contributing to teaching?

Duana: Well we introduced them to NASA School, which is a citizen scientist program. Part of that might have been happening with Ailanthus which I think is now starting to replicate out. With intention Ailanthus went about doing those sorts of thing. Now some of those things are also finding their way into the other curriculum. It's almost as though if those things once again were put in with purpose and intention then it would be more a mirror of what happened at Ailanthus. I think you can look at all of those individual pieces that we know were some best practice and others might be doing little bits and pieces of it but not necessarily in a cohesive manner to build an experience for kids. I think Ailanthus was trying to build this experience, cohesively. It could be done in other places if it's just done with intention and with purpose.

Interviewer: Is there anything I haven't asked or you wish I would have asked that might reveal any other interesting facets about the academy?

Duana: No I think you're gonna find when you observe, and this isn't just true about the academy instructors, I think you'll find that the teachers at Ailanthus and across the city some dedicated teachers who have put a lot of skin in the game and I think that's part of what their angst is, that they've built and defined something that they think is really special and unique. And not to be elitist, but I think that's why they're clinging on to it so hard.

Interviewer: Do you think they've received what you'd consider to be sufficient recognition over the years for the groundbreaking things they did back then?

Duana: In its initial couple of years, they were empowered. When Mrs. Wise left, they were beaten down.

Interviewer: I see. Interesting how just a couple of years can erase all that good feeling. Do you know when Mrs. Wise left? You might have even told me that already.

Duana: I don't know. My years all blur together. It was like one side of the coin to the other side of the coin, and she really was like a mother bear protecting them. And then part of what ended up happening was it was just such a backlash that was really probably a backlash against Mrs. Wise, but they were the ones that were left.

Interviewer: And did the parents engage then at that time in any recognizable way that you're aware of?

Duana: The parents have been a strong support from the very beginning and I don't think the teachers let them know what was going on. I just know that morale was pretty low when there was that switch and then throughout the next few years morale had been pretty low and they just felt pretty beaten down. And as if all of the work they kept doing it because they thought it was good for the kids but they were wounded.

Interviewer: Interesting. Well if you think of anything else --

Duana: -- I know how to get you.

Duana: It was a hard time. I can remember end of the year school being over and being invited to join them for dinner and they had been beaten down pretty hard.

Appendix F. Transcript of Interview with Madison Croft
October 25, 2012, 12:45pm

Madison Croft is the Gifted Resource Teacher at Dogwood Elementary School

Interviewer: Okay, so you started to say that you're new to Piedmont County, or you're from River County...

Ms. Croft: Actually, my previous experience was in River County schools for eight years, and I taught there in what was considered like a satellite gifted program. So experience with that -- so having taught coming to Piedmont, I had experience teaching as a 4th grade teacher, administrator noticed that I had the experience of a gifted resource teacher and aligned that position and I became a gifted resource teacher.

Ms. Croft: Through that experience, I work with the STEM center as the liaison between the school and STEM, setting up applications have been ** to their presentations where they've come out to their school and presented to second grade teachers, shared with them how that application process works. I have honestly not been in attendance, have not seen the program in action, have not been aware of what the curriculum is like at that particular school and how it's differentiated from regular curriculum.

Interviewer: And how many years have you been here now?

Ms. Croft: This is my fifth year as a gifted resource teacher.

Interviewer: And will you just tell me a little bit about how your day typically works and which grades you work with?

Ms. Croft: My responsibility at Dogwood Elementary as a gifted resource teacher is that I work in grades K-1 in what's called a future scholars program. Through that emerging scholars program, I go into the classroom and work with teachers and students. I work with teachers on the basis of the collaboration where we plan different ** lessons, which align to curriculum. Those lessons are then employed by me. Initially I go in and teach and model four lessons, sharing higher level thinking strategies, and then the teachers and I take turns teaching on a rotating basis. And we take turns kid watching and recording student potential. And through that we have some math activities, some science activities, as well as critical thinking, and it's all based on a very rich piece of literatures.

Interviewer: And that's K-1..

Ms. Croft: And that's K-1, so I'm in all those classes once a week. And then in grades 2-5, I'm the gifted resource teacher for students who have been identified as gifted intellectual ability. And those students are placed in a gifted cluster class in grades 2-5.

Interviewer: So the class I witnessed you working in today was a cluster class, but was it also heterogeneous or was everyone there identified?

Ms. Croft: That class is heterogeneous, we have gifted learners in that class. We have a high number of gifted learners in our third grade classes this year. We actually have two second grade cluster classrooms, you were in one of them today. The class that you observed today was the result of a gifted collaboration. As well as going into those classrooms and working with those teachers, I collaborate with those teachers on a weekly basis. And the teachers share with me data and where students are within the classroom, and then we pull the levers with where we need to differentiate curriculum to meet the needs of those learners. At this time, I think you noticed the teacher was doing an expanded number notation -- that aligned beautifully with our M3 math unit. So we were able to come in and stretch student's thinking a bit with that M3 math unit, and that those students had already shown her in a pre-assessment that they were ready for a different shaded curriculum. So you were observing probably the second to the last lesson of a full unit in the M3 math program called Molly Stone.

Interviewer: Okay, so if I could jump up a thousand feet or so, how many third grade classes are there total in the school?

Ms. Croft: There are five this year.

Interviewer: Oh, so five classes, two of which are gifted learner clusters, and to be in a gifted learner clusters, have they been identified in at least one area?

Ms. Croft: In Piedmont County Public Schools they identify at this time as intellectually gifted. I know that they are up for a new status of identifying students in the future. And the system that I worked in previously, we identified in language and/or mathematics. In Piedmont, we identify with a solid intellectual identification at this time. But with that said, the students within that class who are identified as intellectually gifted still need a differentiated curriculum at different times. And so, they may show a stronger potential within mathematics or they may show stronger potential within language, so our groups are flexing all the time. So as I go in and instruct, it may be that we're doing whole group instruction right now within the Molly Stone with math because that's where the data led us. But the next time that I go in, for instance when we're doing a Socratic seminar, we may flex group that Socratic seminar where we are pushing the levers with their structures and nature unit, and I may go in and have a higher group working with me, the teacher may have another group that's working with her. So that flexing occurs and it's on a continuing basis based on the data that the teachers are constantly getting from students, is they pre-assess at the beginning of the unit and then we move through that unit.

Interviewer: Very good. And then, about the selection process -- so initially those teachers help you identify students, and then are students encouraged to apply well, through their parents, or do parents come to you, or is it a combination?

Ms. Croft: Actually it's really exciting, Piedmont has a great system with that because students can be referred by a parent, they can be referred by anyone who works within the school system

who notices. Say for instance, an art teacher comes to me and says, "you know Ms. Croft, Johnny was just expressing this amazing vocabulary during our art lesson, have you noticed this?" And I may not be in his cluster class, but when I hear that, I'll go visit that classroom and have a conversation with their teacher, call the parents and see if they would be interested in referring the child. A classroom teacher may say to me, "Mrs. Croft, there's a student in my classroom that's really showing a potential in mathematics. I think we need to look at this child to see if this child really needs a differentiated curriculum." Classroom teacher, anyone who works in the building, a parent. I receive phone calls all the time from parents that see this potential within their children.

Ms. Croft: And then within our emerging scholars program, in K-1 is we're taking those anecdotal notes, we see a pattern of notes, we use a one note system that we started about a year ago. And I was just in a first grade classroom this morning and I'm taking notes, a pattern is starting to emerge of a very young learner, for example in one class, and as I'm looking at that pattern I'll share those anecdotal notes with the teacher. The teacher has access to this as well, so when it's time to refer first grade students, she's got a pattern of student behavior that she can look at and then write a really reflective referral based on how the students are performing during the course of the year.

Interviewer: -- With input from a wide variety of people.

Ms. Croft: -- With input … With that said, I employ that same process with our teacher's grades 2-5. I talk with them about writing a reflective referral when they have come to me and told me that they really want to refer a student. For instance, I just met with a teacher yesterday and talked about, you know she was able to share certain things that the student was doing and I had her go back and pinpoint and give specific examples. So teachers are trained to write those referrals and we really work on having teachers employ that behavior through writing as reflectively as they can with the students.

Interviewer: Okay, so the referral to gifted learner status still remains optional?

Ms. Croft: Yes. Basically the parent has to make that agreement to have their child identified within Piedmont County Public Schools. The parent will sign on a form, and testing will not test a child unless we have permission from that parent.

Interviewer: Okay. Now about students who might go from Dogwood to the Ailanthus Academy...I'm trying to think of the best way to ask this. I suppose the best way is simply: what motivations are there for parents, sometimes I suppose there's students, parents and students, that you perceive? Or maybe, can I ask an introductory question first?

Ms. Croft: Yes.

Interviewer: What do you think are the advantages are of a student going to Ailanthus's Academy, if any?

Ms. Croft: Well I think, one... upfront, well upfront I honestly don't know that I can evaluate curricular what they do because I have not been in and observed one of those classrooms. And honestly would like an opportunity to see one. But as far as students who show a propensity for math and science, I think that in a program where that is well-matched with learner need, I think that is something that we need to develop. If we look nation-wide at our students who are progressing, I think we truly do need to develop students who are strong in math and science. I think that opportunity starts at a very young age. My concern with it is that it is offered to a select few. I like where we're located because I get to refer students to that. My colleagues who are not located in this zone don't have that opportunity, and as long as I've been teaching one of the things that I've really been, um...if I have a mantra, it is that all students have access to opportunity. And I think that through that opportunity, who knows what potential students we'll be able to develop. So I think that with that said, I would like to see something like that established a little bit more in depth and to see it offered to not just one group of students who live in a particular zone, but to students who may have that propensity who live over on the other side of the Lake.

Interviewer: Mhm. What if instead, if there were enough students in any given school like say Dogwood, that maybe two teachers decided that they would pair up and offer a math and science integrated approach to the standard curriculum within a school? And then it could be self-selection based on interest, and maybe not testing-in or doing portfolios but simply being interested and a lottery, if necessary.

Ms. Croft: -- Potential, by pure interest and potential. Absolutely, I think that would be a great model...coupled with appropriate teacher training, monitoring of the program...absolutely. I would like to see something like that because there are kids, I don't know if you noticed today within that class, there are kids when I go in and push the levers with math and science, they light up. And I think that that opportunity would definitely be something that should be explored.

Interviewer: And what obstacles from a professional development perspective might there be, what sort of training do you think would be the priorities?

Ms. Croft: Well first of all, I think that the first training of all training, anybody who works with a child who's got a differentiated curriculum, is understanding characteristics of the learner. I think they would need to definitely understand the characteristics of those learners. I think that they would need to know what the core curriculum is first, which in Piedmont that's changing and I think we're all right now figuring out what our core curriculum is.

Interviewer: Are you part of the math pilot here?

Ms. Croft: No, we're not. But I am aware of the changes and the alignments and realignments. So I think that first of all, becoming familiar with curriculum and then knowing, just like a gifted resource teacher knows, where to appropriately impose models, strategies, curriculum at the right place. And it would be someone who is really used to working with, you know, looking at student data, looking at placement, looking at acceleration, where students need to have that curriculum accelerated and when we need to pull back and do a mini lesson that's appropriate. I think the danger sometime would be going off on a particular tangent because it's a STEM

program and yet still not covering your core curriculum standards. When we taught, from my prior experience, having taught in River County schools as a resource teacher, although it was gifted. In applying the strategy to this, teaching with a core standard card, we had a card with standard curriculum on one card. The other card was a card where we had places where we could push the levers. If our students new the core standards then these were places we could go.

Interviewer: So curriculum extensions...

Ms. Croft: Yes, curriculum extensions, where appropriate, with having first core knowledge.

Interviewer: Very good. So the very good list that you just shared with me of professional development priorities, are understandably things that we would want every teacher ideally to pursue? But I can understand why it would be good to identify teachers who are sort of predisposed to really digging in...

Ms. Croft: Yeah, they would have to have the mindset to certainly be able to have the ability to let students get there. As the lesson that you saw today, the teacher that I was working with today, she's learning, she's quite structured but she would turn and look at me a couple times, I don't know if you caught it, she'd say, "I'm not gonna give them too much information just yet, I'm gonna let them get there."

Interviewer: Mhm. The dialogue in that class was so wonderful, I decided to...

Ms. Croft: And honestly, I didn't know you were coming, I want you to know that.

Interviewer: Oh don't worry about that, I --

Ms. Croft: I want you to know, so that's why I came up and introduced myself because I told Ms. **Sussmen over and over again, whoever wants to come in can come into a program because that's what we do. You know, if I need to change something, I'll change it, but the beauty of that is, what you got was, we were plowing through at our normal pace and what we do. We were doing how we do, which was a neat thing. But once again, as a gifted resource teacher, having the ability to coach teachers to think that way.

Interviewer: Well it was clear that between the two of you, you were very comfortably maximizing individual students' potential, and that's I think is the predisposition that we would all aim for. But I wonder about the obstacle of, if there was a math and science integration, say in every school, are there teachers with enough science expertise to pull that off?

Ms. Croft: That I don't know because I don't know individual teacher backgrounds. But I do know from working with teachers who have been cluster teachers, who work as a cluster teacher I would certainly think that they would be reasonable candidates because they have that training. They have the training through many years of working as a cluster teacher, having some of the models and strategies through gifted that certainly would be applicable to a STEM program. As far as teachers, you know, teachers grow and learn all the time. And I think there are different teachers who would step into those positions, and having worked on different teams of teachers,

we all offer different things. So it could be that you have one STEM teacher that's more versed in one area and they complement each other. So I would think the hiring would be pretty crucial in that you match up teachers who complement each other, much like you saw today. That complementation is really important for students because then they've got the beauty of both worlds because different kids are going to respond differently to teachers. So I'm not sure how the structure would work, if they spent half the day with one teacher and half a day with another, I've seen systems like that...

Interviewer: Well from what I've seen when those pairings take place, one teacher in a two teacher team would be oriented to the math and science and the other social studies and language arts. But because of the emphasis on reading/language arts and math, the day can be broken up in a way that that complementary relationship can work nicely, then they integrate some of the novels or stories that they read...

Ms. Croft: Well, it's exactly what we're doing in fourth grade in our language. I don't know if you were able to visit any of our fourth grade classes today --

Interviewer: -- Yes, but it was Ms. Weber's math class, which was wonderful to watch.

Ms. Croft: Well, Ms. Weber's actually plans with me so you probably were seeing an M3 math lesson.

Interviewer: It was and it was great, and she was teaching it much in the way I've seen most gifted instruction approaches, but she told me it was heterogeneous and only four were identified.

Ms. Croft: Right.

Interviewer: It was actually really nicely done, and to look around and see the engagement told me they were right on.

Ms. Croft: The unit was weather, and we plan it with collaboration, and that lesson is aligned with where they are within math. There are different points where we may need to go in and shift the gears. But within our collaboration, we discussed that they were working on the new weather unit, so I go over and service those students also in language/arts, so I found a piece of literature that aligns with their science and where they are right now. It's called in the eye of the tornado. So I came in, DRT just got new iPads, took my new iPad in, showed them a tornado on the iPad, small flex screen. Now these are students who have an accelerated DRA and really need to have an enriched piece of reading. I could have pulled in any piece of literature but determined that it would be best to pull in something that's related to science with what they're learning right now. So I pulled in this great story called "In the eye of the tornado," so we got engagement at a much higher reading level, brought in science so we did a pre-reading on science, and I had them use their Kaplan icons, I think you've seen me talk about those --

Interviewer: -- Oh yes.

Ms. Croft: -- So we use Kaplan, and we went through and talked about the language, the patterns, the details within, what happens when there's a real tornado. And now they're reading a piece of literature that's in depth. They'll be able to take all this understandings back into the teacher's class and make some of those applications across divisions. So when I go back in now and we're doing weather, we may end up doing some type of a Socratic seminar and either side of those two classes tying in the weather and everything that they've learned.

Interviewer: I've witnessed Socratic approaches in every class I saw today, so to what degree is that widespread in Piedmont County Public Schools or do you believe that has simply been an emphasis here, maybe elsewhere too, but -- ?

Ms. Croft: I think it's an emphasis here, I will say that it has been one of my emphasis because I really believe that students need to know how to look eye to eye, speak to one another. One of the things you've seen imposed is one of the things that, from the time that I got here from kindergarten all the way up to fifth grade, that I felt like was very important and that is communication between students. About the same time the M3 math within one of our units came out where they talked about talk moves, you call it accountable talk, but it's very much the same thing, everything kind of dove-tailed into that. So from kindergarten all the way to fifth grade, having students turn and talk to one another and engage in conversations and apply that information. There are different levels of that within the cluster, you know, we'll do things like parallel readings and we've got several books going in that Socratic seminar. You've seen basic intro levels where kids are basically turning and talking to one another. All of that is a master plan to help kids learn how to communicate with each other effectively, and then gleam from one another as they're all bringing in different parts of information. But it takes a while to build that up.

Interviewer: Well, I've got to say, these teachers did not know I was coming until last night apparently, maybe not at all.

Ms. Croft: Right. And like I said, I came and introduced myself to you, so I didn't know.

Interviewer: And what I witnessed here in mid-October seemed comfortably routine for the kids and regardless of which class I was in, gifted cluster or not, when it came time for that Socratic discussion, no one had to stop and say "Okay, now it's time for Socratic discussion." The teacher just started talking in a way and the students responded in a way that I could tell that even for October, this was a comfortable routine ---

Ms. Croft: It starts in kindergarten, and it starts with those students learning to turn and talk, and there are times when we have to, like you saw me coaxing kids to actually turn and look and face the speaker. Personally, I feel like that's a huge benefit because we are a society of, you know, I have two sons, and we pull the 'we don't have the Ipods on at dinner'. We stop and we talk to one another, I feel like that's a skill set that kids need to know. But not only that, I think it deepens understandings, it helps them with their reasoning, and it certainly engages them. So besides being a gifted strategy, I think it's just flat out good teaching.

Interviewer: It also facilitates when you have that much student interaction, reconvening them seemed very comfortable every time I witnessed today. It wasn't even disruptive, it was just five, four, three, and students were ready by two, you know.

Ms. Croft: Different teachers have their different methods --

Interviewer: But I didn't see light switches or anything, and I know depending on the activity that can be necessary at times, but I got thinking as I was witnessing it after the second class, that perhaps by having that regular engagement with them in this very comfortable now adult diction and format, you may have overcome many of those classroom management challenges at the same time.

Ms. Croft: Well one of the things that we share when I first began working with the principal here, I came to her actually not ready to come back to work. I wasn't going to, former principal sent things in, but I had taught in years in River using habits of mind. And she saw me working at the time over at Alder Elementary with her, she talked me into coming back to work. I came back to work, (laughter), and I just began using what I call habits of mind. And half way through the year she noticed, she said, 'you've got these kids thinking, you don't really use a behavior management program, what are you using?' I said, well I'm using habits of mind. And so as she saw me use these, and then an opportunity came for her to be at Dogwood, and then there was a need for a GRT here, she asked for me to transfer here with her. It was a perfect opportunity coming in new to introduce habits of mind from kindergarten to fifth grade. And so some of the things that you see in the classroom are really and truly imposed because we are what I call a habits of mind school. We use habits of mind effectively from kindergarten all the way to fifth grade school wide. We've done several school-wide trainings where we've had teachers understand what habits of mind are, and then learn how to use those habits of mind effectively for their learners. So teachers had some choice in the matter where they could use habits of mind effectively for their particular grade level. So when I introduced it to teachers, I said the beauty of habits of mind is that you can teach it appropriately even at kindergarten level by just sharing maybe just four of the habits of mind. And so it kind of took the pressure off everybody, they said 'what do you mean, we don't have to do all sixteen?' I said no, pick and use the ones that you want, so then they started picking and choosing and what's happened is after, for instance, first grade said, we're only going to start with four.' I said, well that's great. And so about halfway through they decided that perhaps they wanted to add more in because they started seeing the value --

Interviewer: And actually that's a smart way to do it, start with four and --

Ms. Croft: Exactly. And that was a little strategy in there imposed for people to try to get some takers and before we knew it, it exploded. So we have actually gone into other schools...I take our posse with us and we travel...we've traveled to different schools and shared our habits of mind theory with other schools in the division.

Interviewer: That's one of the options I'm thinking of recommending for the academy folks. They've got great ideas and they've got very talented teachers --

Ms. Croft: Absolutely.

Interviewer: -- But if indeed the curriculum becomes universal this year and next with the math curriculum, it's hard to recommend that they go through the expenses of bussing kids, and uh -

Ms. Croft: And that's my husband's theory. He looks at it from an outside perspective and we've had this conversation, and that's a concern when you look at it in monetary cost and what's available within site-based schools. But to me, and I've always made it about kids. If you make it about kids and what kids need, and not just in this particular district but what kids need across a school division, to me, that's what's more important. And if you can make it about what kids need in Sycamore, and Tupelo, and Alder, and all of the schools across the division, a couple of those do feed into Ailanthus, but where those students have opportunity to learn--that's what it should be about--is providing that opportunity to kids. Where if some of those monies could go into training folks across the division, personally, I think that would be a beautiful thing.

Interviewer: I think so too. I understand budgets may be quite tight and that could be a very comfortable way to do it, because money tends to go toward teacher training before anywhere else.

Ms. Croft: Yeah.

Interviewer: Tell me about the phrase I've heard, each of the three classrooms I was in -- language of the discipline.

Ms. Croft: Those are gifted clusters; this is Kaplan. Language of the discipline is where the boys and girls learn to speak like, for instance, a mathematician. I believe when I came in, I believe I heard the principal talking about their language of the discipline with their homework. That's where they would use mathematical terms, so they're taught to speak like a mathematician. We would frame whatever studies that we're doing. For instance when we're studying science, the language of the discipline within science and you're talking about weather, would be a meteorologist. So you're using terminology as if you are a real-life person within that, so the language at the discipline is used in that way. Another way we use it within our readings, for example, we use junior gradebooks when I go into the gifted cluster classrooms, and as we're reading a story, students will pick out the language that is specific to that particular genre. If we are reading a story, for instance, we read the story "Thank you ma'am" by Langston Hughes. There was a lot of slang and the dialect was a bit different, so the kids got to pay attention to that dialect as they read, and it just deepens their understandings. So the language of the discipline used effectively helps to deepen understandings whether you're talking about a piece of literature or you're acting like a meteorologist. So that's one of the things, probably the classes that you were in, were cluster classes.

Interviewer: I believe Ms. Saunders was not.

Ms. Croft: Ms. Saunders is a gifted cluster teacher.

Interviewer: Even this, but this morning's class?

Ms. Croft: Well she, now it may not have been her... she herself is trained as a gifted cluster teacher, she's one of my fifth grade math/science/social studies teacher, she was a gifted teacher before I got here.

Interviewer: Okay. She was using techniques but I gathered the students were not, but she was comfortable with the differentiation necessary to do it.

Ms. Croft: And she, and that's the beauty, that's one of the things -- some schools use Kaplan, there are very few that use them. One of my GRT colleagues, her principals had her training the whole school with Kaplan. We weren't there yet, we decided to use habits of mind first.

Interviewer: Okay.

Ms. Croft: I'm using Kaplan in all of my clusters as well as one of my first grade teachers who came to me just this past week and said, "I really need to differentiate" and I said, "you know what, let's start with Kaplan" and I gave her four that I want her to start with -- patterns because they use patterns, details, language of the discipline, and unanswered questions. So I gave her those four Kaplan icons to start with. It's just a way to help begin to differentiate curriculum for her first grades. That group of first graders is very high, and they just happen to be together in the way the class was rolling. She was looking for different ways to push the thinking in there. So yes, you see the Kaplan icons in our gifted cluster classrooms. Some of our teachers are switched teachers so they may be using some of those strategies, hopefully appropriately for their non-cluster kids.

Interviewer: When you say switched teacher, meaning they might teach one group in the morning, one in the afternoon?

Ms. Croft: Yes.

Interviewer: And I wondered, I just happened to see Ms. Saunders --

Ms. Croft: -- And that's hard to do, by the way. It's very hard to do.

Interviewer: Yeah, I can imagine. I taught five different levels of biology in one day...

Ms. Croft: ...so you know.

Interviewer: I saw on her agenda that she had math this morning and then again after lunch.

Ms. Croft: Yes.

Interviewer: Is it the same students, math twice, or does she might get a different class?

Ms. Croft: Um, I would believe that one of the classes would be the identified gifted fifth graders, and then one of the classes would be probably just a regular fifth grade class of students.

Interviewer: Okay very good. Integration -- do you know if the teachers here have had any professional development in curriculum mapping and integrative teaching and learning? It comes instinctively, I think, to an elementary teacher.

Ms. Croft: Well, a lot of it depends on the division that you work in. When I was first trained in River, initially that's how we did our curriculum. And then things kind of rolled and changed, but we were given the objectives for the year. We sat down and we kind of mapped out our year and we looked at our students and resources available. The past few years, Dr. Geary was here and our principal did a beautiful job of setting up collaborative planning with our teachers because she was able to employ monies at certain times to have subs for teachers to have that coverage. This year we don't have that as much and it's been quite a miss for the teachers. I think they greatly miss that because they were actually doing that; they were actually taking time with the curriculum specialist to go in and look at the curriculum and actually map it out as a team. And that's a beautiful thing.

Interviewer: And Dr. Geary, her current role is elementary curriculum specialist?

Ms. Croft: I believe so. She is an instructional specialist. She is assigned to a different zone now. She's not in our zone but she was with our zone. They get moved around.

Interviewer: I see.

Ms. Croft: And she was with our zone for a while, but she helped them through our plan of ideally having time during the day for teachers to be able to collaborate and talk about curriculum. Now within that there are different places where, you know, the gifted cluster teachers would plan collaboratively and then we would plan later and look at where we could impose different curriculum where boys and girls needed that curriculum differentiated. But there were times when there were things that we could do that would work for everybody. So there was some of those collaborations that I was able to be a part of and some not because we kept the GRT rolling on the regular pattern to keep our cluster classes in place because of the structure that is set up now.

Interviewer: I feel so lucky that I just happened to see your name on your door. I was just looking down the stairs I said, "I wonder if she's in there?" But I do have one more question about what you may or may not perceive in students who apply to the academy but aren't accepted, or why they choose not to go, or why they might even choose not to apply even if they have that potential? And how it might affect them or influence them?

Ms. Croft: You know, I don't know. I do know, I have heard from parents and I think your question earlier when you said, is it a parent's interest or a child's interest.

Interviewer: --Motivation.

Ms. Croft: Yeah, who's motivating the initiation of the referral? I think sometimes parents and I've always believe that parents know their children better than anybody else. They know if a child is interested in math and science, they've watched that child from infant through toddler, and they watch how that child interacts in their world. I've seen children who are disappointed, obviously because they are not in the program and that leaves you wondering, okay well they don't get into the program, they go back into a regular class, so they're probably wondering in their mind: 'Am I really aligned to be someone who can be a mathematician or not? Or am I going to be a scientist one day?' So I wonder what effect that does have on students. There was a pattern before I came here. Evidently there were large numbers who applied to the program. Over the course of years, our numbers have declined. I don't know why that is. We certainly have encouraged if we see someone who has potential to apply. Honestly, our people who live in this community love this school. They like it here, they're happy here. And I think that's a huge concern for (our Principal) and how she set up this environment in the school.

Interviewer: How long has she been here?

Ms. Croft: Five. We've been here the same amount of time.

Interviewer: And what's the bus ride like from here to Ailanthus? Is it ten minutes, or?

Ms. Croft: It's not far, I mean it's just right up the road.

Interviewer: Okay.

Ms. Croft: I mean I don't think that the bus ride, I would think that, from what I have heard, is that the routes I don't know if they have as many buses, and the actual time frame is not that far. It's a matter of logistics and how many buses they have picking up children from which areas, and how long they actually end up being on the bus is another thing. I mean a ten minute drive for you or I from here to here is not long, but if you have to be on a bus that's starting at, you know, a certain time in the morning could turn into a -- 45 minute bus ride.

Interviewer: -- maybe 45 minute bus ride.

Ms. Croft: So a lot of that is logistics. I know that is a concern even for our parents who make application to the gifted center, that's one of the things that we tell them upfront when we do open houses and share information with them. We let them know that that is a possibility and what I say to parents is -- there are some kids who thrive on that. They get their homework done, they have buddies on the bus, they're happy campers.

Interviewer: We're probably just a few years from wireless on the bus, too (laughter).

Ms. Croft: Right. And there's some kids who are wireless on the bus --

Interviewer: -- with their phones, yeah.

Ms. Croft: There are also opportunities where it's very stressful for families. I've got one dad who says, I work out there, I'm gonna drop her off everyday, and it works beautifully. So I give parents all the scenarios. Do what's right for your family. And we do the same thing with math and science. "I mean, yes I'd like to hog tie them and keep them here, but we don't do that obviously, and those who want to go, who truly show that propensity want to go. I've had one father who's new to this area, a plastic surgeon who just moved into this area, met with him earlier this year and he wants his daughter assessed for gifted and he said, you know because of his background in math and science, he's thinking that maybe STEM academy might be something for her based on their family and how she learns and what she's interested in. So I've only had this one request for the STEM Academy so far this year.

Interviewer: Okay. You mentioned the Honeylocust -- how do you see students choosing between them, of parents and students choosing between them? Obviously at the Honeylocust they can get an arts focus as well.

Ms. Croft: Well that's a separate application process.

Interviewer: Oh it is. Well you mean from Ailanthus, right? Or at Honeylocust they choose art or science or math or academics or…

Ms. Croft: No. The way I understand it, at Honeylocust there is an application for students applying to the art program, there is an application for students applying to the dance program. That's a one-day program. We have students here at Dogwood who are in either the art or dance program. Our day is Monday. They get on the bus, they ride out there for art or dance for that one day. It's a full day, it's not just art. It's art history. Its applications - reading, writing, they tie in all of the curricular needs in that one day. Brook who you saw in the class today, the little girl who said, "I don't know if I have that, I wasn't here, I was at art." She was not there. We make sure they have all the components so that when they come back, then they can put the pieces together. So that's art and dance. Then they have students in grades 2-5 at the Honeylocust who are identified as intellectually gifted. And all of those students who are in those second through fifth grade classes are all identified as gifted learners. So that's how that's set up.

Interviewer: Okay. And in choosing between them, do you perceive that there is, I'm just going to use the word status... It's not the perfect word, I know... but do you perceive that a parent might see that as goal number one, Ailanthus, maybe goal number two, gifted cluster?

Ms. Croft: Oh I've had parents share with me that their goal in life is to obtain entry into the Honeylocust for their children. I've had parents who are very adamant for whatever their personal reasons are, I've had parents who are, parents of identified students, who have said, you know "my child is identified gifted but I really believe in the home-based school situation. I really want my child to go to their home-based school." So I truly hear all perspectives when it comes to that. As a parent of a gifted learner, we had just moved here. My oldest son was identified gifted and he would hold out his arms and would use just those words, "Mommy, I want to go to my home-based school." And we drove here from Washington D.C., My husband and I took him over and showed him the different schools, and he saw the school, he knew that it was near the baseball field which he loved, and his mind he would hold out his arms like this.

Well my husband and I looked at each other and said, you know what he's telling us something and we need to listen to that. So I investigated what the cluster program was like. At the time I wasn't teaching and I looked at how things worked and aligned, and I felt like he was going to be fine where he is. He's in high school now, he's taking AP Euro and he's come in pretty much at the same level as some of his counterparts.

Interviewer: Sure.

Ms. Croft: Because one, he has the ability, and two, you know, if I'm a little biased, he's an excellent student. He knows how to study, he's smarter than I am, and it's a beautiful thing to see that come to play. So he had opportunities along the way that also helped him to propel, so I can speak from a parent standpoint as well. He has friends that attended Honeylocust as well as Chrysalis and just as wonderful, well-versed kids, they're in all the classes together. So those opportunities, the way it's setup to provide parents and students the ability to make an appropriate decision for their family and meet learner needs. So that I've been pleased with as a parent.

Interviewer: I can see an opportunity in personal identity for going to a STEM program. If you believe your student wants that as the core of their identity, or I could see them going to an art program if they really wanted to establish themselves as an artist, but the reality is they can get that in so many ways. It's hard for me to --

Ms. Croft: -- Well the thing about it is the way I look at the art and the dance program, I think about, for instance, we have a student here who has the best way to put it is, extreme family challenges and difficulties, and would have never otherwise probably had the opportunity to have any type of formal dance study. She shows potential in that. She is truly a gifted dancer in that arena, but because of her home life actually has had a social worker get her to the bus stop on time and because someone cared enough about her to get her where she needed to be. So once again, you make it about kids and kids getting what they need. There are kids who truly benefit, and I've seen the same thing with art students because we serve a really diverse population here, students who need that true chance to grow in an area. For instance, this young man I'm thinking about with art, by him doing well in the art program it actually helped to build him up in other areas, his academic. So we've seen it both ways. We've seen kids who go to those programs who also struggle too because they've missed a full day of curriculum. There's gotta be a good match with the teacher who's willing to help close those gaps on those days that they miss.

Interviewer: It's also terrific that they teach in context at the Honeylocust so it's not going from zero to fifty or fifty to zero.

Ms. Croft: Yes, and as far as it being a selective process for Honeylocust...I mean the students who are formally identified for Honeylocust are the only ones who make that choice. So students have to be intellectually identified for Honeylocust and/or Chrysalis to even be in the position to make that decision. We have students here at Dogwood who decided to stay within our cluster program, and we have parents who go to Honeylocust and they're very happy. And the principal and myself both tell them to go out there, go to the open house, talk with them...

Interviewer: Where is there, by the way? How far is it, is it further?

Ms. Croft: Honeylocust is a pretty good hike, it's out in the Winton area. If you're familiar with the Piedmont town center. Basically east of the town center. So it's all the way down Piedmont Boulevard...

Interviewer: Okay, that's where I would stay when I would come down here for --

Ms. Croft: Yeah, so it's a pretty good hike in that direction. So that bus ride can turn into an hour depending on the routes and the transportation with that.

Appendix G. Transcript of Interview with Ginger Fishman
October 8, 2012
Ms. Ginger Fishman is the current Principal of Ailanthus Elementary School

Ms. Fishman: There's that big difference in how they teach secondary versus an elementary.

Interviewer: That's right. But it's not to say there has to be. And I think what I saw today were, especially among the MSA teachers, an instinct to talk to them like young people rather than kids. But I saw a wide variety of other things that really impressed me. When I went into Ms. Carlisle's and Ms. Chamberlain's class, and with Mrs. Harley's class I was there already, but I saw the same kind of thing -- the students were really gregarious toward saying hello or welcoming a classroom visitor.

Ms. Fishman: And they're both what I would call very low classes as far as test score wise. I wanted you to have the range of the other classes, but that you knew that they were low level classes so the pacing might have been a little bit different.

Interviewer: Sure. But in both cases, students would show me their work. Well they could see that I was curious about what they're doing just watching me I think, and when a girl said "would you like to see my work" and I thought well yes I would! Anyway it was fun to see the variety of classroom atmospheres. One thing that's very clear is that the MSA teachers are terrific teachers - that was very impressive.

Ms. Fishman: I agree with that.

Interviewer: So I think if called upon to make recommendations, I really do want to strive for how to celebrate the work they've done, celebrate the work they're doing, and at the same time help them reach more people. You know what I mean?

Ms. Fishman: Yeah.

Interviewer: And here's the challenging part -- if we try to make a recommendation that they go on the road and start training other teachers, we remove them from the classroom, are they tremendously effective?

Ms. Fishman: Right.

Interviewer: And I don't know, maybe there's some way to have them videotape their lessons and help them be recognized for the good stuff that they've done. And it is more than the individual components. They've tied it all up in this nice way that's very effective. And maybe if there's one thing that's -- there are several things that I know will be transferable and replicable as components -- but it would be effective for those teachers to be able to demonstrate to others how you can really tie it together in this comprehensive way. Because based on what I've seen, they're using strategies that would be useful with every student.

Ms. Fishman: Exactly.

Interviewer: And that may be the biggest challenge -- how could they continue to teach at the level they teach without increasing the level, maintaining the rigor and the vigor --

Ms. Fishman: -- Without having this cream of the crop... you know Lisa Austin was at another school with me. Lisa Austin is one of the best teachers that I've ever seen. She's really strong in integrative technology and I wanted you to see her.

Interviewer: That's one thing I noticed -- your teachers blow away the secondary teachers I know when it comes to classroom technology, especially having their kids use it.

Ms. Fishman: I agree with you. I think a lot of that work was done here before I got here. With the smart boards and all that is really strong, but it is different when you have these hand-picked kids. And what I'm saying is what you're wondering, which is that what you're doing is good for everybody.

Interviewer: Right. Yes.

Ms. Fishman: But Benigna doesn't believe that it can be done with everybody, the other two do. And I do, you know I think it's the same thing it's just different kids.

Interviewer: Yeah that's interesting. I did see some interesting things in Benigna's classroom. There were times when she would intentionally make mistakes just to kind of keep them alert. And other times she would make mistakes and they caught her real mistakes, her authentic mistakes, (laughter). That was a fun class to watch and she has the right personality to manage that situation. It would be challenging or embarrassing for some teachers.

Ms. Fishman: Benigna is also very engaged, involved in everything, and extremely reliable, but she is also the most emotional out of these guys, really emotional. And you know, wants it to stay as is. She really likes the program and cares deeply about it. I think the other two are flexible and believe in the program just as much, but are willing to consider other options.

Interviewer: I'm eager to walk through the questions with them because they are designed to help any person answering help see the big picture and the microcosm at the same time.

Ms. Fishman: Yeah.

Interviewer: I'm curious to see how these teachers will see themselves and the big picture at the same time. What do you know about the demographics and diversity and how the academy compares to what would be called the neighborhood that the school represents, or the collection of neighborhoods that the feeder schools represent. I saw some interesting differences. I didn't pay attention to the first class because it was so striking in the second one. Sometimes overwhelmingly Caucasian and then um --

Ms. Fishman: And the neighborhoods are the same, too.

Interviewer: Ah, okay. Because when I got to the other classes, with Ms. Carlisle's class that was much more diverse, but then Ms. Chamberlain's class was not as diverse as the others. And then when I got to the gifted cluster class with Ms. Harley that looked a lot more like the STEM Academy class.

Ms. Fishman: Yeah, basically it's like, first choice around here if you live in the north end of Piedmont is math/science, second choice is the gifted cluster, third choice is a regular class and by no means do you go into an inclusion class.

Interviewer: Okay. I just see so [many lakes] around here, you can just imagine the property values are such that --

Ms. Fishman: Right. And then I have all these apartment complexes, yeah, so October 1st I had a whole new enrollment because the apartments switched.

Interviewer: Yeah, and there are so many things that could evolve. The idea of a lottery could be a wonderful compromise isn't the right word, but it enables special things to continue. Selection is a challenge when you're talking about rising third graders, how much of the selection is the students' self-selection versus parent's aspirations versus parents' knowledge of their kids. If it was the first reason or the last reason, great. If it's just parents' aspirations without the kids engagement or involvement than that may not be best for the student, even if it's not wrong.

Ms. Fishman: -- But like you said, that's a problem all the way up through high school.

Interviewer: It certainly is.

Ms. Fishman: And eventually that weeds itself out, and maybe that's the answer to that.

Interviewer: But it does a lot of damage on the way.

Ms. Fishman: I know, and it takes up slots of someone who really has a strong interest.

Interviewer: It's actually worse at the undergraduate level when they take those weed out biology 101 courses where they weed out the pre-med students or some of those calculus classes where they weed out the prospective engineers, the engineering programs and the myriad of science programs except far more freshmen than they anticipate having as juniors. It keeps people applying but at the same time it lets the students self-select out and feed the business school or feed the other schools.

Ms. Fishman: Yeah, and you just get smarter as you have your own children and as you go through this, but you probably couldn't have talked me into it either when my kids were younger. But you make one force move and it doesn't work and you learn a lot from that.

Interviewer: But there's nothing that I've seen today that suggests that those STEM Academy teachers don't have the differentiation skills to do great things.

Ms. Fishman: Right.

Interviewer: And they've already learned how to interact with their students as young people not just kids and that always seems to be the two biggest hurdles when I see teacher success. They all have the diction and the vocabulary and the interpersonal skills to make it work. So it might just be a change thing.

Ms. Fishman: Right. And then buying into it. One of my issues as principal is the feeder school issue.

Interviewer: Yeah, how do the other principals feel about it?

Ms. Fishman: They don't like it 'cause we're taking their best kids. The academy runs, the bus runs, I know this is a logistic issue but they're a pain and they're a long time.

Interviewer: Yes, I saw the bus schedules online. They begin very early.

Ms. Fishman: Okay. Yeah, and they're on the bus for a long time and we have a lot of bus issues with that because this one bus will go all over the place. Just some of the logistics of that are troublesome for the school. The school's overcrowded, you know, so we've got six portables. So I get complaints about the STEM academy kids being in the building and 5th grade being out of the building and they're not in zone kids. Field trips -- I know I've shared with you, using the big pot to support all of the field trips. Well every child would benefit from the field trips that they're going on and so, trying to make that an even mesh has been challenging for me as a principal because I don't want to squash their creativity, but some of it is ** teaching and is not along with the curriculum and it's costing money...and so a whole grade level is not going on a field trip…you're going to the Zoological Museum four times...so I've had that battle and continue to have that battle.

Interviewer: Arguably, it's the students who don't have those life experiences from their weekend activities with their families, et cetera, who need it more.

Ms. Fishman: Right.

Interviewer: And there is grant money to pursue --

Ms. Fishman: -- What I did do...there's a cave field trip coming up for 5th grade. In the past it's only been Academy 5th graders, so I took summer camp money and all the 5th grade is going. I just can't sleep at night knowing that these kids who have probably been to this cave five times are going again and these kids who have never had the opportunity would be left behind.

Interviewer: Do you go all the way across the state for that?

Ms. Fishman: Yeah, it's a four and a half hour drive. And they do regions on the way up there, they all have Ipads, and it's a great field trip. It's very expensive, and you know it's funny because they'll say most kids outside the STEM Academy won't be able to afford it. So the understanding is that kids in the STEM Academy can *afford* to go on more field trips than kids *outside* the STEM Academy.

Interviewer: Afford it because they can't afford time away from school?

Ms. Fishman: No --

Interviewer: Oh, financially.

Ms. Fishman: -- Afford it because fifty dollar **pass and it's okay to ask the STEM Academy kids.

Interviewer: Boy that's revealing in itself.

Ms. Fishman: Isn't it? Are they waiting for you?

Interviewer: I don't know, I see movement back there but I think it's somebody in a photocopy room or something.

Ms. Fishman: So I'm like, well how can all the kids in the STEM Academy afford fifty dollars for a trip? "Well it's never been a problem, we just ask our parents..."

Interviewer: I'm not sure if I asked this -- Is there a distinct PTA for the academy versus the entire elementary?

Ms. Fishman: One PTA.

Interviewer: Okay. And is there any preference in participation in the academy across families just because of the convenience of having your kids go to the same elementary school if they desire to?

Ms. Fishman: Like siblings of kids? Yeah there are bunches of siblings in here and they're granted an out of zone, which doesn't help with the overcrowdedness.

Interviewer: What is that called? Granted what?

Ms. Fishman: An out of zone. So they can ride the academy bus with their sibling and they might be in kindergarten, first or second grade, and they get to come here, but we're over capacity.

Interviewer: At the school that I've spoken of, that was one of the first things to go when capacity became an issue then they stopped granting those opportunities to siblings. And it suddenly became a lot less appealing...

Ms. Fishman: Yeah I can understand that. But then again, I've got four at four different schools because of different interests so you make it work if...

Interviewer: That's right, that's right. It also reveals some of the ways folks think about schools, babysitting and when they make decisions for their kids based on --

Ms. Fishman: -- And convenience. Not that I don't value that, having four kids and working full time, there's something to be said too....I was talking to somebody about the high school IB program because it's 45 minutes away from my house. So my daughter's in middle school IB and really I'm ….

* Interrupted conversation *

[Ms. Fishman was called to a problem in the building.]

Appendix H. Notes from Meeting with Dr. Piper Geary
October 1, 2012
Dr. Piper Geary is the Science Curriculum Supervisor for Piedmont Public Schools

Piedmont has been using Everyday Math up until 2012-2013

Piedmont is field testing new math curriculum in 7 schools this year, including Ailanthus ES.

Moving away from tie to a textbook. In 1999-2000 Chicago Math (Everyday Math) was recommended to the School Board (number sense). They "Piedmonted" it to make it teacher-proof.

RSA's were entered into the gradebook.

Daily assessments

Difficult to differentiate, group, etc.

Everyday Math one of the textbooks under consideration as a text, but there is

Piper started in 2000.

Computer Resource specialist - 5 years, AP for 4 years, and C&I for the last two. Originally Elementary Science. Now on the K-12 team.

No math specialist in the building, but will have a half-time (Sandra Overcash) this year. 56 schools, 13 Title 1) . All Title 1 will have a full-time. 32 will have a half-time. 10 will have none, 1 lost Title 1 funding but will still receive.

Math coach plans with the team meetings, comes in for team teaching then observation, and then troubleshoot specific groups with classroom teachers.

No additional specific math training, but there was money set aside for STEM conferences.

Teacher Orientation provides teacher acclimation to the curriculum. They then provide PL Opportunities throughout the year (strongly encouraged) conducted by the Math Team .

Math instruction daily for 75 minutes (like Language Arts, - 140 for K-2 and 120 for 3-5) AT K-2 content (Science or Social Studies increase to 50 minutes). Content = anything other content.

Language academy at Oakmont, but funded through parent-funding.

Janette Oakley was an administrator pushed for STEM Content. Roxanne Wise pushed for Math and Science. She recruited (or identified within) six teachers. Not all six remain.

There was a divide. Academy shirts. Ms. Ruskin (5th grade science) emerged as a leader. Phenomenal teacher.

Science Focus -
Delta Foss kits adopted in 2010.
State framework Essential Skills and Knowledge (actually learning events) column were adopted as Piedmont objectives. The need for assessment led to a disassociation, and now there are Big Ideas and Learning events.

Strands have also been moved to other grades because it made sense for students.

4th and 5th grade are survey courses, and too little time.
4th is now heavy in earth science with life process; 5th will be physical science and plants.

Abstract concepts will be taught the year they're tested.

No science coaches.

Two people (one coordinator and one specialist) to focus on elementary curricula. One ESL, some math, some social studies.

Curriculum writes and instructional support (subdivided by groups of schools, but with lots of overlap for division-wide needs).

STEM Academy. She has not seen all of their curricula. She worked with them to align their curricula with the division

Bog Turtle Research project is distinct. Other schools (Dogwood Elementary is two blocks from the lake).

Mrs. Daniels was an interim this last year. The number of 4th grade objectives was reduced, and science was integrated with social studies.

In the Academy, one teacher teaches Math and Science, the other teaches LA and SS (two teachers in each grade in the academy). There is not enough time for SS with the LA demand. K-2 units are LA focused.

Systems are the 2nd grade generalization. Matter-native Americans-weather-ancient Egypt - systems in nature.

This is the first year there was curriculum-mapping, starting K-5 and moving to secondary.

The Academy

K has 2 teachers

3 has two other teachers, same with 4 and 5.

Second year of the academy they received funding for three additional teachers to cover and additional 26 students in each grade 3-5

The division is moving away from teaming because of the time wasted. No parent push-back. Piper suspects greater integration and fluent transitions.

==========

Turtle project is for the academy only.
Meryl Winfield may do more with electricity than what is done with the rest of the county

Countywide model for 4th grade science. Her success has partly diminished the negative feels toward the STEM Academy from within Ailanthus Elementary.

Nothing unique in the curriculum

75 minute and 35

190 minutes
- ask for a memo (to be revised)

K-3
140 LA
75 math
25 science
25 ss

4-5
120 LA
75 math
35 sci
35 ss

Academy 3-5
120 LA
35ss
75 math
35 SS

no special integration in the math/science teacher (nothing official, and probably no effort informally)

In Academy 3rd grade, one teacher teaches LA and the other subdivides the other three.

Fourth grade is a big concern for Piper.

many schools do Lego camp, robotics, engineering.

Looping
Piper is all for looping K-3 and 4-5. Ginger came from a school where some looping was common.

Without looping, many students experience the same exact lesson. Other teachers enhance the early year lessons with future information under the guise of rigor.

==========

How students become part.

2nd graders from 6-7 schools (including three Title I schools (now 2));
The Academy probably does not contribute to the

All first-grade students are G-T tested for Honeylocust ARTS PROGRAM, which accepts 120 per grade (division-wide) .

Dr. Moore and Ms. Huddleston created an application process. It included a science experiment, and there was a parent survey and teacher survey.

Dogwood and Tupelo did not necessarily encourage their best students to apply.

Some students reported “Ailanthus is easier than it was here.

Willow Elementary is where this could be replicated,

Ailanthus is close to Honeylocust ARTS PROGRAM, but the other regional schools are closer.

Ailanthus is special to Ailanthus K-2 students, but less so for Sycamore or Chestnut.

*Does the Academy show up on the transcript?

The high school has a STEM academy. Its application process is based on test scores (Stanford) and observations, surveys, middle school track. Piper: "it's unlikely that Ailanthus participation would affect acceptance or preparation,"

Chrysalis is a GT middle school.

Kids from Chrysalis MS said they were better prepared.

Highland County has teachers that teach other courses or subjects outside the academy.

The Language Immersion Program teaches M&S in Language. Otherwise, the instruction and student experience is the same.

A Gifted resource teacher is in every building. Enrichment, curriculum extensions. The six teachers can do some, but otherwise do not welcome the GR teacher's involvement.

Attachments:

3rd grade unit -

Unit 1 in Math
Unit 2 in Science (November) - Matter, Geography, Structures in Nature

Sequence of Ailanthus Elementary Principals
Roxanne Wise
Loretta Huddleston
Shannon Daniels was interim for 6 to 7 months
Ginger Fishman

Dr. Moore oversaw all Academy programs, and is now in charge of Curriculum K-12

Appendix I. Notes from Phone Interview with Loretta Huddleston
10-30-2012

Loretta Huddleston is the Former Ailanthus Principal.

1. What attracts students and parents to the Ailanthus Academy?

Noted for rigor of the curriculum, they hear about outstanding teachers and their passion, and their connections. They hear about field studies (State Arboretum), culminating activity in the 5th grade. All are out of the box.

A lot is driven by the parents - they've got choices, Gifted Cluster, Honeylocust ARTS PROGRAM, or the Academy. Parents were looking for the cream of the curriculum. Honeylocust ARTS PROGRAM starts one year earlier,

2. What distinguishes the Academy program from the traditional Ailanthus Elementary program? From other Piedmont elementary schools?

The regular curriculum has evolved very quickly. The MSA enhanced the curriculum. The distinction was much greater

UbD has been around Piedmont for 10-12 years, but it was site based.

3. What is unique or special about the Ailanthus Academy curriculum?
What distinguishes the Academy curriculum from the traditional Piedmont elementary curriculum?

4. How was the Ailanthus Academy program and curriculum developed?

5. How has the Ailanthus Academy program and curriculum changed since it began?
They were writing the curriculum to replicate the curriculum in other parts of the curriculum.

Janette Oakley was a consultant to help write the curriculum. Every three or four months they came together.

6. What ongoing work continues to modify and evolve the program?

More integration, more language arts, writing across the curriculum. 5th grade did a very good job.

7. How has the curriculum in other Ailanthus Elementary classes changed since the academy began?

It was a real challenge to have that school within a school; invisible walls. The STEM Academy wanted to be so unique, they had technology before others. There was a grant was for 3 SMART boards for the whole school. It required a lot of transparent conversations. Claymation was held as a secret, and then one of the LPE teachers did too.

More sharing and more collegiality

8. How has the curriculum in math and science classes in Ailanthus Academy feeder schools changed since the academy began?

Initially, when I went to LPE, the selection process was different. When she reviewed it and got opinions from central office. It was only taking smartest and brightest, not every kid with a strong interest. It created animosity between school administrators. Mirrored after other academies, it considered a portfolio (similar to Honeylocust arts program and the high schools - five components) Performance tasks required travel on a Saturday initially. So instead, teams went to the schools, "Look-Fors" to the 2nd grade teachers - based on potential; Principal and Gifted Resource Teachers recommendations; Alder, Tupelo principles would allow 3-5 minutes to talk - AA and girls specifically. Report card, parent component (parent scored student on scale of 1-5, and then a 4 or 5 invited a narrative story about their child); teacher component (similar scoring and then narrative); 2 components in the performance task 0- science and math.

9. How does the curriculum in Ailanthus Academy compare to the math and science curriculum throughout the school division?

10. What role did you play in designing, developing or modifying the Ailanthus Academy curriculum?

Started in 2005 through January 2012. She was instrumental in expanding the opportunity for all children; also Carolina Moore; diversity improved, cheerleader for all kids, but also for working hard.

The teachers were not curriculum writers; it was hard, they weren't trained.

They gave out first, second, and third place.

You mentioned STEM. ODU has a contact for STEM with lessons - very exciting for the teachers for Cheyanne, Meryl and Benigna. There's a middle school ,high school and

11. How is the Ailanthus Academy perceived by others in Ailanthus Elementary?

The Lottery has been a topic for the teachers and others. Increase numbers of AA and girls; the teachers were concerned about the types of kids they'd get, particularly with behavioral challenges.

12. What challenges does the Ailanthus Academy program face in the next five years?

Has been and continues to be an elitism piece. Little kids who think they might not be smart enough and don't apply. First time their kid didn't make the team.

13. What components, if any, of the Ailanthus Academy should be replicated elsewhere in Piedmont?

Integrated unit on the oceans. Compacting, differentiation requires master teacher.

Financially - we were given a very small budget. Monies that were received was for staff development, materials over and above what they supplied, busing. Three staff positions. (50% from LPE and 50% from the feeder schedules - one class per grade)

14. What components, if any, of the Ailanthus Academy should be replicated elsewhere in the state?

Appendix J. Transcript of Interview with Dr. Carolina Moore
October 31, 2012

Dr. Moore was the Supervisor of Gifted and Talented Programs and is now Director of K-12 Curriculum in Piedmont Public Schools.

Interviewer: So, because I promised to take just less than a half an hour of your time, I wanted to focus on a subset of my questions that really pertain to your experience, and not only with the academy, but what I'm sure you've seen elsewhere in Piedmont Public Schools (Piedmont) and even elsewhere in the state or maybe even the country. Of course the focus of the evaluation is to determine what components of the STEM academy, if any, should be considered for replication, or we often use the term transferability and replicability, elsewhere in Piedmont? So that's a context by which you're welcome to frame any thoughts that you have.

Carol Moore: Okay that's fine.

Interviewer: The first question is -- what currently distinguishes the academy curriculum from the traditional or regular, I should say, Piedmont Elementary curriculum?

Carol Moore: I have not looked at the academy curriculum; I haven't been in charge of that program for two years. When I was in charge of it, the things that we were pushing for were things like - to make it more conceptually based, to make it more inquiry-based because it was activity driven, to imbed language arts skills within the curriculum, particularly research. Those things the last time I looked at the curriculum, which would have been two years ago, those things had not been put in. I had actually hired a consultant who has a background in science and math education, Janette Oakley --

Interviewer: -- Yes, I got to talk with her.

Carol Moore: Okay. And I also had brought in a, at the time the secondary English coordinator to talk with them about research. This was when I first took over in 2007. When I reviewed the curriculum just prior to a change in my position where I was no longer overseeing the academy but overseeing the regular education curriculum *, it was noticeable that those components that we had worked on were not in the curriculum. All of those components are what we've been moving toward in the regular education curriculum. So I can say that two years ago when I looked at the curriculum, the components of it being inquiry-based, conceptually-based, and integration of language arts skills, particularly student-driven research were not in the curriculum. Those things presently exist in the curriculum that's being developed at the division level.

Interviewer: I'm glad to know this. This is one of, many of the things that you mentioned are among those things most frequently cited about the academy. So that suggests that a) they have been adopted, but it also helps me to appreciate that there has been an important blending of the academy curriculum and the Piedmont curriculum, and they may no longer be that distinct.

Carol Moore: Well the point I'm making is that they never developed the curriculum, that's not to say that things were not going on instructionally, but in terms of actual curriculum units of study, they never developed fully the curriculum that was supposed to embed those things. We are developing that curriculum at a division level.

Interviewer: I see, so it may be a question of how the curriculum and teaching and instructional practices were documented.

Carol Moore: Right, and when I'm talking about the curriculum, there was *science* curriculum that was in development which is why I brought Janette Oakley in, there was no separate mathematics curriculum developed for the academy. I realize it is the STEM academy, but they used the core program which was every day mathematics, and that was the program and that curriculum was not integrated. In other words, mathematics was not pulled into science or vice versa.

Interviewer: Okay, very helpful.

Carol Moore: So when you talk about the math/science curriculum, what you're really talking about is science, not math. Where at the division level what we're developing is a conceptually-based mastery program that's not dependent on a textbook but is driven by updated standards and then process skills which are in the front of the research in mathematics.

Interviewer: And this is something that Piedmont is developing?

Carol Moore: Yes.

Interviewer: Great. So I guess along those lines -- have you seen any influence from the academy on curriculum elsewhere in Piedmont including the rest of Ailanthus Elementary?

Carol Moore: The question kind of broke up so I want to make sure I have the question correct, you're asking me if I've seen the academy curriculum influence the division curriculum or even influence non-academy classrooms at Ailanthus? Is that correct?

Interviewer: That's correct, and when I'm using that term curriculum I am including some of the teaching strategies which could even include the things that I understand the academy has become noted for which is community connections and partnerships outside of the classroom.

Carol Moore: Right. As far as its influence on mathematics and science teaching at the division level, I'm not aware of any influence that the academy has had.

Appendix K. Notes from Phone Interview with Dr. Janette Oakley
October 5, 2012

Dr. Oakley is the former Gifted and Talented Programs Specialist assigned to help Academy teachers document their curriculum.

I'm also interviewing

- Ailanthus Academy teachers;
- Other Ailanthus Elementary teachers;
- Current and past Ailanthus Elementary administrators;
- Current and past Piedmont math curriculum supervisors and specialists;
- Current and past Piedmont science curriculum supervisors and specialists;
- Other Piedmont curriculum and instruction leaders; and
- The state elementary math and science curriculum administrators.

Superset of Proposed Interview Questions

I was at the time they developed the academy, I was the elementary science coordinator for the division. Initially they had an outside person. The last year that I was in the division I brought in Chelsea Ortiz, the instructional assistant at the time

1. What attracts students and parents to the Ailanthus Academy?

Certainly interested in math and science now, given the importance put on STEM careers, and a little a bit of prestige. There is only one other academy, the Language Immersion Academy. Some of the students are certainly interested. They were not necessarily labeled as gifted, but merely expressed an interest. They did a performance based piece; given a problem. I helped in the development of some of those tasks. We watched how they solved mathematical problems as well. They used a portfolio based assessment. They looked at the whole picture of the child.

2. What distinguishes the Academy program from the traditional Ailanthus Academy program? From other Piedmont Elementary schools?

Became involved in 2008.

Well, I think initially the concept of having integrated math and science and real-world problem-based learning. To be honest with you (Interviewer), I worked with teachers to provide them feedback on their units to improve them. They implemented some of the suggestions I made, but I think if it ever came to an inquiry base, from structured to guided, and you know we had a nice structure in place. I would probably say (Interviewer) at the time the curriculum was intended to move ahead of the Division. Now the rest of the division has caught up.

I struggled to get the buy-in of the teachers. You have good teachers that are comfortable doing what they've always done. When the written curriculum units were turned into Dr. Moore, a lot

of the recommendations I made were not put in place. A lot of what was talked about in terms of integration never happened.

3. What is unique or special about the Ailanthus Academy curriculum? What distinguishes the Academy curriculum from the traditional Piedmont Elementary curriculum?

Pockets in VB implemented HOMS. They had done PD with HOMS it wasn't anything

4. How was the Ailanthus Academy program and curriculum developed?

From my understanding, they actually hired Duana Clinton with those original pieces. It was originally developed by the original teachers and Duana. My role was to make sure they were using best practices. We had also done training to integrate research. I worked on really experimental, descriptive or historical research.

5. How has the Ailanthus Academy program and curriculum changed since it began?

I think maybe there have been one or two changes in the teachers. Really you know in terms of the curriculum, what we talked about, what we recommended, not many other pieces.

We worked in 2008 on a couple of units, and then the next year on a couple of units, but the interesting piece is that what was developed was not what was implemented in the classroom. The previous gifted teacher shared information that helped me see that many things weren't being implemented. The principal was also to assure that things were being implemented.

6. What ongoing work continues to modify and evolve the program?

I think after 2010 they began developing some assessments. I have no clue now.

7. How has the curriculum in other Ailanthus Elementary classes changed since the academy began?

8. How has the curriculum in math and science classes in Ailanthus Academy feeder schools changed since the academy began?

So I helped with the development process of the elementary curriculum division wide. (The feeder schools) have moved forward in adopting best practices promoted throughout the division, often similar to those implemented earlier at Ailanthus, but often different.

Particularly with the s in grades 4 and 5 with Social Studies and Language Arts, K-2 Science and Social Studies with Language Arts, Grade 3 is a standalone. They're redeveloping the math curriculum. I heard that, but I don't know.

9. How does the curriculum in Ailanthus Academy compare to the math and science curriculum throughout the school division?

10. What role did you play in designing, developing or modifying the Ailanthus Academy curriculum?

11. How is the Ailanthus Academy perceived by others in Ailanthus Elementary?

Yes. I think they tried to really make it stand out really be different, and really make it stand out from the LP community. I think it probably rubbed people the wrong way. The had a science lab they created, and I don't know that the group of teachers really did much with the others.

What I really which is that this curriculum had forced the others had forced them to continue to change their curriculum. When Carolina Moore came on, we thought we could push this into elementary science. That relationship pushed me to improve. I'm not really sure that happened at Ailanthus.

I think the Teachers need to think the curriculum was so radically different, that it may not have been developmentally [age appropriate]

12. What challenges does the Ailanthus Academy program face in the next five years?

Well I'm aware that last year there was a move to phase it out, and parents were upset about it. There's always a concern when you heard something would change.

I think it was a perk, I don't think it influenced where people moved.

13. What components, if any, of the Ailanthus Academy should be replicated elsewhere in Piedmont?

Um, I think they did a good job of integrating some, but probably they've

Research-based components, descriptive, historical, and definitely the experimental research. The way I see elementary teachers doing research is read about Albert Einstein and do a book report. They can do the research; they would read the biography, if Albert Einstein were alive today, he would actually be diagnosed with learning disabilities. They would then generate a

question and begin surveying people about Albert Einstein. Letting what they read become a catalyst for developing their own questions.

14. What components, if any, of the Ailanthus Academy should be replicated elsewhere in the state?

None specifically. I don't even know if other school divisions are doing this now.

Interviewer: Who else should I talk with?

Dr. Moore - she was the gifted resource director at the time.

And then when that became the office of academy programs. Chrysalis, and the HS academy programs.

Appendix L. Transcript of Interview with Mr. Nevil Tyson
10/08/2012

Mr. Nevil Tyson is the Assistant Principal of Ailanthus Elementary School.

Interviewer: The thing that's been a pleasant surprise is that Dragon Software, it works with it in an integrated way so that it will transcribe it for me. I'm a pretty fast typist, but I have to stare at the screen to keep my pace.

Mr. Tyson: I can remember my college professor, I was in a Wesleyan library typing a paper, and he was my religion guy and he walked behind me and says, "Mr. Tyson, I understand and witnessed that you using a biblical method of typing." And I said, "I'm not familiar with that sir" and he said, "Well, you were seeking and finding." <laughter>

Interviewer: I actually had a shop accident in 8th grade, and the planer guard was too tight and didn't fall down, and I mean, that's not to say it's anyone's fault other than mine, but it took off the top of my finger just a little bit, and I used it as an excuse to withdraw from typing class and I've suffered since.

So I couldn't access the wireless, but I think I can do this from memory. The first question is: Just in general, what do you think distinguishes the *Ailanthus STEM Academy program and curriculum from the rest of Ailanthus Elementary but then also the Piedmont curriculum. I will give you sort of a head start by telling you that it seems when I've asked that before, a lot of people found it more comfortable to answer over a period of time. I think you and I have talked about this before.

Mr. Tyson: Absolutely. I need to preface this by saying that last year was my first year here. I was at Central Administration as an employer relations specialist, employee conduct and offering folks their choices. When I got here, I noticed a number of things that stuck out. Number one was the pride, or exclusiveness that the folks that were in the STEM Academy had that was different than the rest of the school, which presented a problem.

Interviewer: When you say folks, was that inclusive of students and teachers?

Mr. Tyson: I think students and teachers. It was a separate organization to the extent that they can be, instead of Ailanthus as a whole, as represented from top to bottom. Whatever socio-economic class you came from, whatever area you came from, whatever curriculum you were used to, it had a pride within itself.

The issue too, is that there were parents who came to me, saying that we don't prefer to be separate or to be excluded. Having said that, I've had one year to witness it so far.

Interviewer: How representative of the parents do you think those particular parents were?

Mr. Tyson: They were very afraid of the retaliation that they would receive in the neighborhood if they brought it up, so they did it in confidence. There were some folks that wanted to see

Ailanthus as Ailanthus, not of the prestige or having their child in a program at Ailanthus the STEM Academy.

Interviewer: But clearly they were aware that other parents were counting on that prestige when they answered the question, "Where does your kid go to school? Ailanthus. Oh, in the STEM Academy?"

Mr. Tyson: That came out first.

Interviewer: And no one can say, "no."

Mr. Tyson: That seemed to be the biggest issue for me my first year here last year.

Interviewer: Did you actually have to deal with that, as an administrator, in any way that required you to facilitate or negotiate anything, or was it just a matter of answering those parent questions?

Mr. Tyson: Well, to jump forward a little bit -- is when the parents applied to be in the academy this year, there were folks that appealed three or four times because they did not get in the academy.

Interviewer: I see. And they would base their appeals on an inappropriate evaluation of their materials. I understand it is a collection of things.

Mr. Tyson: There is a collection of things, yes sir.

Interviewer: Test scores... ?

Mr. Tyson: Interest in math and science. There was, now I wasn't provided with the ranking of those individuals who didn't get in, so as far as a PR parent-relations thing, it was a pride factor for a number of them.

Interviewer: I wonder, I just want to stay on parents, but I also want to ask: Do you think there is a way to distinguish kids' interest at the end of second grade from the parents' interest?

Mr. Tyson: I find that hard to imagine that, because every kid coming out of the second grade, the majority of them would be fascinated by the things in science, and typically that peaks kids' interest. The study of what the moon, the sun, and hands-on things; however, I don't know if that's able to be conveyed by a student.

Interviewer: And I imagine some of those students' genuine authentic interest in an extension of what they've already enjoyed in their other schools and other classrooms.

Mr. Tyson: Absolutely. Now, the curriculum certainly has been changed, and we're implementing new curriculum now.

Interviewer: That's specifically in math?

Mr. Tyson: In math, that is rigorous, and it's able to be implemented given the opportunity to every student to gain from those type of things.

Interviewer: So do you see any type of distinction from the rest of Ailanthus?

Mr. Tyson: Not this year on the playing field.

Interviewer: Because you're part of the seven school pilot?

Mr. Tyson: Correct. The rigor is there for everyone, and I think that's one of the key points. I think the way teachers teach now is you have to reach the kid individually, it can't be a cookie cutter implementation of a math program because there are kids who learn differently.

Interviewer: This is something I just witnessed in a third grade math classroom observation was -- even in that group where you would imagine to be reflective of what otherwise be a gifted and talented identified group in other schools, there was an obvious need for differentiation. And something I look forward to asking the teachers later today is what they perceived to be the need for a group of accelerated learners, and whether they could have enough accelerated learners from within the school to makeup a class. What additional differentiation would be necessary if their classrooms were populated entirely by Ailanthus students?

Mr. Tyson: Well, you hit on a key point because there is a gifted cluster class at each grade level, and if I may jump back for just an opportunity... the gifted cluster of fourth grade does an electricity, that's above and beyond in science in my opinion, that all kids can be exposed to with grants. They apply for a grant every year and they get that, but the electricity keepers is certainly one of the things, and here's some personal reflection if you don't mind -- is above and beyond what the normal classroom does, but here's a gifted cluster class doing it, but everyone has the opportunity to do it, and I think that's a science experiment.

Interviewer: And what's the name of the teacher who does the electricity?

Mr. Tyson: Mrs. Harley.

Interviewer: And she's not part of the academy, but in doing this she makes the opportunities available throughout the school. Has the same been true with the academy, has some of that academy curricula expanded to the whole school at times?

Mr. Tyson: The state capital trip they take at the end of the year, but they only work with the Academy folks from 3-5, I mean, it's the trickle down plan. That was a field trip. I do believe that the exposure is related directly to the teachers' interest sometimes. I can only reflect on my past experience, I was a big science guy, we would do the electricity and what not, but I had my room full of frogs and fish and everything you can think of, which is a life experience. And I relate life experiences to giving kids the opportunity to put their hands on it, and sometimes there is no difference between a science curriculum that's a math/science, what you're talking about,

and the normal classroom. But a lot of it depends on the teacher and the differentiation they give as far as that curriculum goes.

Interviewer: Do you have a sense of how the curriculum may have changed over the last few years, and there's a blink of demarcation that I'm curious about when the initial principal, Mrs. Wise left, I gathered there was a curriculum change almost immediately after that just because there was a county-wide initiative with Understanding by Design.

Mr. Tyson: From what I understand, I wasn't a part of that, and just coming in on the tail end of this I can only reflect on what I see. I know Mrs. Huddleston came in, Loretta Huddleston, was principal after Wise, and I know the curriculum was, how do I put this, developed in a more stringent environment while that transition occurred with input from central administration. I believe Janette Oakley was part of that.

Interviewer: And that would have been working with Dr. Moore?

Mr. Tyson: Dr. Moore, yes, from what I understand.

Interviewer: And do you know if there was any particular coordination between Mrs. Huddleston and Dr. Moore and Mrs. Oakley at that time? Was it part of a larger initiative, or was it just a new principal left to reassess?

Mr. Tyson: I'm just going to have to pass on that one, because I really don't know the background on that one.

Interviewer: You might have some particularly good insight on this one, which is, what initiatives do you see among the STEM academy teachers to continually evolve their curriculum now. And the reason I want to ask you that is, this was one of my original questions initially, but I'm seeming that many of those initial curriculum strategies that were part of the early academy are still recognized today. In fact, most of them are still recognized today as best practices. So all of these other schools understandably are picking up on it, because they're in all of the research journals and all the trade journals, but that also means there hasn't been a stimulus for the STEM academy teachers to say, go do something new or different. They're almost being recognized …

Mr. Tyson: There's a point where you can only go so far with elementary, and I don't know that it's reached that point. I do know that they were given time to plan curriculum, to write on professional days where they have a couple of days to write curriculum. But you are absolutely right, as far as seeing what they've initially started with in other schools from what I've heard, those things are being done standard now. I think it was maybe a good program, but at this point, it's planted the seeds in everyone else, which has been a tremendous success in that aspect about growing these areas. But I don't know how far or what the cap is that you can go with fifth graders as far as curriculum before you get into how many years in advance, two or three years down the road you're teaching BBOs or state objectives or Piedmont objectives and compacting how much can that kid absorb.

Interviewer: There's another way I've seen curriculum evolve where maybe the teacher takes on a new strategy for teaching the same thing. It might be switching from electricity to circuits to simple machines, maybe it's in pursuit of a new grant or maybe it's a new opportunity. I think when you were showing me some of the facilities, you talked about how some of those things came to be. But do they continue to happen, do they continue to seek grant funding for different things or has that plateaued?

Mr. Tyson: I think it maybe has plateaued at this point. An interesting thing is they participate in more field trips than anyone else, and life experiences through field trips is wonderful in my opinion, but that's not reaching everyone who is in the school who could be doing that also.

Interviewer: A related question -- if this requires a little imagination on your part, I know, if those field trips included an entire grade, do you imagine those other teachers sharing the leadership role or do you imagine it would be the NSA teacher out there in the lead?

Mr. Tyson: I see a little bit depending on the teacher and what grade level you're talking about, it would have to be magnified that far down. And if I might add, the technology part of all this, I envision, and this is just my own personal thing, if every child having an Ipad with downloaded textbooks on it and things like that, I would like to see grants happen. If you're going to take technology and math/science, and integrate it together which is a big part of it, those are things I would like to see growing the math/science. I think that's very realistic.

Interviewer: Is the integration with social studies and English with the math and science uniform across the three grades, or is that also a function of teacher capacity?

Mr. Tyson: I think that's with the teacher. I know it's mandated and we have to have social studies, that's new this year, being implemented into the regular curriculum with math/science and English. That's a good question, I'd have to think about it a little bit more. I know that we are heading as a division the integration because everything's gone self-contained now, it's strived to go self-contained.

Interviewer: Explain the self-contained.

Mr. Tyson: Teaching has been accessible to a lot of the schools and depending on the principal; one does language-arts, one does math, and one does social studies and the classes switch. I know since last year, there's been emphasis on making all classes self-contained, where teacher teaches everything in the elementary level.

Interviewer: And is that based on a new research outcome or...

Mr. Tyson: Time constraints also.

Interviewer: Oh, time constraints.

Mr. Tyson: And I know there's some philosophical debate also about what age is appropriate for team teaching. And the math/science academy has always been partnered team teaching.

Interviewer: What specific components of the STEM academy, recognizing that some already exist elsewhere in the elementary schools in the school division, what other strategies do you think maybe deserve more attention and could be replicated elsewhere? Or maybe not just the components but something more holistic?

Mr. Tyson: I think in theory, math/science is a great topic for those kids who are tagged as gifted, and even some who are in a position to show interest or here again, what grade is really the grade that you want to start a math/science academy. Because we touched on it earlier, second graders I'm not so sure how we weed those out other than test scores or an even playing testing field. Just saying I have an interest in science, that's kind of vague and ambiguous to make a decision as to who is going to be in that program. I see it because I have a passion for science; however, we have come to a point where the whole division is being exposed to the same things they are. The bottom line is that it served a purpose. Some things have come out of it that are real good, but I guess I'm a little tainted and biased because of what I've witnessed over the past year.

Interviewer: You have one of the most interesting perspectives as somebody who just landed here a year ago and has been digesting it over that period.

Mr. Tyson: Well, take a school like Alder Elementary. Some of the populations, I'm a firm believer that these kids need to be exposed to life experiences and if you're bringing things into the classrooms such as the math/science activities with technology partnership, then that would be beneficial to all kids. So I guess in some ways, yes, it would be beneficial to every school to have something of that interest.

Interviewer: Let me ask you about that because you have another great perspective here in the application process. If there was advertised math/science/technology integration focused programs, and they were lottery based... It does come back to you can a sense that your child has a strong interest or capacity, but then it's lottery based. Do you think that would still generate the same sort of enthusiasm for a program like that but transcend or escape some of the baggage that comes with that might be perceived as an elite academy or an exclusive academy.

Mr. Tyson: That's a very interesting point. It would certainly take some of the elements out of the neighborhood prestige part, but here again, would it be feasible for everyone to be exposed to that curriculum.

Interviewer: I imagine it would take some thoughtful curriculum planning. Does it mean a little less art or does it mean a little less music, or could they say, "all our art, all our music, all our P.E. will have that math/science/technology integration as well." It could mean instead of learning to play or sing, we actually make our own instruments or we create simulated voices on the computer. That kind of thing.

Mr. Tyson: I see that. At one of the previous schools I was assistant principal, we had people come in, guest musicians and they made instruments, and the whole school was able to make them through art. So that was a great experience. The kids loved it, but it was something they've

never done before or even heard of these instruments, but they got together and played some songs with it, and that was a very unique opportunity. Now whether I can see that happening with what you're talking about... I guess I haven't thought that far down the road yet about the benefit of, I guess I haven't thought that far down the road yet about the benefit of, I guess you would call it a charter school, if there was someone to start one. I'm sure that would be possible in Piedmont.

Interviewer: I've seen elsewhere, even when it is entirely lottery-based and interest, and there's a prestige factor that goes with it, but you get the sense that people feel lucky rather than like they were hand picked to go to an elite academy. It's not without its baggage.

Mr. Tyson: Well, I mean, as you wear your t-shirt from the math/science academy, that separates you from the rest of the school. But then again, there's the social aspect that in the community, talking about the school community itself, there's a lot of pride among students when they do fundraisers and things like that, that they do very well. So I begin to question or think about, would 55 elementary schools and what you are going into, that would be probably two schools needed or the sheer numbers are intriguing to me, but whether you go lottery or hand-picked, there's always going to be somebody who's not happy.

Interviewer: I want to ask you something that wasn't a part of my original questions that I had set up for the teachers and others, but I was sitting a class just now, I think I counted 17 Caucasian students, two students who were Asian, and two young men who I couldn't tell whether they were Hispanic or potentially Asian, I couldn't tell. And I wondered how those demographics reflect the rest of ...

Mr. Tyson: …of Ailanthus?

Interviewer: Well, the academy feeder schools as well. And I wish I made a similar observation in the first class I sat in, but it could be that it's reflective of this part of Piedmont.

Mr. Tyson: Well, you're only drawing from a certain amount of schools here.

Interviewer: You pointed out before that they tend to be around the water and uh

Mr. Tyson: Yes, although some do have the possibilities of being a little bit more demographically diverse.

Interviewer: It seems that other are learning from Academy successes, and they're able to accelerate three times faster than those of us who plowed our through it. They did some innovative things that were deserving of attention and others paid attention. I am looking to see now whether you feel and others feel like they got the recognition for developing something good, or they're still seeking recognition as professionals for what they've accomplished? Or they feel like they're losing their grip on what identified them as special?

Mr. Tyson: There's two things you're talking about: are you talking about the individual teachers or are you talking about the program?

Interviewer: Actually I should have disaggregated that I suppose. I guess I was thinking of it as a whole and the teachers representing the whole. But I imagine there's a lot of differences.

Mr. Tyson: You know, these teachers put a lot of blood, sweat and tears into this and to start it. They have ownership, it's their baby. With any parent and their child's being threatened, the emotions come out that "I want to protect my child." They're wonderful teachers, they're great with kids. But to speak with a bias, I think everyone should be exposed to what they are having. However, and I think we've caught up to that I think. With the use of some of their pre-planning for the rest of the division. I can see some of that would strengthen the program. But there's still a lot of teachers out there doing a lot of science on their own, like the Electricity project. Even related to gardening, bringing their greenhouse programs and botany to all students would be good for these teachers. I would hate to see the teachers go away because I don't think their heart would be into it anymore."

Interviewer: I've wondered about recognizing them by giving them professional development leadership roles, but at the same time, when you do that with great teachers you sometimes lose them from your classroom forever, and as long as they love being in their classrooms, you hate to rob them or the kids of those experiences.

Mr. Tyson: You're exactly right with that. And plus the flip side to that too is that if too much recognition is given, it causes dissention among that grade level. So you know, you're walking or balancing a tight wire here.

Interviewer: It was wonderful to be recognized as a teacher and win an award or two, but after that first one, I just photocopied it, put it in my principal's inbox and said, "don't tell anyone about this but please put it in my file (combined laughter). Cause you do suffer."

Interviewer: I think I'm in Cheyanne's room here in a few minutes, but you know can follow-up if you think of other things, too. I like the way you reflect on these things, and because we discovered before, we kind of come from that similar orientation in childhood of just being wet and muddy and smelly as kids. Those life experiences drive not only our identity, but our curiosity and I like hearing more about that.

Mr. Tyson: And your interests, what you want to do later in life.

Interviewer: Thank you for your thoughtful reflections today.

Appendix M. Virginia Tech Institutional Review Board Approval Letter

VirginiaTech

Office of Research Compliance
Institutational Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE:	May 7, 2014
TO:	James A Egenrieder, William Joseph Glenn
FROM:	Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)
PROTOCOL TITLE:	Dissertation Project - Elementary School STEM Program Evaluation Model
IRB NUMBER:	**12-1047**

Effective May 6, 2014, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the Continuing Review request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Expedited, under 45 CFR 46.110 category(ies) 5,7**
Protocol Approval Date:	**May 21, 2014**
Protocol Expiration Date:	**May 20, 2015**
Continuing Review Due Date*:	**May 6, 2015**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.