THE IMPACT OF COLLEGIAL TEAMING ON HIGH SCHOOL AND UNIVERSITY INSTRUCTORS: A DESCRIPTIVE MULTI-CASE STUDY

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This descriptive multi-case study systematically explored the team teaching relationship between a secondary teacher and a university faculty member. Multiple interviews, classroom observations, and analysis of available data provided insights into the interactions of these particular collegial-teams, drawn together for the purpose of providing rigorous STEM curriculum to high-ability students during a three-week residential program.

Data revealed that successful collaboration can be described by the emergent themes of reciprocity, respect, flexibility, and time. It appears that an active interchange, or reciprocity, and mutual respect between partners during curriculum/lesson/unit planning, instructional delivery, and assessment facilitate effective collaborative instruction. Findings further revealed that instructors expressed an overall positive experience with collegial-teaming; one that has been valuable to them as professionals. The university instructors reported acquiring and improving upon their own pedagogical skills, while the high-school instructors reported gains in terms of obtaining in-depth content knowledge. The partnership also assisted in bridging insights between the secondary and college arenas in terms of content and academic expectations at both levels. The overall experience provided professional growth and development that would not have occurred without the unique pairing of a high-school instructor and a university faculty member.

ACKNOWLEDGEMENTS

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CHAPTER 1

INTRODUCTION

Texas Governor's School

In 2003, the Texas Legislature established the Texas Governor's School (TGS), a summer residential program for high-achieving high school students, housed at a public four-year college or university. The responsibility for administering the TGS program was later placed under the Texas Higher Education Coordinating Board (THECB) through Texas Education Code §29.124.

In 2007, the University of North Texas (UNT) received funding from the state to establish a three-week residential summer program for high-achieving high school juniors. The main purpose of this program was to provide a rich and challenging academic experience in science and technology (Reidy, 2007; Reidy, 2008). The UNT TGS addresses the high-ability students' need for rigorous programming, exposure to like-ability peers, and access to knowledgeable instructors / mentors.

During the three-week residential experience, students take coursework taught by two-member teams composed of a secondary school teacher and a university faculty member. The instructors shared equally in curriculum development and course instruction. According to Reidy (2007), the instructors collaboratively

> …expose the students to new concepts in science and technology; expand the students' views of science and technology and their interrelation with other aspects of human development including the arts, history, and philosophy; encourage the students to look beyond their high school coursework and seek novel relationships among diverse topics; and develop new instructional methods and course materials for secondary and university programs. (p. 4)

State reported data from the first three years of the TGS program suggested that the needs of high-ability learners were being met and the two-member instructional

team approach met the professional development needs for the instructor teams (Reidy, 2007; Reidy, 2008; Reidy, 2009). Specifically, the collaboration between instructors exposed the secondary teacher to advanced material and the university faculty to new pedagogical practices.

High school teachers and their university faculty member partners engaged me in conversations about how teaching in the TGS classrooms and being a part of the three-week residential program provided exposure to advanced materials and varied pedagogical approaches to instruction. TGS provided both the secondary teacher and the university faculty member the opportunity to discuss and share ideas. Secondary teachers found these exchanges were ones in which they could learn about current scientific research relevant to their subject matter and teaching in their high school classrooms. They noted the experience proved more beneficial than most professional development training they had previously undertaken in their home districts. Both the high school and college teachers recognized the knowledge gap between the subject matter students were exposed to in the summer-program classroom and what these students had covered in their high school Advanced Placement courses. These insights offered direction for the high school teachers in terms of potential unexplored areas of curriculum. Additionally the insights helped the university faculty members clarify what background knowledge to expect from the entering undergraduate students. As a result, both groups of educators could better strive to meet the needs of the students they served outside of TGS.

Collegial exchanges within the teams of high school teachers and the collaborating college faculty members often dealt with effective teaching approaches

and practices. These active exchanges resulted in high school teachers being excited about being better able to meet the needs of their high-achieving gifted students and in bringing new resources to their classes and curriculum during the regular school year. The university faculty members also noted the benefits of working with a talented high school teacher in terms of observing varied instructional methods that moved beyond teacher-directed lecture formats. The idea that high school and university instructors working as collegial-teams during a three-week summer program that could become a source of continued personal and professional growth for both members of a collegial-team provided the impetus for this study.

Pairing of Instructors

Although the idea of co-teaching is not new in education, it is most commonly done in special education settings. Effective co-teaching and collaboration between instructors is beneficial to students with or without disabilities (Rice & Zigmond, 2000). For example, co-teaching allows one teacher to continue with student instruction while the other teacher deals with classroom management issues. One teacher can assist students who completed tasks earlier while the other teacher works with students taking longer or who needed more individualized assistance. In addition, two teachers can more easily address the need for multi-leveled assessments as opposed to a single class activity given to all students. Such an approach often assisted other “at-risk” students who might not be labeled as special education, but who still required a differentiated curriculum (Rice & Zigmond, 2000). In another study, co-teachers from four exemplary high schools attributed part of their success with students to their

collaboration and regular exchange of information about content and teaching strategies (Wallace, Anderson, & Bartholomay, 2002). Data from a mixed-method study revealed that the collaboration between a classroom teacher and a university faculty member, while working with students with disabilities in a general education setting, was successful because each brought different spheres of knowledge and experience; and these differences greatly enhanced the likelihood of student success (Ravid &Handler, 2001).

The ability to share expertise is an ongoing benefit reported for co-teaching and collaboration (Shaplin & Olds, 1964; Snyder & Anderson, 1986; Ravid & Handler, 2001; Carless, 2006). An additional benefit of co-teaching is the professional input and feedback it provides each partner (Shaplin & Olds, 1964; Gray & Harrison, 2003).

The value of exchanges occurring between the secondary classroom teacher and the college faculty member are shown in current research in the area of student success at the post-secondary level. Partnerships have assisted instructors in higher education to observe and develop pedagogical practices that are more learning-centered in their approach (Martin, 2008). Methods that incorporate learner-centered strategies in the college classroom create an atmosphere that promotes higher student engagement, and generates higher-level thinking (Cuseo, 2006). Some learner-centered strategies include classroom discussions, hands-on demonstrations, and small group activities.

McCombs and Whisler (1997) established the concept of increasing student success through learner-centered research-based strategies. Here, the focus is on the individual learner in terms of their experience, interests, capabilities, and needs. In

addition, the focuses of teaching is upon instructional practices that best enhance the learning, achievement, and motivation of all learners. The infusion of learner-centered, research-based strategies in conjunction with the use of lectures is a viable format for the college classroom. Strategic principles include active involvement, such as debate or open-ended questioning; social integration, such as instructor-student or student-peer interaction and collaboration; self-reflection, such as journaling about one's meta-cognition; and personal-validation, such as acknowledging students for their insights (Cuseo, 2006). "If learner-centered teaching strategies effectively implement all four of these principles simultaneously, they can be expected to exert synergistic effects on multiple positive outcomes, including deep learning, intrinsic motivation, and student retention", all of which are issues of consideration on the 21st century university campus (Cuseo, 2006).

The ability to share expertise is a common benefit reported for co-teaching and collaboration (Shaplin & Olds, 1964; Synder & Anderson, 1986; Ravid & Handler, 2001; Carless, 2006). An additional benefit of co-teaching is the professional input and feedback it provides each partner (Shaplin & Olds, 1964; Gray & Harrison, 2003).

TGS Instructional Teams

The Texas Governor's School (TGS) is somewhat unique among governor's schools in its pairing of a good secondary school teacher with an effective university faculty member to form a collaborative teaching team. Most governors' schools participating in the National Association of Governor's Schools provide a single instructor for their courses (NCOGS, 2010). Instructors range from university faculty or

secondary school teachers to professionals in a given field. In situations that provide more than one instructor, the paring is normally a university faculty member with a teaching assistant or graduate student.

Collegial teaming (such as co-teaching, teaming, etc.) involves two or more faculty members joining together for the purpose of planning and delivery of instruction. It is the instructional method utilized in cooperative school models in which delivery of instruction to the students occurs through cooperative learning often done in small groups. Having the instructors engage in collegial teaming provides opportunities for increasing teacher instructional knowledge and has been shown to contribute to greater teacher morale, productivity, and professional self-esteem (Johnson & Johnson, 1994). Exploration of how the TGS collegial-teams created and maintained their working relationships in planning, delivering, and assessing course curriculum and instruction, as well as individual perceptions about possible benefits of the collegial teaming experience, is the focus of this proposed study.

The collaborative pairing of a secondary teacher with a university faculty member was an important element in planning the TGS program. The TGS programs offered in the summers of 2007, 2008, 2009, and 2010 allowed the participating secondary school teachers to expand their content knowledge beyond that normally taught in regular high school settings. The university faculty partners learned new instructional methods that included and expanded upon their traditional lecture-heavy format. Both the secondary-school teachers and the university faculty members addressed the need for faster paced and deeper science, technology, engineering, and mathematics (STEM) curriculum required by the high-ability learner.

Villa, Thousand, and Nevin (2008) suggested that a variety of elements must occur for effective collaboration to take place: coordinating work towards one or more agreed upon goals; having a common belief system that acknowledged each member's unique expertise; expressing a willingness to be both an expert or a novice based upon one's own strengths and weaknesses; distributing tasks amongst team members; and undertaking an open, cooperative process that acknowledged positive interdependence, interpersonal skills, and individual accountability.

Common goals provide guidance for successful team collaboration (Rice & Zigmond, 2000; Wenger and Hornyak, 1999; Wild, Mayeaux, and Edmonds, 2008). Without common goals, collaboration can easily wander off in multiple directions and stagnates there. With common goals, team members can explore one another's core beliefs and philosophy surrounding learning (Carless, 2006; Powell & McGowan, 1996; Wild, Mayeaux, and Edmunds, 2008). They can explore each person's area of expertise and its potential for addressing the goals (Carless, 2006; Gray & Harrison, 2003; Maguire, 1994; Shaplin & Olds, 1964; Wenger & Hornyak, 1999). The teachers in such a team develop a culture that reflects the ways they best can share their talents (Snyder & Anderson, 1986).

A national survey of co-teaching National Center for Educational Restructuring and Inclusion (1995) examined interactions among teachers engaged in collegial collaboration in the inclusion classroom. Four patterns of approaches emerged and were later labeled by Villa et. al., (2008): supportive, parallel, complementary, and team-teaching. Factors common to all four patterns were two or more teachers in the classroom, and each capitalized on specific strengths and expertise of the co-teachers;

classrooms consisted of a greater teacher-student ratio and one-to-one student support than the non-co-teaching classrooms; students were heterogeneously grouped; and the teachers shared a responsibility for all students (Villa et al., 2008). Factors unique to co-teaching are to support a lead teacher in the room and complete equitable sharing of roles and responsibilities in the classroom are shown in Table 1 (Villa et al., 2008).

Table 1

Similarities among the Four Co-teaching Approaches

<table>
<tr><td colspan="4">

- Two or more co-teachers in the classroom
- They capitalize on specific strengths and expertise of co-teachers
- They provide greater teacher-to–student ratios and additional one-on-one support in the classroom
- Students are heterogeneously mixed
- There are shared responsibilities
- Each approach requires trust, communication, planning time, and coordination of effort (Note: The needs for all of these elements increases as you move from supportive to parallel, parallel to complementary & complementary to team teaching co-teaching).

</td></tr>
<tr><td>Supportive Approach Differences</td><td>Parallel Approach Differences</td><td>Complementary Approach Differences</td><td>Team-Teaching Approach Differences</td></tr>
<tr><td>One co-teacher is in the lead role; the other provides support. Who is in the lead and who provides support may change during the lesson.</td><td>Co-teachers work with different groups of students in the same room. (There are at least seven different options for arranging the groups).</td><td>One co-teacher teaches content; the other clarifies paraphrases, simplifies, or records content.
One co-teacher may pre-teach specific study or social skills and monitors students' use of them; the other teaches the academic content.</td><td>Both co-teachers are equally responsible for planning, instruction of content, assessment, and grade assignment.
This approach requires the greatest amount of planning time, trust, communication, and coordination effort.</td></tr>
</table>

Note: Similarities and Differences of Supportive, Parallel, Complementary, & Team Teaching Co-teaching Approaches (Villa et al., 2008 p. 129).

The distinguishing characteristic of the “supportive approach” is that while one teacher instructs the entire class, the co-teacher provides tutorial support. This provides a classroom in which one teacher is the master of the content while the other provides direct one-on-one teacher instruction. In the “parallel approach” one or more teachers opt to teach the same content by working with separate smaller groups of students. In the “complementary approach” one teacher pre-teaches a study skill and then monitors its use while the other teacher teaches content or one teaches content while the other clarifies and simplifies the content for students. In this approach, teachers have preset roles, one focused on content while the other is focused on pedagogy. The “team teaching approach” is one in which both teachers operate as coequals. They take equal shares in planning, instruction of content and study skills, assessment, and grade assignment.

The method for course development and instructional delivery by the TGS collegial teams was the “team teaching approach” (Villa et al., 2008). Both members of the collegial-team are master teachers. This model was chosen in part to bring the expertise and experience of both instructors to bear on “helping gifted and talented students identify their strengths, improve upon their weaknesses, and set high, yet realistic goals” (McHugh, 2006, p. 185).

In this study the exploration and synthesis of the data concerning the unique pairing between the secondary school teacher and the university faculty member provided new and unique insights into what makes effective instruction of high-ability students during a residential summer program. Analysis of the instructors’ collegial “team teaching” approach verified whether it was actually being used or if the

participating teachers moved to an arrangement more like one of the other models.

An additional area of consideration, revealed in two separate meta-analyses and syntheses of co-teaching in the inclusive classroom (Murawski & Swanson, 2001; Scruggs, Mastropieri, & McDuffie, 2007), is the importance of opportunities for professional growth for the teachers through the sharing of their expertise and talents. However, both meta-analyses found the studies reviewed lacked enough procedural details and insights about how successful and non-successful co-teaching partnerships were formed and specifics of how they functioned; thus sharing their individual expertise and talents during the instructional process. As few previous studies have described the instructor actions during the process of co-teaching, this study made repeated observations of such details.

Statement of Problem

The problem for this study was to describe, using a multi-case study approach, (1) the collaboration between a secondary teacher and university faculty member as a collegial teaching team during a three-week math and science residential program for high-ability learners, and (2) the perceived impact of that collaboration on each team member's perception of this professional growth in content knowledge, pedagogical knowledge/skills, and each team member's instructional practices inside and outside of the TGS program. This study documented how participating teams created and maintained their working relationships in planning and delivering instruction, and it described perceptions of what individual team members acquired from the experience and what the experience meant to them.

Purpose of the Study

The intent of this study was to look for commonalities in the participants' perceptions of how their collegial-teams developed and functioned over time while designing, delivering, and assessing curriculum for their particular course. The results provide insight into individual team members' perceptions about how the individuals of a collegial-team worked together, and whether individual members identified any benefits from the collegial teaming experience. Furthermore, the researcher explored reported similarities and differences between other collegial-teams (a) perceived change in individual participants' thinking about their own planning/teaching inside and outside of TGS and (b) perceived change to individual participants' professional growth/development.

Research Questions

The following research questions guided this study:

1. What perceptions do team members have of themselves and each other (in terms of personality type, working style, teaching style, conflict resolution style, relative strengths and weaknesses in content knowledge and pedagogical knowledge/skills that each brought to the program)?
2. What perceptions do team members have of the roles that each team member played during the collaborative process (in curriculum/lesson/unit planning, instructional delivery, and assessment)?
3. What perceptions do team members have of the types and significance of problems that arose (if any) and how each member worked to resolve the problem?

4. What perceptions do team members have of the strengths and weaknesses of the STEM/TGS program, in general, and of the collegial teaching team approach, in particular?
5. What perceptions do team members have of their own professional growth (in content knowledge, pedagogical knowledge/skills) as a result of participating in a collaborative teaching experience?
6. What perceptions do team members have of the impact of their collaborative efforts on their own teaching inside and outside of TGS?

Definition of Terms

For the purpose of this study the following operational terms are defined:

- High-ability - refers to students “who give evidence of high performance capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who require services or activities not ordinarily provided by the school in order to fully develop such capabilities" (Improving American Schools Act, P.L. 103–382, Title XIV, p. 388). Further, high-ability adolescents may differ from their fellow classmates in cognitive skills, interests, modes of learning, and motivation, resulting in a need for a different instructional format than the one required by other age-peer students (Krebs, Richards, Tomlinson, Kasak, & Robinson, 2005). When it comes to identifying and serving the high-ability student in different states, the term *high-ability* is used interchangeably with *gifted*. For example, Indiana, Kansas, and Nebraska use *high-ability*, whereas Texas uses the

term *gifted* in the public school setting for students who have undergone formal identification and are therefore being served through a designated program. The TGS does not require students to hold the gifted label for admission into the program. While some TGS students are a part of a gifted program in their home schools, other TGS participants are not. In this study, high-ability students are those who have maintained a high grade point average (GPA) with a rigorous course load (i.e. AP classes in math and science), have strong recommendations from multiple sources (counselors, math teachers, and science teachers), and complete two written essays as part of the application process. Although all may not fit the requirements of gifted at their particular home campus, those accepted into the TGS program are high-ability learners who have demonstrated self-motivation, above average academic achievement, and high intellectual ability.

- Teaming - (also referred to as team-teaching, collaborative teaching, and co-teaching) is an instructional method in which two or more instructors share responsibilities in the same classroom (Price, Mayfield, McFadden, and Marsh, 2000).
- Collegial-team – in this study the collegial-team is comprised of a college and high school instructor. Under the design of the Texas Governor's School at the University of North Texas, this partnership engages in the planning and co-teaching of a course for high-ability rising high school juniors.
- Co-teaching - normally involves the following: Two or more professionals; Instruction within the same physical space; a sharing of teaching

responsibilities; Instruction provided to a heterogeneous group of students (Cook & Friend, in Murawski & Swanson, 2001).

- Professional Development - is “a comprehensive, sustained, and intensive approach to improving teachers’ and principals’ effectiveness in raising student achievement (No Child Left Behind Act, 2001). It entails the “systematic efforts to bring about change in the classroom practices of teachers in his/her attitudes and beliefs” (Guskey, 2002, p. 381).

Assumptions

The researcher assumed that the participating instructors would provide accurate self-reported information through multiple interview formats, the Myers-Briggs Type Indicator (MBTI), journal entries, and program evaluations. No ties to compensation, tenure, or normal employment were jeopardized due to providing this self-reporting information. Participants were advised that the information would be used solely for research purposes and anonymity would be maintained.

Limitations

A portion of the data collection utilized interviews, videoed observations, and reporting in journals. In this situation it was possible to get a Hawthorne effect. This effect involves participants acting differently due to the knowledge that one is being observed (Franke & Kaul, 1978). To counter this effect, triangulation of data through multiple input methods by the collegial-teams (i.e. interviews, journaling, conversations throughout program), videotaping, and extended classroom observations was used.

Design

This descriptive case study utilized a concurrent mixed methods design to examine the collegial relationships of sets of secondary instructors and faculty members who formulate and implement STEM (Appendix C) curriculum for a three-week residential program for high-ability students. Multiple systematic interviews, extended classroom observations with video recording, and the MBTI profiles were used to gain insights into the collaboration between a secondary teacher and university faculty member as a collegial teaching team and into the perceived impact of that collaboration on each team member's professional growth in content knowledge and pedagogical knowledge/skills. Once data were collected, analysis consisted of reviewing, coding, categorizing, synthesizing, and interpreting information from the multiple sources. For the purpose of supplementary triangulation, the researcher explored the development of the instructors' working relationship, based upon historical program data consisting of additional videotaped classroom observations, surveys, and journal entries from each instructor's prior yearly involvement with the TGS program.

Summary

The purpose of this descriptive case study was to explore systematically the team teaching relationship between a secondary teacher and a university faculty member. Multiple interviews, classroom observations, and analysis of available data provided insights into the interactions of these particular collegial-teams, drawn together for the purpose of providing rigorous STEM curriculum to high-ability students during a three-week residential program.

Of particular focus was evidence of professional growth that enhanced content knowledge and instructional practices for both members of the collegial-team. Specific dynamics were explored to delineate the following factors: the contributions of each instructor to the collegial-team; the role of each member during the instructional process; acquisition of new content knowledge or instructional practices; the role of each member in resolving any curricular, instructional or assessment problems; and the professional learning gained by the instructors that motivates them to return each year.

Additionally, I explored the perceptions team members have of their own professional growth (in content knowledge and pedagogical knowledge/skills) as a result of participating in a collaborative teaching experience at TGS. The perceptions of the team members about the impact of their collaborative efforts on their own teaching inside and outside of TGS were noted.

CHAPTER 2

LITERATURE REVIEW

To begin to examine the practices of educators, one must have an understanding of the population(s) that they serve. In the case of programming designed to address the needs of high-ability learners, one must have insights into the adolescent gifted learner. An understanding of highly-qualified teachers and effective learning environments is desirable. In terms of the dynamics of programming at the Texas Governor's School (TGS) at the University of North Texas (UNT), an understanding of the concept of teaming is also needed.

Section I: The Adolescent High-Ability Learner

The transition from childhood into adulthood is marked by dramatic changes in physical, emotional, and intellectual development. Factoring in the intricateness of giftedness can further add to the complexities of this life phase. How best to meet the intellectual and emotional needs of the secondary gifted learner both in and beyond the school setting produces a quandary that continues to be discussed in the field of gifted education.

In terms of psychosocial development, the adolescent has moved from the concrete operational stage, of beginning to think abstractly, into the formal operational stage, now using reasoning and abstraction (Piaget, 1977). Adolescence is normally a time to begin to consider hypothetical situations and over-arching issues (Neel, 1997). Adolescents wrestle with the questions of "who am I," develop mature perspectives, and acquire a sense of self certainty as opposed to self-doubt. These developing concepts

often lead the adolescent to seek out leadership in someone who will inspire him/her (Erikson, 1997). Notably the gifted child may advance through these cognitive milestones earlier or even much earlier than peers, due to their “asynchronous development” (Davis, 1998, p. 29). Asynchronous development refers to irregular intellectual, physical, and emotional development that the high-ability child may experience with some areas being far above average and some other areas being at or above the average. An average-ability child normally experiences these developmental milestones at about the same rate, making his or her development in "sync." For the high-ability child, intellectual development may be ahead while the child’s emotional level may be at the same level as his or her actual age in years, thus asynchronous to the child’s overall development. These occurrences in development impact the curricular needs in the classroom. Students need opportunities to explore this deeper ability to reason, and they should do so at a challenging rate that meets their individual needs in order to explore fully their own potential while still acting, at times like students of their own ages.

Learning theorists have explored the implications of adolescent psychosocial development in the classroom. Normally, by age 8, a student is in the final stage of cognitive development (symbolic) and is able to grasp concepts (Bruner, 1966). Building from this notion, Vygotsky (1978) suggested that the cognitive happens best within a zone of proximal development. This is a phenomena in which "the distance between the actual development level, as determined by independent problem solving, and the level of potential development, as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86) may differ due to exposure and/or

encounter. Exposure centers on the previous educational, family, and other environmental factors that the student may have encountered in the past. Exchanges deal with the opportunity to observe or interact in similar situations as those that the student is currently engaged in during the present learning process.

To challenge the needs of the student, a constructivist or discovery approach to learning is often helpful. With roots in Jerome Bruner's work in cognitive psychology and its relationship to learning, discovery learning is an "approach to instruction through which students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments" (Ormrod, 1995, p. 442).

An instructional strategy to assist in the discovery approach is known as *scaffolding,* which begins by providing a general understanding of the content being taught, followed by building upon the basic understanding through the addition of more complex knowledge and skills. This strategy provides the learner with the confidence and support needed to manage the depth and complexity of the content material (Young, 1993). This approach entails an active engagement process on the part of the student as s/he encounters content. Here, the teacher acts as a facilitator. Scaffolding is then the means by which the student progresses effectively through the levels of cognitive development. This development is accomplished through interaction with peers, teachers, mentors, or other influential human interactions. It is reasonable to assume that development for the gifted adolescent experiencing asynchrony is facilitated by interaction with intellectual peers as opposed to age peers. Interaction with intellectually compatible peers challenges and assists the students in reaching their full

potential (Bruner, 1965).

An additional approach to promoting cognitive development found in adult learning theory is through transformative learning. Adult learning theory centers on how adults acquire new skills and/or information. It differs from how children are taught in that adults learn best when they are able to reflect upon their own extended life experiences and then relate these experiences to their own learning process (Knowles, 1990; Vella, Berardinelli, & Burrow, 1998). Transformative learning then aims to utilize previous experiences and deeply examine them. This exploration leads to "a comprehensive and complex description of how learners construe, validate, and reformulate the meaning of their experience" (Cranton, 1994, p. 22). In essence, the learner is challenged to examine his or her own knowledge and beliefs as she or he studies and gains new perspectives. This leads to "perspective transformation" (Mezirow 1991) in which individuals are able to understand why they think or respond in a certain manner, based upon their own perceptions of the world. Through critical analysis of their own perceptions, they are able to develop multiple perspectives, opening themselves up to a more empathetic, inclusive, and integrating perspective. This can enable them to make new decisions or engage in more meaningful dialogue based upon a more holistic understanding of a given situation. Such transformation is applicable to the gifted learner who is more advanced than their same-age peers in terms of cognitive development.

Defining Giftedness and Talent

Pushing students to learn at their potential is a curricular goal in education that certainly applies to gifted education. However, to explore the curricular needs of

the gifted adolescent, one must first understand what is meant by the term *gifted*. Early psychometric understandings of giftedness centered on ideas of high verbal and analytical ability. These concepts were based in part on the work of Alfred Binet, Lewis M. Terman, and Leta Hollingworth. Binet created the notion of *mental age* (1904). He determined giftedness as a measurable means of intellectual ability through the use of the testing instrument that he created (Binet, 1904). In the 1920s, Terman used his Americanized version of the Binet test and identified children in terms of their intellectual abilities (Terman, 1925). In 1930, Hollingsworth developed the first curriculum and counseling services for gifted children. Again, she identified qualities of the gifted as intellectual. However, she recognized that students with an IQ above 140 were educationally at risk due to lack of challenging curriculum in the regular classroom (Hollingsworth, 1942).

During the mid-20th century events in history impacted the field of education in the United States (U.S.). The Soviet Union's launching of *Sputnik* in 1957 challenged America to consider deficits and the need for change in public education. Addressing this effort, the National Defense Act was passed in 1958, a part of which gave the first large-scale support for gifted education in the public schools. The national interest in gifted education was abandoned or minimized with the call a few years later for equal opportunities for all races and abilities of students in education. This shift culminated in the 1964 Civil Rights Act. Ten years later, Marland (1972) in a report to Congress again visited gifted education. His report provided the bases for a federal definition that defined the gifted person as an individual capable of high levels of performance, singularly or in combination, in the following areas: general intellectual; specific

academic aptitude; creative productive thinking; leadership ability; visual performing arts; and psychomotor ability.

Concepts of giftedness have continued to broaden over the years. In addition to traits possessed by a person, other factors began to be considered. Of consideration were a variety of factors that make a child gifted: “Superior general intelligence; distinctive special aptitudes; the right blending of non-intellective traits; a challenging environment; and the smile of good fortune at crucial periods of life”(Sternberg, 1986, p. 49). A broadening of perspective continues to move the field into a conception of giftedness that is not limited to intellectual ability. For example, Renzulli’s (2005) three-ring model defines giftedness in terms of above average general ability, high levels of task commitment, and high levels of creativity.

Gagné’s Differentiated Model of Giftedness and Talent

A more recent concept of giftedness is presented by Françoys Gagné. Often the terms gifted and talented are viewed as a single entity. Gagné (1995) presents a definition and a model that breaks apart gifts and talents. He acknowledges that they are linked, but considers gifts as the predecessors to talents. He states that giftedness is the “possession and use of untrained and spontaneously expressed natural abilities (called aptitudes or gifts), in at least one ability domain, to a degree that places a child at least among the top 15% of his or her age peers” (p. 103). In contrast, talent is defined as a “systematically developed abilities (or skills) and knowledge in at least one field of human activity to a degree that places an individual at least among the top 10 per cent of age peers who are or have been active in that field or fields” (Gagné, 2004, p. 120).

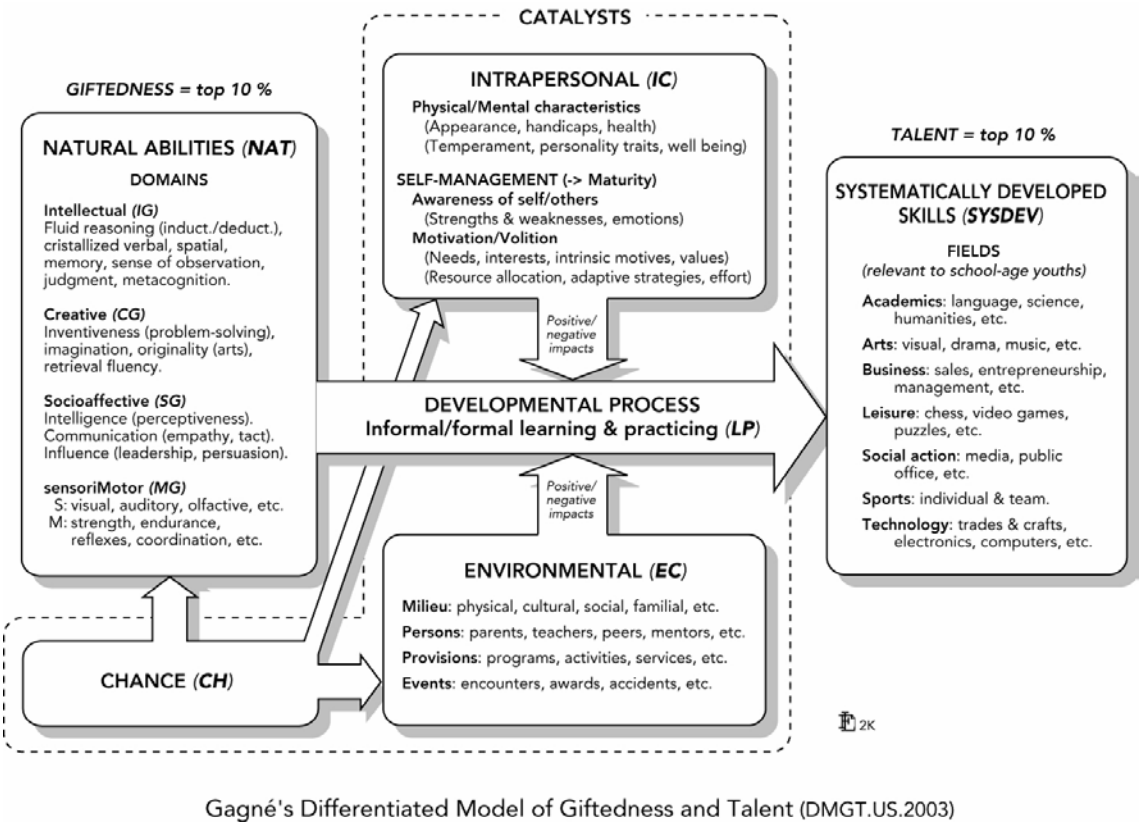

Figure 1. Gagné's differentiated model of giftedness and talent (DMGT, Gagné, 2003).

Training and development constitute the predominant process for transforming gifts into talents. Enhancing or limiting development of talent are two categories of catalysts - intrapersonal and environmental. Intrapersonal has suggested sub categories of physical/mental characteristics (i.e. appearance, handicaps, health, temperament, personality traits, and well-being) and self-management (i.e., awareness of self/others and motivation/volition). Other intrapersonal catalysts are possible; environmental catalysts include milieu (i.e. physical, cultural, social, familial, etc.), persons (i.e., parents, teachers, mentors, peers, etc.), provisions (i.e., programs, activities, services, etc.), and events (i.e., encounters, awards, accidents, etc.) (Gagné, 2004).

Gagné's work is important to the consideration of the student's curricular needs in two ways. First, it acknowledges multiple fields of gifts (aptitudes). It clearly breaks from a traditional understanding of giftedness only involving intelligence. In addition, it recognizes the potential for aptitude in one or multiple areas as opposed to a purely academic, core content-related area. There are direct implications how schools, educators, parents, and students themselves directly address the identification of, and respond to a variety of aptitudes. By using instruments multiple instruments designed to identify various forms of aptitudes of the gifted child (SAGES-2, Torrence Test of Creative Thinking, etc.) specific areas of focus can be identified for fostering growth of the child through programming that offers acceleration and/or enrichment.

Second, Gagné's model addresses the transformation of aptitude into ability. Crucial to that conversion of an aptitude into a talent are certain environmental catalysts, including teachers and the school environment with its contributions to the student's individual needs. Without the fostering of aptitude by the institution of school and the educators who work directly with the student, student potential may not be reached (Gagné, 2004).

Social Cognitive Theory

Bandura's social cognitive theory also proposes consideration of "environment" as a necessary component of human development. Social cognitive theory postulates human functions are directly tied to an individual's perceptions of the impact of the environment around him/her. This theory is rooted in the concept that "individuals are agents proactively engaged in their own development and can make things happen by their own actions" (Pajares, 2002, p. 3). Moving away from the ideas of the behaviorists,

whereby behavior is only an elicited response from a set stimulus, Bandura (1977) suggests that learning can also occur through the observation of others. A reciprocal determinism occurs in which personal cognition, behavior, and environmental influences interact with one another (Figure 2).

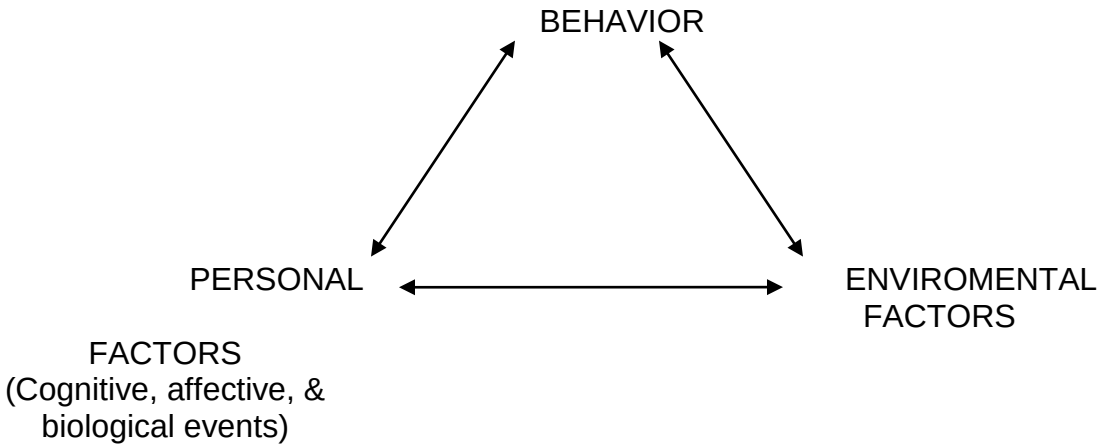

Figure 2. Bandura's triad reciprocality model (Bandura, 1986).

An example of social cognitive theory in action can be given in terms of when the high-ability learner is not challenged in the classroom. Cognitively speaking, a high-ability learner may already know the content that is being covered in the curriculum, resulting in boredom. The boredom may result in acting out in some manner, adversely impacting the normal classroom environment or disengaging for active learning, quietly slipping off into one's own thoughts. However, if differentiated curriculum that challenged the learner's academic needs were presented, the disruptive behaviors may then cease, as the school environment has changed in an effort to meet the cognitive needs. This interaction between cognition, behavior, and environmental influences, labeled *triadic reciprocality*, aligns with Gagné's (2003) DMGT (see Figure 1).Both

personal and environmental factors impact the behaviors and outcomes of the human potential.

Though instructors for high-ability students may be aware of the need for differentiated curriculum, they may not know the best instructional practices for meeting these needs. Often additional specialized professional development is then required for the instructors (Gubbins, et. al., 2002).

Section II: Effective Environments for Talent Development of the High-Ability Learner

Characteristics of the High-Ability Learner

Research has identified common traits in the student who shows evidence of high levels of intellectual ability. From early on these students often demonstrate long attention spans and extreme perseverance when engaging in tasks of interest. Only later do some develop the skills of deep involvement in tasks of less intrinsic interest. They have an intense yearning to delve deeply into the subject at hand (Feldhusen, 1986; Silverman, 1993). They are rapid learners able to absorb and comprehend advanced subject matter, further synthesizing it with their own knowledge base (Clark, 2002; Silverman, 1993; Sternberg, 1986). These traits serve them well in their desire and quest for understanding.

High-ability students often possess an exceptional memory (Silverman, 1993). They are observant and curious about numerous areas (Bloom, 1982; Clark, 2002; Silverman, 1993; Terman & Oden, 1951). They are able to use these interests as means of feeding their intrinsic intellectual curiosity. High-ability learners' advanced

cognitive skills assist them as they “think about thinking” (Colangelo, Assouline, & Gross, 2004, p. 29).

It is these unique qualities that *A Nation Deceived: How Schools hold back America’s Brightest Students,* a report by Colangelo, Assouline, and Gross, (2004) addressed. This report highlighted that the discrepancy between the positive researched benefits of acceleration are contrary to the actual implementation of accelerative practices in educational settings. Without opportunities to encounter accelerative options, high-ability students typically do not encounter curriculum that addresses their true capabilities. Adverse effects may indeed result in the holding back of our brightest students (Colangelo, Assouline, & Gross,2004). Thus, it is crucial for institutions to provide opportunities of acceleration so that the high-ability learners might reach their potential

Enrichment and Acceleration

Two common methods used by institutions to meet the needs of the high-ability learner are enrichment and acceleration. Enrichment involves the elaboration of basic concepts presented in the standard curriculum. It refers to opportunities for students to research and investigate topics of interest (Borland, 1989). While the average student works to master basic concepts, the gifted learner is given opportunities to explore the same or related concepts in more depth. In an enrichment paradigm deeper inquiry is seen as more important than accelerating the curriculum or going to the next curricular content level (Gallagher, 1985). Enrichment is not designed to achieve accelerated grade advancement or credit (Davis & Rimm, 1998). In the classroom, enrichment may entail additional materials or independent study units. Beyond the classroom, students

may engage in programs such as odyssey of the mind, destination imagination, university interscholastic league (UIL) activities, science fairs, spelling bees, or chess clubs.

Acceleration involves providing various educational provisions so students meet curricular goals at an earlier age or a faster pace than is typical (Borland, 1989; Colangelo, Assouline, & Gross, 2004). The work from later in the year, or form usually given to older students, is provided to the gifted at an earlier biological age according to the intellectual and academic need. The emphasis of acceleration is on providing opportunities to do advanced work as soon as possible (Gallagher, 1985). With acceleration high-ability learners learn to cope with a complex system of ideas at younger ages. Acceleration includes at least 18 approaches from grade skipping, dual enrollment, early entrance into college, to advanced placement (AP) curriculum (Colangelo, Assouline, & Gross, 2004). In short, the aim of enrichment and acceleration is to differentiate the curriculum in order to meet the unique academic and intellectual needs of the high-ability learner.

Summer Programming

Programs that occur outside of school and provide accelerative and/or enriched opportunities to gifted students beyond the regular classroom help to compensate for their needs not being met in the normal classroom (Feldhusen, 1991.) For example, students attending residential summer programs reported that the summer programs gave them interactions with like peers who shared their “deep desire to learn” and afforded the opportunity to “…participate in classes filled with challenging concepts, exciting discussions, and real-life experiences” (Enersen, 1993, p. 172). The time spent

interacting with like peers at residential summer programs increases the individual's self-concept (Cunningham & Rinn, 2007; Johnsen, Witte, & Robins, 2006; Wright & Leroux, 1997). Parents report that the participation resulted in an increased interest in specific subject areas and more motivation to learn on the part of their child. The parents developed higher academic expectations of their children (Olszewski-Kubilius & Seon-Young, 2004). Concerning peer interactions and access to academic rigor, students in a residential program "wished these same circumstances existed in their home-town schools (Enersen, 1993, p. 171).

These summer program opportunities address two key components in Gagné's (2003) differential model of giftedness and talent (DMGT, see Figure 1). Summer programs for high-ability learners relate to components within the DMGT's environmental and intellectual peer catalysts. The setting provides an atmosphere for peer interaction through academic rigor. Second, the program provides interactions with teachers and mentors who are experts in the academic field of interest to the student. This relates to the DMGT's environmental catalysts as it contributes in the development of aptitudes into actual performance. Arguably a key component for the success of such programming lies, in part, in the effectiveness of the instructors. This holds true for the success of any program designed to meet the needs of the gifted learner.

Section III: Producing Highly-qualified Teachers and Learning Environments for the High-Ability Learner

Effective Teachers of High-Ability Learner

What has research found in terms of the qualified and effective teacher of the high-ability learner? Must the teacher of the gifted be gifted themselves? This question has been posed in the field of gifted education (Robinson, Shore, & Enersen, 2007). While teachers may not be inexplicably gifted, research shows that effective teachers of the gifted do share some common traits or biological innate qualities with their students.

Successful teachers of the high-ability learner should possess a high intellectual capacity (Robinson, Shore, & Enersen, 2007; Goodhew, 2009). They commonly set personal goals that involve high achievement and strive to meet those goals through their own passion for learning (Goodhew, 2009). They have an intrinsic enthusiasm for learning and extensive knowledge in the field that they teach (Goodhew, 2009; Robinson, Shore, & Enersen, 2007; Borland 1989.)

An equally important behavior exhibited by successful teachers of the high-ability learner is they setting high standards and expectations for their students (Turncliffe, 2010; Goodhew, 2009; Tomlinson, 1999). They maintain an environment that is organized, yet allows flexibility of activity and thought (Wallace, Leyden, Montgomery, Winstanley, Pomerantz, & Fitton, 2010; Goodhew, 2009; Tomlinson, 1999). This environment also encompasses freedom of thought and expression of opinion where students can search for their own answers (Turncliffe, 2010; Goodhew, 2009). The teacher acts as a facilitator or guide (Goodhew, 2009; Tomlinson, 1999); and the teacher asks probing questions (Wendel & Heiser, 1989) and is tolerant of diverse

answers and theories (Goodhew, 2009; Tomlinson, 1999). These teacher's characteristic traits and behavioral factors align with the gifted students' need for aspects of environmental catalysts as addressed in Gagné's (2004) DMGT (Figure 1).

Professional Development

In order for reflection to occur and for behaviors to change on the part of the classroom educator, a methodical professional development process is needed to be put into practice by administrators and educators. Professional development involves "systematic efforts to bring about change in the classroom practices of teachers regarding attitudes and beliefs, and in the learning outcomes of students" (Guskey, 2002, p. 381). Such systematic development improves the teachers' sense of personal teaching efficacy and their ability to positively and profoundly impact student learning. Typically, with regard to professional development, "…significant change in teachers' attitudes and beliefs occurs primarily after they gain evidence of improvements in student learning" (Guskey, 2002, p. 383).

Professional development can consist of a variety of formats including day workshops, book studies, and ongoing collaboration with fellow educators. Although one-time workshops are the most commonly used mode of professional development delivery, scholars agree that long term active engagement has greater impact on the changing of behaviors and instructional patterns in the classroom (Guskey, 2000; Cohen & Hill, 2000; Hawley & Valli, 1999; Wilson & Berne, 1999).

One form of interactive professional development involves collaboration. The use of teacher collaborative exchange has been found effective in modeling teaching

practices (Robinson & Schaible, 1995; Glazer & Hannafin, 2006; Chiou & Yang, 2006), as well as interactive peer and self-assessment (Ross & Bruce, 2007).

Section IV: Teaming

Teaming Defined

Collaboration between professionals in the classroom is referred to as *teaming*. Origins of the modern teaming concept stem from the work of Robert H. Anderson in the late 1950s. Anderson and others established the Franklin School, which served as a laboratory environment to explore this concept. Here teachers worked in teams, rotating their time in an effort to interact and collaborate while planning, delivering, and evaluating instruction. Team-teaching developed from these early approaches (Wilhelm, 2004).

In teaming, members take on the mentality of “two heads are better than one” (Villa, Thousand, & Nevin, 2008). They embrace the role of co-teacher. The team is able to capitalize on individual skills and knowledge (Bauwens, Hourcade, & Friend, 1989; Hourcade & Bauwens, 2002). Together, they are able to utilize higher-level thinking and create more innovative solutions (Thousand, Villa, Nevin, & Paolucci-Whitcomb, 1995). They often show more resolve to tackle challenging tasks in an effort to meet the overall team goals (Johnson & Johnson, 1997).

Factors for Successful Collaboration

Components have been identified for successful collaborations in which team goals can be met. A core factor is mutual respect for each other’s strengths and differences (Cohen & DeLouis, 2001; Harris & Harvey, 2000). With the presence of a

developed mutual respect, the teaming process can transform into unity among co-teachers through the development of common goals, examination of core beliefs, and the identification of individual strengths (Duhardt, Marlow, Inman, Christensen, & Reeves, 1999; Wild, Mayeaux, and Edmunds, 2008). This then sets the stage for "productive interactions", or the establishment of a unified team that has a collaborative working relationship (Wild, Mayeaux, and Edmunds, 2008, p.11).

Productive interactions will not necessarily occur unless co-teachers maintain a willingness to share leadership and ideas, and scheduling time for planning and reflection (Cohen & DeLouis, 2001; Duhardt et al., 1999; Harris & Harvey, 2000; Dieker, 2001). Such commitment to co-teaming allows instructors to come together and share their knowledge of best instructional practices, methods of student engagement, and their other strengths. The sharing of opinions creates an atmosphere of authentic collaboration (Wild, Mayeaux, and Edmunds, 2008).

Team growth and collaboration can become stagnant if members are not flexible and open to feedback (Duhardt et al., 1999; Cohen & DeLouis, 2001). If open to feedback and dialogue, co-teaching provides a unique opportunity to see and learn from other educators (Harris & Harvey, 2000). They can potentially use disagreements as educational opportunities for growth and change (Harris & Harvey, 2000). They are able to work together to solve problems as a team (Duhardt et al., 1999). The mutual reciprocity is crucial to a well-functioning team and "if the co-teachers do not share an interest in learning from each other, there will be a limit to the possibilities that can emerge in the teaming experience" (Harris & Harvey, 2000, p. 33).

Classroom Environment

The interaction of the individuals involved in teaming can take on a variety of arrangements and is a plan where the teachers in a team develop a culture that reflects the ways in which they best can share their talents" (Snyder & Anderson, 1986, pp. 206-207). Successful teaming involves reorganization of instructional delivery, ongoing conversations about classroom operations, and a willingness to integrate instructor roles within the classroom (Friend & Cook, 2003; Diecker & Ousley, 2006; Wenger & Hornyak, 1999).

Classroom environments that employ student-entered learning are conducive to co-teaching. One study on co-teaching identified instruction that focused on active learning, setting and maintaining high expectations, and creative ways to evaluate student progress as important to a successful co-teaching situation (Dieker, 2001).

Co-teaching Approaches

There are the four different approaches to co-teaching: supportive, parallel, complementary, and co-teaching. All utilize two or more co-teachers in the classroom who share responsibilities. It is the degree in which the teachers lead and plan that differs. However, all require trust, on-going communication, time to plan, and coordination of efforts (Villa et al., 2008).

Collaboration at the Elementary and Secondary Level

Collaboration has been used in special education service delivery for students with special needs, at risk students, or students with behavioral problems. Collaboration as an instructional option for the gifted student population warrants exploration, as this population also has needs that differ from the regular education population.

Collaboration at the University Level

While collaboration occurs regularly in university research, it still rarely occurs in the university classroom. University faculty members often teach alone and continue to utilize ineffective methods of instruction (Skoog, 1993). Often differentiation in method of delivery does not vary in subject matter. For example, while new methods have been advised for the instructional delivery at the higher educational level in areas like science, not a lot of difference beyond the use of lecture has been utilized (Hrepic, Zollman, & Rebello, 2007).

Peer coaching through observation has been used as a means of increasing faculty instructional effectiveness at the university level. Pioneered by Robert Anderson, the peer observation model served as a systematic means for colleagues' to discuss teaching methods. During its use at Texas Tech University faculty reported "intense dialogue, self-analysis, and increased collegiality" (Skoog, 1993, p. 297). Over time the system was phased out. What it does provide is the understanding that dialogue can impact change in instructional delivery at the post-secondary level.

When collaboration does exist in the university classroom, it has been met with success. Research examining such collaboration reports that while some (but not all) noted resistance from institutions and instructors at the onset, overall the co-teaching experience proved to be beneficial to those involved (Cohen & DeLouis, 2001; Skoog, 1993; Harris & Harvey, 2000; Duhardt et al., 1999). Interestingly, one university instructor that has engaged in both teaching alone and teaching in teams found that the most effective teaching model was not autonomously taught classes. Namely, they lacked additional input and d perspective to the content and occurrences in the

classroom (Perry & Stewart, 2005).

Benefits of Co-teaching

A variety of benefits arise for educators that engage in co-teaching. It provides a boast to pedagogy, creates a more dynamic and interactive classroom environment, and can help model thinking and problem solving across multiple disciplines (Anderson & Landry, 2006). A sense of empowerment occurs when teachers make decisions together collaboratively (Duke, Showers, & Imber, 1980). Through working with one another and observing each other in the classroom, teachers are able to learn from each other's teaching styles (Cohen & DeLouis, 2001). Teachers also challenge each other to grow professionally (Cohen & DeLouis, 2001; Thousand et al., 1995; Johnson & Johnson, 1997). There are reported increases in their individual teaching skills (;Cohen & DeLouis, 2001; Jang, 2006).

Use of Co-teaching as a Tool for Professional Growth

Teaming provides a "collegial interaction and acknowledges the naturally occurring relationships among professionals" (Guskey, 1991, p. 242). These interactions are a key element for "…improving teacher practice, getting better achievement results, and improving communication" (Ebmeier, 2003, p. 137). The ability to share both expertise and provide professional input is an ongoing benefit reported from co-teaching and collaboration (Ravid & Handler, 2001; Carless, 2006; Gray & Harrison, 2003). Ashton and Webb (1986) further suggest that "strong collegial support may bolster and sustain teachers' sense of efficacy, enabling teachers to be more effective with their students" (p. 19). More recent studies support that these collegial interactions positively impact teacher attitude and student performance (Scruggs,

Mastropieri, & McDuffie, 2007; Austin, 2001; Jang, 2006). Capitalizing on the teaming as opportunity for professional development would seem optimal.

Opportunity for Professional Growth for Co-teachers at TGS

In his discussion of enhancing the effectiveness of professional development programs, Guskey (1991) emphasizes the importance of individuals working together as teams. Teaming utilized in this manner underscores that "…productive peer relationships are an important ingredient in improving teacher practice, getting better achievement results, and improving communication"(Ebmeier, 2003, p. 137). In terms of training for the secondary gifted instructor, some more generic training proves to be "irrelevant, impractical, time-wasting, frustrating, and dull (Dettmer, Landrum, & Miller, 2006, p. 615). Rather the majority of these instructors seek relevant development from content similar to theirs that has specific application to various content areas, where they are able to ask "hard, no-nonsense questions" (Dettmer, Landrum, & Miller, 2006, p. 616). The model that provides the unique pairing of a secondary teacher with a faculty member that occurs in the TGS program provides an environment conducive to in-depth exploration of the interactions between the collegial-team. Here, both participations are able to probe one another about an array of information from pedagogical practices, to the latest research in content specific areas.

Summary

Adolescents naturally seek out those who inspire their aspirations (Erikson, 1997). The process of seeking out such mentors is necessary for talent development (Gagné, 2004). Academic needs can be served through access to highly-qualified teachers No Child Left Behind (NCLB, 2004). Enrichment programs foster the

encounters between the student and the instructor (Enersen, 1993). Collaboration consisting of a faculty member with a secondary AP teacher at the TGS provides the opportunity for such encounters. This teaming also serves as a catalyst for professional development for the instructors. The two-way exchange provides insights into pedagogical practices and enhanced knowledge of subject matter for members of the collegial-teams. Although there has been research into the relationship of the collegial interactions and their constructive impact on teacher attitudes and student performance (Ashton & Webb, 1986), there is little research of teaming for the purpose of training teachers of the gifted student. Of interest and focus for the present study is the impact of teaming on what each instructor offers to the collegial-team, the role of each member during the instructional process, whether new content knowledge or instructional practices were acquired, how team members handled conflict when it arose, and what each instructor gained from the program, resulting in their return to TGS in subsequent years.

CHAPTER 3

METHODOLOGY

Introduction and Research Questions

The purpose of this descriptive multi-case study was to document how participating teaching teams created their working relationships in planning and delivering instruction. It also describes perceptions of what individual team members gained from the experience. The intent was to look for commonalities and dissimilarities in teaming relationships/experiences. The results provide insight into what makes a collaborative team work well together or not well together and what makes individual team members willing to continue participation in collegial teaming. Furthermore, it explored whether successful teaming can (a) change individual participants' thinking about their own planning/teaching and (b) contribute to individual participants' professional growth/development.

This chapter addressed the methodology utilized to answer the following research questions:

1. What perceptions do team members have of themselves and each other (in terms of personality type, working style, teaching style, conflict resolution style, relative strengths and weaknesses in content knowledge and pedagogical knowledge/skills that each brought to the program, etc.)?
2. What perceptions do team members have of the roles that each team member played during the collaborative process (in curriculum/lesson/unit planning, instructional delivery, and assessment)?

3. What perceptions do team members have of the types and significance of problems that arose (if any) and how each member worked to resolve the problem?
4. What perceptions do team members have of the strengths and weaknesses of the STEM/TGS program, in general, and of the collegial teaching team approach, in particular?
5. What perceptions do team members have of their own professional growth (in content knowledge and pedagogical knowledge/skills) as a result of participating in a collaborative teaching experience?
6. What perceptions do team members have of the impact of their collaborative efforts on their own teaching inside and outside of TGS?

Method

A multi-case study method was utilized for this study. As a qualitative strategy, a case study involved an in-depth exploration by a researcher over "…a program, event, activity, process, or one or more individuals. The case(s) are bound by time and activity and the researchers collect detailed information using a variety of data collection procedures over a sustained period of time" (Creswell, 2009, p. 13). As the name multi-case implies, this type of qualitative study involves the examination of multiple cases as opposed to the single case study that examines only one person or grouping. By nature the multi-case study is a constrained and focused form of data collection (Miles & Huberman, 1994). Such a format proved useful for this study for data gathering, and may prove useful for later data required for state reporting and future funding.

Data for this study were collected through systematic multiple interviews (structured interviews, and post observation interviews), extended classroom observations with concurrent videotaping, instructor journaling and use of the Myers Briggs Type Indicator (MBTI). Use of these data helped with understanding the interactions and dynamics within multiple collegial-teams, each consisting of a secondary school instructor and university faculty member. Once data were collected, analysis consisted of reviewing, coding, categorizing, synthesizing, and interpreting information from the multiple sources, through the construction of grounded theory.

Participants and Setting

Selection of Participants

Selection of the Texas Governor's School (TGS) faculty was made by the TGS director and curriculum director. All selected faculty had previous experience in their course content area and were selected based upon (a) previous experience in teaching advanced and enrichment courses, (b) a demonstrated openness to student participation, and (c) the encouragement of student questioning of basic concepts in their own instructional practices. Creativity in teaching and motivation of students were other factors considered during the selection process. Due to the pre-selection of instructors prior to the onset of TGS, the participants of this study consisted of a convenience sample.

Cohort Groups

For the purpose of this study instructors were divided into cohorts based upon the number of years they had been involved with TGS. The potential range of experience of the instructional teams was 0 to 5 years. The total number of participants was anticipated to be 10, forming 5 collegial-teams. Participants for this study consisted of 4 science, technology, engineering and mathematics (STEM) instructors who formed two collegial-teams for the TGS at UNT during 2007, 2008, 2009, and 2010; 4 STEM instructors who formed two collegial-teams for the TGS at UNT during 2008, 2009, and 2010; and 2 STEM instructors who formed one collegial-team for the TGS at UNT during 2010.

Setting

Program Project Year 4 2010

The data for the program study were collected during the fourth year of TGS at UNT, held June 6- 26, 2010. Recruiting of high school students occurred from the 20 educational regions across the state, with17 regions having participants selected for the program. The program consisted of 102 incoming high school juniors (50 male and 52 female students). The program curriculum included five science, STEM core courses coupled with four courses that examined the broader impact of STEM fields on society. Previous program years are described as follows:

Program Project Year 1 2007

Program Year 1 for TGS was held from June 10-30, 2007 and consisted of 152 incoming high school juniors (76 male and 76 female students). These students represented 17 of the 20 educational regions in the state of Texas. The program curriculum included five STEM core courses coupled with four courses that examined the broader impact of STEM fields on society.

Program Project Year 2 2008

Year 2 at UNT was held June 8-June 28, 2008, and consisted of 94 incoming high school juniors (42 male and 52 female students) representing 17 of the 20 educational regions in the state. As in Program Year 1, the program curriculum included five STEM core courses coupled with four courses that examined the broader impact of STEM fields on society.

Program Project Year 3 2009

Year 3 at UNT was held June 7-27, 2009, and consisted of 76 incoming high school juniors (35 male and 41 female students) representing 11 of the 20 educational regions in the state. As in previous program years, the program curriculum included five STEM core courses coupled with four courses that examined the broader impact of STEM fields on society.

Data Collection

The collection of data for this research consisted of embedding data within a mixed method procedure of study. "'Embedding' involves collecting the primary data through one means (in this study, qualitative) and utilizing a secondary form of data (quantitative) as a means of providing supportive information" (Creswell, 2009, p. 208). The secondary form is embedded in the data collection of the primary form. While interviews and observations were used as primary support, analysis of frequency counts (i.e. instruction time by instructors, interjections by instructors) within and between collegial groups provided a secondary support for the research questions.

A sequential explanatory design was employed indicating that a simultaneous or concurrent form of data collection, with both quantitative and qualitative data collected at the same time was used. Figure 3 demonstrates this process.

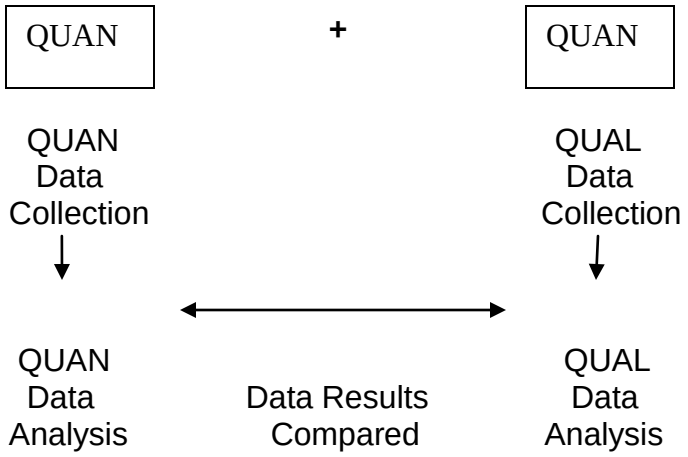

Figure 3. Concurrent triangulation design (Creswell, 2009)

The design provided a systematic means of triangulation. Triangulation refers to the "observation of the research issue from (at least) two different points" (Flick,

vonKardorff, & Steinke, 2004, p. 178). Components of triangulation might include visual data (observations) and verbal data (interviews). Here the process of triangulation can capture and examine different features of a research topic, “such as concrete examples of professional activity and knowledge of one’s own modes of action and routine” (Flick et al., 2004, pp. 179-180). Triangulation does not serve as a means of ensuring complete objective truth, but rather it serves as a method of providing breadth and depth to the research topic at hand (Flick, Von Kardorff, & Strinke, 2004).

Flick et al. (2004) suggest three modes of application of data for triangulation: (1) a validation strategy (as in verifying what is seen and what is said); (2) an approach to generalization of discoveries (new data no longer reveal new knowledge, but lend themselves to theory); and, (3) a route to general knowledge (occurring when theoretical saturation on the topic has occurred through continued over time). This study sought to provide validation to what the instructors’ state is occurring, what they perceive is occurring between them, and what is observed to be occurring between them.

In addition to establishing triangulation, the concurrent triangulation design (Figure 3) was selected for data collection during TGS programming because it provided a way of gathering information during a fast-paced, three-week residential program. It provided a means to capture data concurrent to the instructional activities and events through observation and interviews with the research participants as the three-week programming occurs. Primary data were collected using the concurrent triangulation design in Project Year 4 2010 through observations and interviews during the three-week residential program. Pre and post interviews were also conducted with

the research participants. What follows is the discussion of each data collection method along with an explanation of how each data collection method applied to each research question.

Data Collected from Instructors - Focused Interviews

This study incorporated two series of interviews utilizing focused questions with each of the five collegial-teams. Interviewing for qualitative research can involve structured interviewing in an ordered format that guides the interviewee through a range of intentions. This process allows "the opportunity to learn about what you cannot see and to explore alternative explanations of what you do see" (Glesne, 1999, p. 69). Different types of interviews can be used for different purposes in qualitative research. Flick, Von Kardorff, and Strinke (2004) describe two types: the narrative interview and the focused interview. "The narrative interview, is named such because the data collected is *[sic]* designed to provide a biographical narrative or story; narrative interviews tend to have a broad definition and often make use of life-history semi-standardized biographical questioning designed to stimulate conversation" (Flick, Von Kardorff, & Strinke, 2004, pp. 204-206).

> The focused interview, centers upon a predetermined subject or topic of conversation. The specific topic is pre-determined by the researcher and is guided by the interview questions. The questions, either structured or semi-structured, are carefully designed to act as conversation guides. The researcher must be careful not to lead the interviewee, but provide topic areas in which the interviewee can express their opinions. The focused interview method can assist in defining areas like specific daily occurrences, complex personal issues, or experienced situations such as those that might occur in education. (Flick et al., 2004, pp. 205-206)

This case study employed the focused interview method because an

understanding of specific occurrences was sought, as opposed to a biographical narrative of the participant being interviewed.

A neutral setting with few distractions was selected to assist in putting the interviewee(s) at ease and assisted in addressing the topics at hand (Hancock, & Algozzine, 2006). Examples of mutually agreed upon locations include a coffee shop, teacher classroom, and faculty member's office. An interview protocol, or a pre-developed guide of open-ended questions, was designed for the purpose of guiding the interview process towards insights into the overall research questions. In qualitative research interviews may vary from very structured to semi-structured. A semi-structured questioning format was used in which the interview protocol allowed a flexible conversation that fostered additional open-ended probing on the part of the interviewer (Hancock, & Algozzine, 2006).

The questions (Appendices A and B) were developed for two separate types of interviews. The first interview had both members of the collegial-team present and interviewed together. In the second interview I questioned each collegial member separately from the other collegial-team member. This allowed for input and observation as a team and as an individual.

Both sets of protocol questions began with an icebreaker question. This strategy has been suggested by Creswell (2009) because such a tactic helps establish rapport and put the interviewee(s) at ease. Following the icebreaker, open-ended questions (8 in the team interview; 17 in the individual interview) that addressed the targeted research question were developed. Probes for the questions were included, such as, comments asking for interviewee(s) to elaborate upon a given response, and each

interview session closed with a thank you statement acknowledging the interviewee(s)' time and willingness to contribute to the research inquiry (Creswell, 2009). Subsequently, the interviews were transcribed and coded for emergent themes in relationship to the research questions. In addition, based upon the data collected from interviews, I determined which of the Villa, Thousand, and Nevin (2008) approaches (supportive, parallel, complementary, team teaching) the collegial-teams most often utilized.

Grounded theory involves a coding method in qualitative research that "takes segments of data apart, names them in concise terms, and proposes an analytical handle to develop abstract ideas for interpreting each segment of data" (Charmaz, 2006, p. 45). The coding process requires examination and re-examination of the data. The first examination, initial coding, included line by line coding in which each line of the various interview transcripts were given a short caption for meaning. A comparative method was also used during this phase in which responses to the same research questions were compared within and between the cohorts (Charmaz, 2006).

Focused coding, or using frequent codes found in the first phase to sort through data in the second phase, was utilized (Charmaz, 2006). Through these processes reoccurring themes began to emerge. Memo writing, or writing to "elaborate categories, specify their properties, define relationships between categories, and identify gaps" (Charmaz, 2006, p. 6) assisted in adding clarity of thought and understanding to the relevance of the data to the emerging themes. This process lent itself to the third phase, theoretical coding. The emerging themes contributed to answering the research

questions and made connections to the literature review. The findings from this process are fully described and discussed in Chapters 4 and 5 of this study.

Classroom Observations with Concurrent Videotaping

During Project Year 4 (2010) sessions I videotaped each TGS STEM class a minimum of three times while I concurrently observed. The purpose of recording the classes was to capture instruction in the least obtrusive manner possible in case it was needed for the purpose of research review. Each observation included the activities for the duration of the particular class meeting, the actions of the instructors, and the responses and activities of the students.

To assist in systematic observation of the classroom, the Teaching Observation Protocol Center for Science and Mathematics Education Research (University of Maine Center for Science and Mathematics Education Research, 2005) was utilized. This instrument is readily available as a resource for middle and high school educators through the center's website. The protocol is taken from the reformed teaching observation protocol (RTOP) (Sawada, Pilburn, Turlry, Falconer, Benford, & Bloom, 2000) and the classroom observation handbook (Lawrenz, Huffman, & Appeldoorn, 2002). Sections of the teaching observation protocol center for science and mathematics education research used for this study were: Section I, examination of contextual background and activities; Section II, lesson design and implementation; and Section III, description of events, instructor actions occurring during co-teaching, and level of student engagement. The instrument also provided an area for additional notes as warranted. I used the observational protocol to score each classroom observation. Based upon the data collected from the observation notes, I then determined which of

the Villa, Thousand, and Nevin (2008) approaches (supportive, parallel, complementary, team teaching) the collegial-team most often applied in their instructional setting.

Post Observations, De-Briefings and Instructor Focused Journal Entries

To further explore the instructor's perceptions of what had occurred during the observed lesson, I used two procedures. Immediately following the observation I asked the instructors how they felt about the lesson that had occurred, if it went as expected, and if they thought the students were engaged. For the day of their classroom observation, instructor focused journal entries were also reviewed. The entries reflected the activities that occurred, the students' response to the activity, and the teacher's instructional role during the activity and their response to that role (Appendix D). Both the de-briefing and the journal entries were then compared with the observation notes for insight into what occurred and what was perceived to have occurred.

Observational Notes

I kept observational notes from a variety of encounters with participants. Notes included conversations over lunches, in the TGS office, in the classrooms, before, during, and after staff meetings, and other informal occasions as they occurred.

Myers-Briggs Type Indicator (MBTI)

Myers-Briggs Type Indicator (MBTI) was administered to each member of the collegial-teams. Aspects of the instructor's personality dichotomies were explored on four different continua: extraversion (E) or introversion (I); sensing perception (S) or intuitive perception (N); thinking judgment (T) or feeling judgment (F); and judgment (J) or perceptions (P). Through a series of questions an individual's MBTI was determined as one out of a possible 16 combinations (ESTJ, ISTJ, ENTJ, INTJ, etc.) (Myers &

McCaulley, 1985). The combinations help explore cognitive aspects of one's personality and how the individual relates to the world. Wheeler, Hunton, and Bryant state,

> MBTI has three comparative strengths: (1) researchers have extensively tested the validity and reliability of the MBTI over approximately four decades; (2) the MBTI is grounded within a comprehensive psychology of personality; and (3) the MBTI is well suited for research examining the relationship of cognition and information processing to personality. (2004, p. 35)

For this study I hoped that the MBTI would provide insight into how the instructors interacted with one another in the workplace and how they would interact in different situations, such as problem solving or handling conflict (Buddy, 2007; Rideout & Richardson, 1989; Kuipers, Higgs, Tolkacheva, Witte, & Marco, 2009; Wheeler, Hunton, & Bryant, 2004).

Additionally, Wheeler, Hunton, and Bryant state,

> MBTI has three comparative strengths: (1) researchers have extensively tested the validity and reliability of the MBTI over approximately four decades; (2) the MBTI is grounded within a comprehensive psychology of personality; and (3) the MBTI is well suited for research examining the relationship of cognition and information processing to personality. (2004, p. 35)

In this case study, the MBTI provided additional insight into the interactions of the collegial-teams, especially in the area of conflict dichotomies.

Instructor Demographic Reporting

Information regarding TGS instructor demographics for the Project Year 1 (2007), Project Year 2 (2008), and Project Year 3 (2009) were obtained from reports submitted to the THECB upon completion of the each TGS program year. Similar data were collected for the Year 4 (2010) session. These annual reports are submitted to fulfill requirements set forth by the Texas Higher Education Coordinating Board (THECB) as part of the agreement for program grant funding from the THECB. Reports were

compiled by the program director, with information from the program director, curriculum director, student life coordinator, and administrative assistant.

Data Collection Applied to Research Questions

Analysis of data collected from the multiple resources was applied to the six research questions in this study. Through coding of emergent themes I gained insight into (1) the collaboration between a secondary teacher and university faculty member as a collegial teaching team during a three-week math and science residential program for high-ability learners, and (2) the perceived impact of that collaboration on each team member's professional growth in content knowledge and pedagogical knowledge/skills, and each team member's instructional practices inside and outside of the TGS program. Specifically, once coded using a grounded theory approach, the emergent themes from interview session one (Appendix A) and session two (Appendix B) were applied to the six research questions.

Curriculum Coordinator of TGS

Appendix E of this study contains a researcher identity memo. The purpose of such memo is to allow the researcher in qualitative research to reflect upon his or her role(s) within the study. As the primary investigator of this work, I had the precarious role as researcher and curriculum coordinator. The researcher identity memo assisted me in identifying my own possible biases so that I could be cognizant of them and be a better observer in my research while still fulfilling my obligations as curriculum coordinator.

Summary

The multi-case study approach used in this research examined data sources resulting from the pairing of a secondary teacher with a university faculty member who co-taught in a STEM residential summer program. It provided a means of exploring the relationship between both members, and how such pairing presented an opportunity for professional growth through enhanced content knowledge and instructional practices for both members. Inquiry in this manner resulted in an in-depth exploration of the data that resulted in the emergence of common themes. The process assisted in a better understanding of the impact of collegial teaming on (1) the collaboration between a secondary teacher and university faculty member as a collegial teaching team during a three-week math and science residential program for high-ability learners and (2) the perceived impact of that collaboration on each team member's professional growth in content knowledge, pedagogical knowledge/skills, and on each team member's instructional practices inside and outside of the TGS program.

CHAPTER 4

RESULTS AND ANALYSIS

This research used a multi-case study approach to examine (1) the collaboration between a secondary teacher and university faculty member as a collegial teaching team during a three-week mathematics and science residential program for high-ability learners and (2) the perceived impact of that collaboration on each team member's professional growth in content knowledge, pedagogical knowledge/skills, and on each team member's instructional practices inside and outside of the Texas Governor's School (TGS) program. The following six research questions guided this study:

1. What perceptions do team members have of themselves and each other (in terms of personality type, working style, teaching style, conflict resolution style, relative strengths and weaknesses in content knowledge and pedagogical knowledge/skills that each brought to the program)?
2. What perceptions do team members have of the roles that each team member played during the collaborative process (in curriculum/lesson/unit planning, instructional delivery, and assessment)?
3. What perceptions do team members have of the types and significance of problems that arose (if any) and how each member worked to resolve the problems?
4. What perceptions do team members have of the strengths and weaknesses of the STEM/TGS program, in general, and of the collegial teaching team approach, in particular?

5. What perceptions do team members have of their own professional growth (in content knowledge and pedagogical knowledge/skills) as a result of participating in a collaborative teaching experience?
6. What perceptions do team members have of the impact of their collaborative experience on their own teaching inside and outside of TGS?

This chapter is organized by the research questions. Descriptions illustrate the findings from the data of the research and are based upon a compilation of reported information from interviews (group, individual, and post classroom observation) conducted with the research participants, as well as findings from classroom observation notes, instructor journal entries, teacher course evaluations, and direct quotes from instructors. For the sake of discussion, they are displayed by cohort group and sorted by relevance under each research question. Themes concerning mutual respect, reciprocity, flexibility, and time emerged from the data; detailed analysis of these themes and the data are presented in Chapter 5.

Cohort Groups

A basic overview of each cohort group involved was presented in Chapter 3. The participants in this study were divided into cohorts based upon the number of years they were involved with TGS. The following is a demographic description of each cohort group. Table 2 illustrates each participant's highest level of education to date and the number of years taught at the high school or university level.

Cohort 1A: HS 1A and UNIV 1A

The members of this cohort have worked together all four years since the conception of TGS in 2007. During Year 1 the group consisted of one additional instructor. Two university faculty members were invited to participate because it was known at the start of the program one instructor would be gone to a professional conference during the second week of the three week program. HS 1A worked with this instructor to design the lecture component of the course, while UNIV 1A focused on the lab component of the course.

In Program Year 2 the additional faculty member opted out of participating with TGS. HS 1A and UNIV 1A continued with the development of the course based upon feedback from Year 1 and worked together as a team for all of the subsequent program years.

Cohort 1B: HS 1B and UNIV 1B

The members of this cohort, HS 1B and UNIV1B, first meet at the initial instructors TGS meeting in 2007. They have continued to refine and develop their course work together all four years since TGS in 2007. No instructor changes have occurred.

Cohort 2A: HS 2A and UNIV 2A

The members of this cohort, HS 2A and UNIV 2A, have worked together three years since Program Year 2 in 2008.

HS 2A was a part of TGS during program conception year in 2007. Year 1 she worked with a different university faculty member. The faculty member opted out of participating in TGS Year 2, and UNIV 2A was hired to join the instructional team. They

have worked together since.

Cohort 2B: HS 2B and UNIV 2B

The members of this cohort, HS 2B and UNIV 2B, have worked together three years since program Year 2 in 2008.

HS 2B was part of TGS during program conception year 2007. He worked with a different university faculty member, who incidentally was his brother-in-law. The faculty member opted out of participating in TGS Year 2, and UNIV 2B was hired to join the instructional team. UNIV 2B is the father-in-law of HS 2B and the previous university faculty member. UNIV 2B and HS 2B have worked together since.

Cohort 3A: HS 3A and UNIV 3A

In terms of instructor turn-over, this grouping has been the least stable when compared to the other cohorts. UNIV 3A joined TGS during Year 2. He worked with a different high school instructor for program years 2008 and 2009. The high school teacher opted out in 2010, at which time HS 3A joined the instructional team for this cohort.

The data collected are reflective of their work together as a beginning collegial-team. They provided a unique opportunity to see a Year 1 grouping compared to the other more established cohorts.

Table 2 shows the highest level of education obtained, the years of teaching experience and the highest level of coursework taught by each of the participants.

Table 2

Highest Level of Education of Participants, Years of Teaching Experience, and Highest Level of Coursework Taught by Participants

Participant	Highest Degree	Years of Teaching Experience	Highest Level of Coursework Taught
HS 1A	BS	Secondary 13 yrs	AP*
HS 1B	BS	Secondary 9 yrs	AP
HS 2A	MEd	Secondary 15 yrs	AP
HS 2B	MEd	Secondary 20 yrs	AP
HS 3A	BA & BS	Secondary 21 yrs	AP
UNIV 1A	PhD	Faculty 5 yrs	Graduate
UNIV 1B	PhD	Faculty (2 institutions) 13 yrs	Graduate
UNIV 2A	PhD	Faculty (2 institutions) 7 yrs	Graduate
UNIV 2B	PhD	Faculty 48 yrs	Graduate
UNIV 3A	PhD	Faculty 3 yrs	Graduate

*AP=Advanced Placement

Data for Research Question 1

Research Question 1: What perceptions do team members have of themselves and each other (in terms of personality type, working style, teaching style, conflict resolution style, relative strengths and weaknesses in content knowledge and pedagogical knowledge/skills that each brought to the program)?

Data for this question have been arranged to describe each of the relevant qualities (personality type, working style, teaching style, conflict resolution style, relative strengths and weaknesses in content knowledge and pedagogical knowledge/skills) that describe each of the participants within a cohort.

Cohort 1A: HS 1A and UNIV 1A

HS 1A describes himself as upbeat and easy going. He enjoys a lively discussion and feels that the Myers-Briggs Type Indicator (MBTI) description of extrovert fits his personality type. UNIV 1A uses the word “extrovert” to describe HS 1A. While both of them are extroverts, UNIV 1A believes they do not “trip” over one another in the classroom or lab (Individual interview, February 17, 2011).

HS 1A has the flexibility to meet a variety of situations that occur in the classroom, or as he describes, “the ability to change on the fly” (Individual interview, January 27, 2011). He believes such an approach is vital in the high school classroom, as there are numerous external controls (such as mandated testing, demands of other classes, etc.) that pull from students’ abilities to focus on class. HS 1A also acknowledges the need for an active, student-centered classroom. He thinks that such an atmosphere keeps the students involved and challenged. He further believes that it helps to remove fear and apprehension from students as they are able to relate and learn together (Group interview, June 2, 2010).

As his students, HS 1A has an inquisitive mind and loves to learn. HS 1A’s outside interest, such as reading science fiction adventure and current science articles, gives him fun and interesting material to use when covering content in the classroom. UNIV 1A acknowledges HS 1A’s ability to handle the discipline in the classroom and communicate with the high school student. He is also able to monitor the students’ engagement levels accurately. Because of his experience with high school curriculum, HS 1A is able to conceptualize and “bridge the gaps” in content for students (Individual interview, February 17, 2011).

UNIV 1A describes himself as energetic and a geek. He is excited and knowledgeable about his field of study and research. HS 1A sees UNIV 1A as innovative and passionate about his research field. He is able to use new things in ways never used before.

UNIV 1A believes one of his greatest attributes is his imagination, which is needed in order to see beyond his training in analytical chemistry. Through his creativity, he is able to find new uses for already developed equipment such as the mass spectrometer. He stresses the need for creativity in the scientific community to his students inside and outside TGS.

While creativity is important in research, UNIV 1A recognizes the importance of thorough knowledge of subject matter as an instructor prior to delivery. This entails review and research before presentations, resulting in meaningful dialogue with students. Use of lectures with images and discussions best fits his teaching style, as these methods assist him in connecting with students.

UNIV 1A enjoys the connection TGS has afforded him with students. However, the experience of TGS has also resulted in a self-actualization, or a recognition of how he relates to his students, for UNIV 1A. He admits that in teaching he has a desire to be the one who produces the “ah-ha” moments in his students, which often occurs in his graduate level laboratory. This is not always the case at TGS, as he explains: "…all of us college professors are either ego-stroked or petted…all that stuff. When you're teaching at a high level you want the students to end with an ultimate experience; you realize then that you're a step on the staircase to them becoming" (Group interview,

June 2, 2010). What UNIV 1A has come to realize is that he will not always be the center for such experiences of all of his students.

Cohort 1B: HS 1B and UNIV 1B

UNIV 1B describes HS 1B as easy going and quick on his feet. HS 1B has the capacity to “guide the students on the right path”, or the helping to direct students to make wise choices and resolve problems on their own. HS 1B believes his own life experiences of being a smarter student raised in a poorer minority environment help him personally relate to some of the students he serves and guides both inside and outside TGS.

In terms of his teaching style, HS 1B comments he is able to adjust quickly to meet a variety of learning conditions based on his assessment of what the students need. Though HS 1B has a general outline for his high school classes, he often decides which activity will occur the morning of the class. He is able to relate to students at a variety of levels, from appealing to a large class to working one-on-one with a student. During the group interview, HS 1B explained that he views the TGS classroom “… like a big playground. I’m always trying to figure out what I can do while (UNIV 1B) is lecturing. I’m wondering how I can play with that? What kind of game can I make with that?” (Group interview, June 8, 2010). UNIV 1B says he is more serious in class, while HS 1B is more humorous, but they both like to incorporate humor into the classroom. UNIV 1B comments that “One thing that I appreciate too is that there is a lot of fun and laughter in the class that makes me feel young" (Group interview, June 8, 2010).

HS 1B believes his playful approach to science is one of his strengths as a teacher. He states that most helpful is his “…experience at playing, because as a high

school Physics teacher, that's what I do; I play and then I explain what I just played with" (Group interview, June 8, 2010). HS 1B recognizes that his weakness is his lack of content knowledge about nanotechnology, but reports he has gained many insights into the field after working with UNIV 1B.

Although UNIV 1B and HS 1B do joke, they take seriously the responsibility of their job together. HS 1B notes that they both tend to be critical of themselves, but these high expectations of themselves and their course have resulted in the adaptation of the course to meet the needs of their students (Group interview, June 8, 2010).

UNIV 1B describes himself as easy going. He is flexible, able to collaborate with others and is open to new ideas. HS 1B appreciates UNIV 1B's humor and his ability to relate to people at multiple levels. He is also a humble person. HS 1B reports that when he and UNIV 1B work together their two egos do not battle one another.

In terms of teaching style, UNIV 1B expects the students to be prepared prior to class, ready to ask questions. UNIV 1B therefore reflects upon the students' perspective in terms of what they might want to know and discuss. From this he plans and revises materials for class. HS 1B had a stereotyped conception of lectures prior to meeting; one with little interaction with students in the classroom HS 1B observes that UNIV 1B incorporates hands-on activities with formal lectures.

UNIV 1B's direct connection to current research developments in his field is a strength HS 1B recognizes. This involvement also provides UNIV 1B with a business understanding of science and technology, as he is actively marketing and obtaining funding for various research groups in which he is a principal researcher. He is then able to share insights with the TGS students. HS 1B goes on to explain that "UNIV 1B is

the expert, but at the same time he values what I bring to the table as a secondary teacher, which is important" (Group interview, June 8, 2010).

HS 1B's knowledge of adolescents is one area UNIV 1B greatly values. UNIV 1B acknowledges this as a weakness and admits that he "had no idea what high school students were about" when he began his journey with TGS (Group interview, June 8, 2010). He knew after the first day that his plan for 90 minutes of lecture material would not work with this student population, so he immediately began adapting his materials. HS 1B was able to step in and offer ideas for the class.

Cohort 2A: HS 2A and UNIV 2A

HS 2A reports that while respected by her students, she has the reputation of being a tough teacher with high expectations. She is less nurturing, more practical in nature. She cares about students' problems, but is more apt to help them find a solution than coddling them.

In terms of teaching style, HS 2A reports that she has a different approach to teaching at TGS than her classroom. While in both settings she encourages them to think independently, her "easy going persona at TGS allows more students to open up to her" (Individual interview, March 5, 2011). The grade-free, relaxed atmosphere of TGS allows her to "go off on flights of fancy" (Individual interview, March 5, 2011). It does not matter if it is right or wrong; students are there to talk about ideas, thinking, and possibilities. UNIV 2A concurs that HS 2A challenges the students to think about things and is willing to deviate from the lesson plans.

HS 2A describes her co-instructor UNIV 2A as easy going, making collaboration an achievable task. UNIV 2A describes his teaching style for TGS as trying to create

opportunities to explore what they want to explore as related to the topics they are covering. In conversations with HS 2A he shares that the reason he wants to do so many hands-on activities is based on his own early educational experiences and the enjoyment of doing things in class. He takes the same approach with his university students.

HS 2A reports that she and UNIV 2A are both measured as introverts on the MBTI. She thinks this trait has assisted their working style as there is not a need or expectation to become “best buds” (Individual interview, March 5, 2011). Rather, they can focus their work together in accomplishing the task of curriculum development. Perhaps they are not “best buds,” but they do enjoy working together and get along nicely.

UNIV 2A believes his weakness is his lack of familiarity with the high school biology content level, as well as the expected behaviors of the adolescent students who attend TGS. HS 2A concurs that although he is a very patient person, he is less tolerant of poor behavior on the part of the students.

HS 2A notes that UNIV 2A can be passive aggressive when it comes to student misbehavior in the classroom. She states that he “leaves you to handle your aggravation yourself” (Individual interview, March 5, 2011). Though not formally discussed with UNIV 2A, HS 2A has come to understand UNIV 2A’s limited knowledge of teenagers and their behaviors, as well as his dislike for administrative responsibilities. Therefore, she handles these duties for the course.

Cohort 2B: HS 2B and UNIV 2B

HS 2B describes himself as outgoing and explains that he is “high schoolic” and able to relate to his students (Individual interview February 3, 2011). JA thinks HS 2B is not only outgoing, but also energetic and has a friendly demeanor. In terms of teaching style, HS 2B believes he has a flare for engaging students in mathematical material and is able to approach it with a high school perspective. He is able to get students excited about mathematics.

HS 2B believes one of his personal strengths is the ability to create TGS lessons that are not solely dependent upon a textbook for guidance, but incorporate other resources and ideas such as interactive activities and computer applications. He is able to develop lessons that involve the students in hands-on applications of the mathematics that they are discussing. HS 2B sees the heavy dependence of the textbook is often the norm for mathematics curriculum in public schools and universities.

HS 2B states his weakness is his tendency to dominate the curriculum, but jokingly adds that he thinks both partners he has worked with appeared to appreciate his handling this aspect of the course. HS 2B’s partner states that on occasion HS 2B might not be “super prepared,” believing that HS 2B might benefit from some advanced preparation for classes (Individual interview, January 29, 2011).

UNIV 2B describes himself as a kinder, gentler person when compared to most people. He has noticed that people relate to him with respect, as the “Oriental respect for the older guy” (Individual interview, January 29, 2011). HS 2B describes him as calm and collegiate. His teaching style is to approach his students with calmness and with his

in-depth knowledge of mathematics. In the classroom, he thinks he and HS 2B balance one another.

Cohort 3A: HS 3A and UNIV 3A

HS 3A describes himself as an alpha dog, as he likes to be in charge, but at the same time likes to be liked. Others appreciate him, and they know that he appreciates them. When working with colleagues, HS 3A likes to work with mutual respect for one another, each appreciating one another's input.

UNIV 3A views HS 3A as funny and enthusiastic. He thinks HS 3A can be serious and curious, and explained that HS 3A is quickly learning about the class content.

HS 3A is cognizant of the different types of learners in his high school classroom. HS 3A tailors his teaching approaches in his classroom. He explains that he paces the aisles as he lectures when students are less engaged, while he is more reserved when students are more active, as he does not want to excite them further. He strives to make the students excited about learning and enjoy his class. UNIV 3A notes HS 3A often makes use of analogies that do engage the students. Another form of engagement UNIV 3A notes in high school teachers is the following: "I go into a serious mode; HS 3A and even (my previous TGS partner) before that, used humor in the classroom. They (HS 3A and previous high school instructor) joke around with the students a lot more and when a student is not paying attention, many times, I just give them a look. But they just make some funny remark" (Individual interview, January 30, 2011). He feels that humor, for the most part, is effective with the TGS students.

HS 3A initially had apprehensions about his own content knowledge because he would be working with UNIV 3A (a researcher with applied experience in the area addressed by the course). An additional concern was that he had little time to prepare prior to the start of TGS classes. He noted that over time those apprehensions lessened and in fact they made him more cognizant of material (such as articles and news stories) that will prove relevant to the course for the TGS 2011 program (Individual interview, March 2, 2011).

UNIV 3A describes himself as analytical, viewing everything as a problem to optimize. In terms of working with students, UNIV 3A believes students should be taught to seek information and they should “optimize what they have and gain insight from it” (Individual interview, January 30, 2011). He normally uses PowerPoint™ presentations with lecture to convey information to his students.

Data for Research Question 2

Research Question 2: What perceptions do team members have of the roles that each team member played during the collaborative process (in curriculum/lesson/unit planning, instructional delivery, and assessment)?

Data for this question are divided by cohort and follow the question in terms of each participant’s response in the following areas: Understanding of program purpose, development of curriculum/lesson/unit planning, methods of instructional delivery, and methods of assessment.

Cohort 1A: HS 1A and UNIV 1A

Understanding of Program Purpose

HS 1A sees the purpose of TGS in terms of social and emotional development for the student participant. It provides an environment where like-minded individuals can experience a challenging collegiate life and while living away from home.

UNIV 1A believes the purpose of TGS centers on the content and getting students excited about science, technology, engineering and mathematics (STEM) fields. He hopes students will be introduced to concepts outside the common topics covered in school. Both understandings came together to create their present course.

Development of Curriculum/Lesson/Unit Planning

HS 1A reports that during the first year of TGS, the Cohort 1A instructors often worked "…off the fly and realized what did and did not work" (Group interview, June 2, 2010). HS 1A and another instructor no longer with the program met face-to-face three to four times and via email. They shared concepts high-level kids might want to talk about, with HS 1A's ability to insert a high school perspective. What evolved was a condensed college general chemistry course. It began as "relatively broad…we narrowed the focus as we moved through the session" and began to make use of the laboratory (Individual interview, January 27, 2011). In retrospect, HS 1A thinks it was too much information, and it was not keeping the students engaged. UNIV 1A's role during this time period was the development of lab experiences, which ultimately did engage the students.

UNIV 1A explains that during the second year he and HS 1A met together to plan and re-write the lesson plans. After the first year the focus became less like a general chemistry course and more of a focused exploration of the electron. Plans were made around the available tools and resources in UNIV 1A's chemistry lab. HS 1A added that "a lot of the instruments these kids are going to play with are rooted in the electron: bonding, motion, absorption of energy," and the electron remains the basis of the curriculum (Group interview, June 2, 2010). UNIV 1A describes the course content as evolving into practical material. He defines *practical* as "being in the lab as opposed to formal lecture" (Individual interview, February 17, 2011).

Planning continues to be an evolution with labs added each year. For the fourth year, one more lab was added that incorporated aspects of forensics because of previous feed-back from students and their interest in both forensics and labs. Currently the planning is less formal and more of "a talk right after or before the class starts" (Group interview, June 6, 2010). HS 1A concurs that since the Year 2 re-write, things have matured, but have stayed basically status quo.

HS 1A reports there has not been much need for revamping or extraneous meeting time. They found that through talking during and after class, as well as via email, 'do journals' in class gives time to communicate. Not much time is spent outside TGS for planning. Some face-to-face meetings did occur just prior to the start of the program each summer. HS 1A reports that the second year meeting involved some major tweaking, and the third year mainly consisted of him and UNIV 1A reminiscing. At present the frame is in place and tweaks are minimal (Individual interview, January 27, 2011).

Methods of Instructional Delivery

Both HS 1A and UNIV 1A seem to share similar views about the evolution of the roles they play in the classroom. HS 1A believes allowing students to explore in UNIV 1A's laboratory and exploiting his expertise are crucial to the course. HS 1A is also respectful that this is UNIV 1A's territory. Therefore, he thinks it is proper that UNIV 1A takes the lead, "ultimately going by his timetable" (Individual interview, January 27, 2011). He adds that UNIV 1A is open to exploring ideas that interest him.

HS 1A sees his main role to facilitate the learning as it occurs in the TGS classroom. With his understanding of the high school curriculum and his sensitivity to students that may not grasp a certain concept, he is able to assist in clarifying what UNIV 1A is teaching. This often takes on the role of assisting struggling students. "I can tell what they are struggling with and relate it to high school. My job is necessary because (the students) would not have a clue as to what is going on" (Individual interview, January 27, 2011).

As have the lessons, UNIV 1A and HS 1A's roles have evolved. HS 1A states that "the first Year I felt more like a teacher and less as the facilitator. Now I feel like I am less the teacher and more the facilitator" (Individual interview, January 27, 2011). He defines a facilitator as the one who provides the frame of reference, and a teacher is the one who brings new information. He thinks each role is equally important to the overall success of the students in the course. "UNIV 1A brings a much more applied chemistry to the table. He attempts to gain their understand that, and I try to facilitate their understanding" (Individual interview, January 27, 2011).

UNIV 1A reports similar development of roles. He reported the first year "we tried to micromanage it…You do this - I do this, and that's changed completely…roles have become so comfortable" (Individual interview, February 17, 2011). He elaborates that now, if he begins to lecture and becomes too “long-winded,” the students become antsy, hence HS 1A becomes too much of a disciplinarian so they stop and go with a new approach.

HS 1A and UNIV 1A structured their course to be able to spend as much time in the lab as possible. The fundamentals are taught via lecture in classroom. When asked to describe his instructional role in the classroom, HS 1A reports that he normally starts out by taking class roll and then “hangs in class” (Group interview, June 2, 2010). This is not a passive role, rather a monitoring role in which he sometimes sits in back; sometimes he sits by the kids who struggle; sometimes he initiates questions or answers or “breaks down information because it's on a pretty high level” (Group interview, June 6, 2010). HS 1A further reports that UNIV 1A is usually standing at the front board while HS 1A is somewhere in room. “He's talking, I'm talking, kids are offering up some questions; sometimes I will break it down to the high school level and we move from there” (Group interview, June 2, 2010).

HS 1A and UNIV 1A provide a slightly different picture of what occurs in the laboratory in terms of instructional delivery. In the laboratory students work in small groups and are assigned a project. UNIV 1A states that they make use of a lot of experiments that are not only safe, but also known to be effective and produce anticipated results when followed correctly. "UNIV 1A will walk around - I walk around, and if something is not working we'll suggest they try this way or think about this or that

sort of thing" (Group interview, June 2, 2010). UNIV 1A adds that “we have a lot of offline conversations with the students during the lab and that gives them an opportunity because they have time while they're waiting for something to occur, something to develop, something to happen in the lab, and that's a good time to just pick both instructors’ brains” (Group interview, June 2, 2010).

HS 1A expressed his enjoyment of being in the classroom and lab with UNIV 1A and the students. He feels free to interject and infuse ideas into the conversation, making it a more meaningful experience for all involved.

Methods of Assessment

UNIV 1A reports that some of the activities use competition as a form of motivation and assessment. Observation is the main form of assessment. One such observational insight was noted during the post observation interview by HS 1A; he observed how students were entering lab data and figuring out why certain reactions were occurring. UNIV 1A commented that he had almost given up on one student until he actually stayed back in class until data were properly calculated into a graph. During his individual interview, HS 1A reported they both are good at making sure everyone is involved and responding to answers. Both he and UNIV 1A “switch up” who asks and responds to the questions.

Cohort 1B: HS 1B and UNIV 1B

Understanding of Program Purpose

HS 1B considers that the purpose of TGS centers on the content, which exposes students to outside topics as well as focused ideas in a particular field.

UNIV 1B also identified the purpose of TGS as centering on the content. He views this like planting a seed and introducing students to college and graduate level concepts. Enhancing thinking skills is also important to the TGS experience, as he believes it is important to build a creative environment where students think for themselves. These two similar viewpoints joined together to formulate their course.

Development of Curriculum/Lesson/Unit Planning

The first year curriculum was developed from a lecture UNIV 1B had given titled "Small Technology, Big Business." UNIV 1B recalls how he "…prepared eighty minutes of information which pretty much means sixty slides. In the first class I find out that we can't talk past five slides because that would be a lot of talking, and they lost their concentration. So we quickly changed into project-oriented content" (Group interview, June 8, 2010). HS 1B concurs that after the first day they had to re-vamp the curriculum. He reported that during that year UNIV 1B mainly led, but together they developed a basic outline of topics from information and videos that UNIV 1B wanted to share with the students. In terms of specific plans for each day, HS 1B recalls that they "…pretty much went on the fly" (Group interview, June 8, 2010).

When asked about current planning of curriculum, HS 1B laughs and says, "Basically we whisper to each other during class, ‘OK what's next?’" (Group interview, June 8, 2010). HS 1B goes on to elaborate that they have a basic outline with a multitude of activities in place for the classes. They are able to select activities as they need them, based upon the current response of the students. In addition, because they have taught the class together over time, they basically know how each other works; “I know what he's talking about and know how I can add to it" (Group interview, June 8, 2010). UNIV 1B further elaborates, "You add a few different kids, and then the whole culture of the class becomes different. So we actually adapt to every class. We don't use one cookie cutter for every class" (Group interview, June 8, 2010). Revision of this manner was observed during the post observation interviews on both June 11th and 18th, 2010. On the latter date, UNIV 1B and HS 1B discussed how to cut the material, accommodating for the first class that seemed to absorb the material more quickly and the second class that needed more explanation. Both contributed equally to conversation and mutually agreed upon a plan of action.

When asked about the development of one of their lessons, they explained how the spaghetti tower lesson originated from UNIV 1B. It was originally a national engineering contest for college students. UNIV 1B incorporated the connection to carbon nanotubes. UNIV 1B and HS 1B expanded the idea by adding weight from water balloons. The lesson continues to evolve as both add aspects. Building structures from index cards, another activity HS 1B used in his high school class, has evolved in the TGS classroom. Together HS 1B and UNIV 1B have developed interconnected projects that help students foster ideas in their mind, give students hands-on practice with the

ideas, and then give them some thinking processes to evaluate what did and did not work. UNIV 1B states, "Our projects actually evolved this principle and our lecture materials are given from these three different aspects" (Group interview June 8, 2010).

HS 1B follows UNIV 1B's lead in terms of content as "I'm still learning and still trying to figure out all this stuff and still trying to put it together. I can make sure or try to make sure that some of UNIV 1B's tacit knowledge doesn't just zoom by...I can just jump in and clarify and reinforce what he's said" (Group interview, June 8, 2010).

Year 4 HS 1B is planning to add a lesson that originated from an activity that he does with a peer assistance group at his local high school. The activity incorporates a principle of science, but also emphasizes teamwork.

Methods of Instructional Delivery

UNIV 1B explains that in terms of instructional delivery of their planned lessons, a basic structural progression is followed through the week: Mondays and Tuesdays are mainly lecture; Wednesdays and Thursdays are typically debates and/or projects, and Fridays conclude the week with a big project filled with constraints and competitions. This was planned as a way to address the students' attention spans and energy levels as they tend to wane as the week progresses. The build up to more activity seems to counter this progression.

The progression through the week does not automatically address all of the problems of attention span and energy level in the classroom. In their work together, UNIV 1B and HS 1B have developed a means of sharing time to keep students engaged. In their interview together, UNIV 1B explains that he has noticed that "… as

soon as they start to get bored with me, I pass the ball to HS 1B. Then the fun stuff starts, and that way it actually reinforces them to learn" (Group interview, June 8, 2010). HS 1B then chimes in, “They get bored with me, too. I can see them start to wander off, and I'll pass it." UNIV 1B reflects further as to why he thinks the “passing-off” is effective in keeping the students engaged. He states, "I think it is change...if I just sat there and lectured for an hour and a half, I'd lose 80, 90 or 99% of the kids. I think that in order to have those two contrasts...it’s contrast and it’s balance" (Group interview, June 8, 2010).

Several times during the group interview HS 1B summarized insights on instructional delivery by explaining that the basic content structure remains in place. What is emphasized during delivery is what changes. These changes are gauged upon his and UNIV 1B’s perceptions at what is needed in any given moment in the classroom. Both UNIV 1B and HS 1B identified communication as making such adjustments successful during the delivery of instruction.

Instructional roles began changing as early as the first year. The first week HS 1B reports a more passive role of sitting back and listening to UNIV 1B’s lectures. UNIV 1B’s own recognition that the lecture format was working began dialogue between the two instructors. As a secondary teacher, HS 1B contributed ideas for involving the students and took on a more active role in the classroom. UNIV 1B states that he and HS 1B go into a "rhythm" and after class they identify any problems. They recognize that the students "are not machines or robots; they don't respond exactly the same....the word that might describe this best is organic” (Individual interview, March 1, 2011). This

means that UNIV 1B and HS 1B remain flexible to adjust the delivery format and instructional roles as needed.

Methods of Assessment

Once projects are complete, students reflect upon what did and did not work. Over the years UNIV 1B found it interesting to see the variety of unique designs and continues to be amazed at the high level of creativity for some of the solutions. In terms of helping each student achieve success, the instructors provide access to different types of activities. As HS 1B explains, "Each of them will have an opportunity to step up at some point during some portion of the class, maybe not daily but with writing activities, the discussions, the lectures, the activities, and the competitions...covers various learning styles" (Group interview, June 8, 2010).

Cohort 2A: HS 2A and UNIV 2A

Understanding of Program Purpose

HS 2A believes the purpose of TGS centers on content and expanding students' higher-level thinking skills. She thinks TGS affords an environment where students are able to "indulge their love for learning and inquisitiveness…questioning beyond what is covered in high school" (Group interview, June 3, 2010). HS 2A further believes that key to the environment is the opportunity to interact with university faculty members to get questions answered; this helps to broaden their horizons and offers them fun in learning. UNIV 2A stated that he feels the same as HS 2A. Over the past few years they have collaborated together to formulate their course.

Development of Curriculum/Lesson/Unit Planning

HS 2A reports that in her very first year with TGS, she had a different university partner than UNIV 2A. HS 2A thinks that while her original partner has a brilliant mind, this particular faculty member was not comfortable with the concept of high school students making use of the university laboratory. HS 2A believes this made the overall course development difficult; difficult enough that she considered not returning to TGS the second year. The following summer, her first year experience with UNIV 2A was much different. UNIV 2A is open to students making use of the labs and is welcoming of the high school students using the lab tools and microscopes. When compared to her previous partner, from the beginning HS 2A and UNIV 2A tended to utilize less lecture and more discussions with many more daily labs and activities, both inside and outside the classroom.

Now in the fourth year, HS 2A has been partnered with and has planned with UNIV 2A for the past three years. In terms of planning HS 2A says that UNIV 2A did more of the content planning because botany is his field, while her specialty is zoology. HS 2A thinks UNIV 2A's breadth of knowledge enables him to bring more ideas to the table. However, as they have worked together, he has been willing to teach her new information. In her individual interview HS 2A stated an appreciation for the mutual respect and recognition they share for one another's knowledge and the openness they share for the exchange of ideas.

Since the initial year with her previous partner, HS 2A notes that there are more opportunities to be "hands-on in the lab," which makes it more engaging to the students (Group interview, June 3, 2010). The first year they worked together, UNIV 2A states

that planning was a bit rough due to the short amount of time before the program started.

Due to time and experience subsequent planning has been easier. He reports that they normally talk after class at lunch about what worked and did not work.

Methods of Instructional Delivery

An element that is working well in the course is that UNIV 2A allows students access to the labs and lab equipment. Hence, the instructional delivery design has less lecture and more discussions, with a lot of daily labs and activities. With such design, HS 2A and UNIV 2A effectively take active roles in the classroom, even during lecture. "UNIV 2A may lecture, and I'll draw; or he'll draw....sometimes one of us is drawing, and the other is talking" (Group interview, June 3, 2010). In her individual interview she remarks that it is interesting to watch the students try to "figure out who is boss" (March 5, 2011). "Tag-teaming," with both instructors offering information to the class, keeps the role of who is in charge from being a definitive answer. In his individual interview, UNIV 2A reports that HS 2A is more direct in dealing with student behavior, and he relies upon her to address such issues. Similar information was reported in HS 2A's individual interview.

UNIV 2A reports that the subject material that is covered in class is interesting. The students have the opportunity to work through the exercises, and the instructors just guide them. They purposely do not rush the students, giving the students the opportunity to "…stick with the parts of the exercises that they're most interested in and

are given the opportunity to delve a little deeper if they want to spend more time on them" (Group interview, June 3, 2010).

Both UNIV 2A and HS 2A state that they allow students to make their own slides, as both believe it gives students a better understanding of the process and what they are examining. "...it's important to have hands-on exercise" (Group interview, June 3, 2010). Though lecture is utilized, both firmly believe in the importance of using hands-on experiences in the classroom laboratory and out in the field. UNIV 2A reports that they mutually share in lectures and that "we have a good idea of what we want to say." However, UNIV 2A adds, "Probably 80% of the time we are doing activities" (Individual interview, March 8, 2011).

Methods of Assessment

During the group and individual interview UNIV 2A explains that they both move around the room and observe what the students are doing and that they comprehend the concepts of what is occurring. This was noted during the classroom observation. During all of the post observation interviews, conversation between the two instructors occurred about how certain students were progressing, as well as what had gone well and what could have gone better in the labs that day.

In terms of planning and tweaking, HS 2A reported, "It helped a lot to sit down and talk about what worked…We haven't been rigid about holding onto things that did not work" (Group interview, June 3, 2010). HS 2A gives an example of visiting the local water treatment plant. She and UNIV 2A found it interesting, but the students were less than impressed. The field trip was cut from the curriculum, and a new field trip was added. In terms of balancing the guiding of the students and allowing them to do it

themselves and make mistakes, HS 2A states, “So you shepherd them through it and at the same time you and I need to talk about this and not cover too much; let them make mistakes and be willing to step in when they say they made a mistake and be reassuring that it's okay to make a mistake" (Group interview, June 3, 2010).

Cohort 2B: HS 2B and UNIV 2B

Understanding of Program Purpose

HS 2B considers the purpose of TGS to be the content and the ability to expose students to topics they have not encountered in the high school curriculum. He seeks to provide "…an enriched curriculum, something that motivates or stimulates them to further study, to new ideas, to the cutting edge of things” (Group interview, June 1, 2010). A secondary purpose that HS 2B identifies is the social outlet among peers that TGS provides.

UNIV 2B sees the purpose of TGS as being college-preparatory. It provides an enrichment opportunity that sets up a mini transition experience from high school into college. Though they hold somewhat differing viewpoints, both have contributed to their course.

Development of Curriculum/Lesson/Unit Planning

The ideas for this course originated from three family members, each a mathematician, discussing ideas. As mentioned in the introduction of teams, this cohort consists of father-in-law and son-in-law. They both report that at family gatherings they will often begin a discussion over a mathematical concept that will evolve into an idea for TGS. HS 2B reports that in the first year, one of the original challenges was creating

lessons that were interesting, had a mathematical foundation, and could be contained within a 90-minute time frame. In addition, HS 2B sought material that was not a repeat of the high school curriculum and that did not require additional work outside of class time- "We thought about some things we felt were mathematically cool" (Group interview June 1, 2010). "There are more ideas than can be covered in 15 days, and at some point we have to pick and choose" (Group interview June 1, 2010).

During his individual interview UNIV 2B reported that they still have frequent family dinners where they talk about mathematical problems. Ideas are also drawn from different ideas that arise from other sources, such as articles. UNIV 2B reports that HS 2B keeps a collection of plans they are able to draw upon. HS 2B explains that "we have a bucket list of things we have always felt were cool" (Group interview, June 1, 2010). One such lesson that evolved in their course involves the binary clock. HS 2B explains that idea originated from his Algebra I class, and it serves as a means to introduce the history of how computers basically started. At TGS the clock is shown to the class, and the activity catches the students' attention because "they don't intuitively know how it works" (Group interview, June 1, 2010). The lesson goes on to teach the concept of binary numbers and programming.

During the group interview HS 2B and UNIV 2B discussed possible improvement of another lesson that involves the programming of cars that operate with a TI graphing calculator. HS 2B's discussion is mainly about the mechanics of the car. UNIV 2B's comments focus upon the students' effort needed to complete the task and their attention span. The discussion appears to be an example of friendly discussion that occurs in terms of assessing their lessons. "By the fourth or fifth year we've already

weeded out the things that don't work very well, and the lessons we kept go really well." HS 2B states that for the 2010 year, "We'll probably change a few things, but the foundation will be similar." He goes on to explain that the students' evaluations have expressed a desire for less programming and more math theory; "...UNIV 2B did the last couple of days lectured using math theory kinds of things, and they felt like they were getting real math, and a lot of them thought that was good" (Group interview, June 1, 2010).

During their group interview and their individual interviews HS 2B and UNIV 2B explain that they have a flexible approach to the actual implementation of plans. "With our lessons, we don't just sit down and decide these are the ones we are going to use, rather, we're just going to let it happen." HS 2B: "At lunch we're just saying what we should do tomorrow. What should we tie this to?" UNIV 2B: "...our course is the experience that both of us bring from the subject matter and from teaching." An example of the revision of plans as they happen was explained in one of the observation post meetings. Due to a "back-up" caused by the students' interest in hands-on activities, they had not started *Flatland*, a novel that is used in the course. UNIV 2B announced they had a plan, to which SE chimed in "Cliff Notes!"

HS 2B and UNIV 2B hope to model mathematics in a way that is not dull or boring. As UNIV 2B puts it,"…the thing that we try to model is people who enjoy mathematics, who enjoy communicating mathematical ideas, and hopefully students will pick up on that, that we're not your ordinary math teachers…" (Group interview, June 1, 2010). Part of their tactic for accomplishing this entails the back and forth exchange of ideas. UNIV 2B describes it in the following manner: "It's more like instructional banter;

more like Click and Clack on PBS…The banter is a flow, its natural" (Group interview, June 1, 2010). This banter occurs freely as one main teacher presents at the front of the room and the other moves through the room or stays to the side of the room.

Methods of Instructional Delivery

In terms of instructional delivery, HS 2B reports that they do not teach at the same time. He states that UNIV 2B "defaults to (him) almost exclusively with regard to what they are going to teach and how it is going to be delivered" (Individual interview, February 3, 2011). The majority of the time HS 2B or UNIV 2B is teaching a lesson. According to UNIV 2B, HS 2B normally begins the lesson as he is comfortable with that arrangement. In addition UNIV 2B believes the students respond better to HS 2B because he is younger. UNIV 2B explains the progression of the rest of the class:

> So we have a lesson that runs about an hour- HS 2B will be doing something and I will interject. When I get done with that, he will pick up again. And vice-versa…I will be teaching and he will be watching…HS 2B keeps me from going off the deep end and he will pull me back so that we will get back to the brass tacks... (Individual interview, January 29, 2011)

Both instructors report that while one instructor is engaged in delivery of information, the other instructor roams among the students.

Methods of Assessment

Concerning assessment, both HS 2B and UNIV 2B seem to agree that it has a lot to do with the engagement of the student. UNIV 2B explains that "… both of us observe the students…It's kind of an onsite real-time assessment that we're doing of the students' engagement in the process" (Group interview, June 1, 2010). An example

cited by UNIV 2B is the fact that they are able to see if a student's computer programming is accurate by the out-put that is produced in projects such as Excel™ fractal work, computer cars, and ability to read the binary clocks. Both teachers report that they are equally actively engaged in this ongoing assessment process.

Cohort 3A: HS 3A and UNIV 3A

Understanding of Program Purpose

HS 3A has an understanding that TGS is an enrichment opportunity that challenges students beyond what is offered in high school, providing a glimpse of what college might be. It helps broaden their understanding in various content areas. It allows them to think through problems on their own and then debate them "correctly to another peer" later (Group interview, May 25, 2010).

UNIV 3A believes that the purpose of TGS is enrichment in nature, as he wants the students "… to be able to argue and to understand the debate; to think from a logical point of view and look at open-ended questions" (Group interview, May 25, 2010). He thinks there is not enough discussion in public schools and the teachers often just tell the students what to do. The idea of enriching opportunities is what they have sought to create in their course.

Development of Curriculum/Lesson/Unit Planning

During the group interview UNIV 3A and HS 3A began talking about plans for the upcoming summer. This was their second face-to-face meeting. At one point during the interview, UNIV 3A stated he will email HS 3A notes from the previous years, and based

on that HS 3A can give ideas for more hands-on activities. UNIV 3A explained he is taking the lead on content selection because he thinks "I should, because I have already done it." At the same moment HS 3A pointed to UNIV 3A as the person who leads the content (Group interview, May 25, 2011).

HS 3A contributed ideas for possible labs (developing an ice core, lab for energy, and a lab about technology). Subsequently, none of the ideas manifested into actual course labs. Several times UNIV 3A was observed advising why the ideas would not work, but HS 3A did state "…so I think it's great that we can play off each other and refine your ideas, and it helps the kids too" (Group interview, May 25, 2011).

UNIV 3A's themes for the course curriculum center on fallacies about energy and energy consumption. He explains that he is trying to get conversations and debates going among the students. He believes this is beneficial to the TGS students because they are often not taught logic in high school, nor do they engage in debate over STEM related topics. To prepare the class for the topics he "... made a PowerPoint™ presentation with about 20 different fallacies with examples, and the students really enjoyed it" (Group interview, May 25, 2011).

UNIV 3A acknowledges the need for more hands-on experiments. He indicates that due to a late hire date just prior to the start of the program his first year, he was not able to implement as many hands-on activities as he would have liked. He acknowledges the feedback that he received from the students at the end of the program last year reinforced a need for less "lecture style" and "more participation and hands-on experiences."

Methods of Instructional Delivery

During the group interview UNIV 3A explained how instructional delivery was approached in previous years. Namely, UNIV 3A provided most of the lecture as the previous high school instructor preferred not to lecture. He would instead play “court-jester,” making faces, keeping students awake and engaged (Group interview, May 25, 2011). UNIV 3A further reported that the format of the class normally began with a question for discussion, and ended with a question that was to be considered and discussed in the following class session.

During their first year together, HS 3A had to take the lead the first two days while UNIV 3A was away at a conference. Because of this HS 3A thinks the "kids looked at me; Pecking order; they thought that I was the man in charge. When UNIV 3A showed up, he started taking over the lectures. He was the main lecturer and I was the trusted side-kick" (Individual interview, March 2, 2011). HS 3A observed that students continued to ask him questions and he in return would redirect the questions to make the students "realize that UNIV 3A was the main man too” (Individual interview, March 2, 2011). HS 3A goes on to report what evolved over the three weeks was that UNIV 3A took the lead and he would help as necessary. He would supply “relevant information” that he knew the students would be familiar with from the high school classes (Individual interview, March 2, 2011). He would also help answer student questions.

Methods of Assessment

When asked about assessment, UNIV 3A reports that he makes use of student feedback from previous years to modify plans for the course. Due to previous feedback

the class has evolved to incorporate hands-on experiments and projects to the classroom discussions that were already in place. UNIV 3A further adds that"...based on the feedback last year we had not only discussion, we also had a field trip and we also had hands-on experiments and a project for them to do something...you learn over a period of time and you use things that work and perhaps modify...if you feel that's not going to work, then you discard things that don't work and use something else" (Individual interview, January 30, 2011).

In terms of assessment through the use of technology, HS 3A suggests the use of Classroom Performance System (CPS) software for assessment to UNIV 3A during the group interview. Ultimately this did not transpire in the classroom plans and it is unclear as to why this did not occur.

Classroom Observations

Observational visits were made in the classrooms during the 2010 TGS session. The purpose of the visits was to note the instructional role of both the university and high school instructors. One visit was made to each of the cohorts during the three weeks of programming, totaling three visits to each cohort. Notation was made of what was occurring at three minute intervals during the 90 minutes of instruction. Instructional roles were divided into if the university instructor, high school instructor, or if both instructors were the primary instructional leader at a given moment. The “primary instructional leader” was denoted as the person at the center of instruction, be that lecture, demonstration, leading discussion, and so forth. Notations were also made stating what the other instructor was doing if s/he was not in the primary role at that

given moment. Figures 4 - 8 reflect what was observed in each classroom during the three visits.

The figures demonstrate what was observed during each of the visits. Classes that were more lab oriented (1A and 2A) tended to have more equal distribution of co-leading on days with labs. The use of co-leading was also observed more often when the other classes were engaged in hands-on activities.

When lecture occurred, there was an identifiable primary instructional leader with the co-instructor adding occasional commentary. In the majority of the classes when lecturing occurred, the university instructor was the primary instructional leader. The exception to this was Cohort 2B where the high school teacher was the primary instructional leader, as noted in Figure 7.

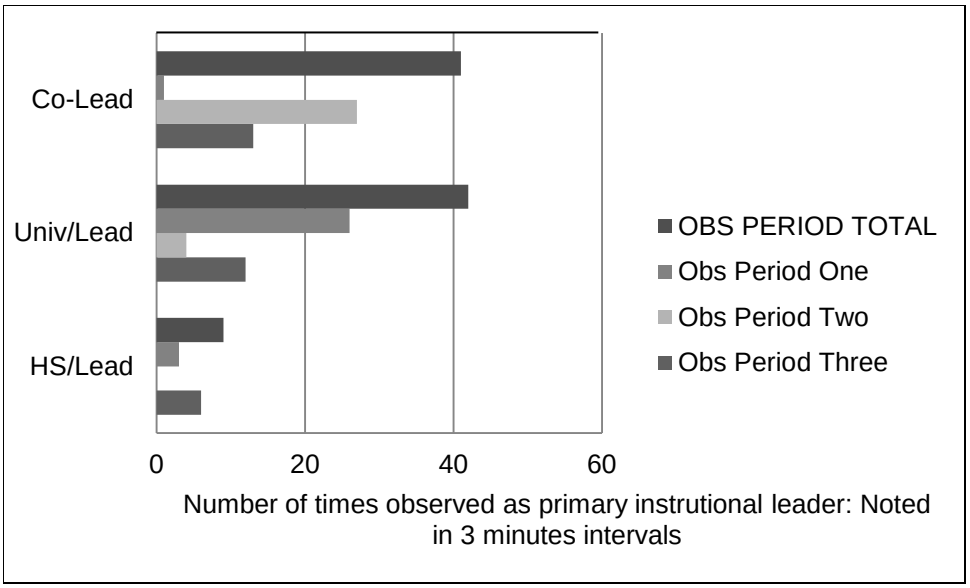

Figure 4. Cohort 1A: Observed instructional role in classroom.

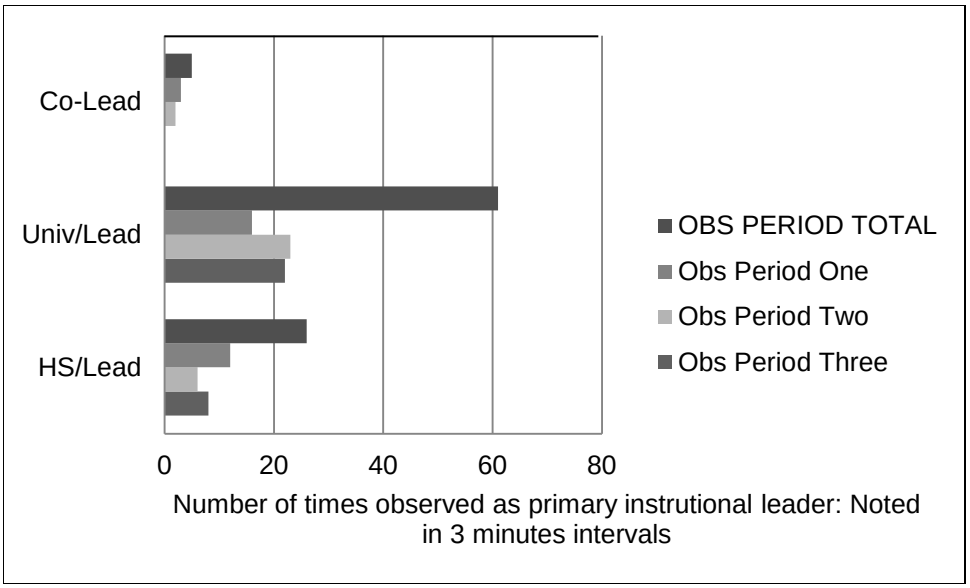

Figure 5. Cohort 1B: Observed instructional role in classroom.

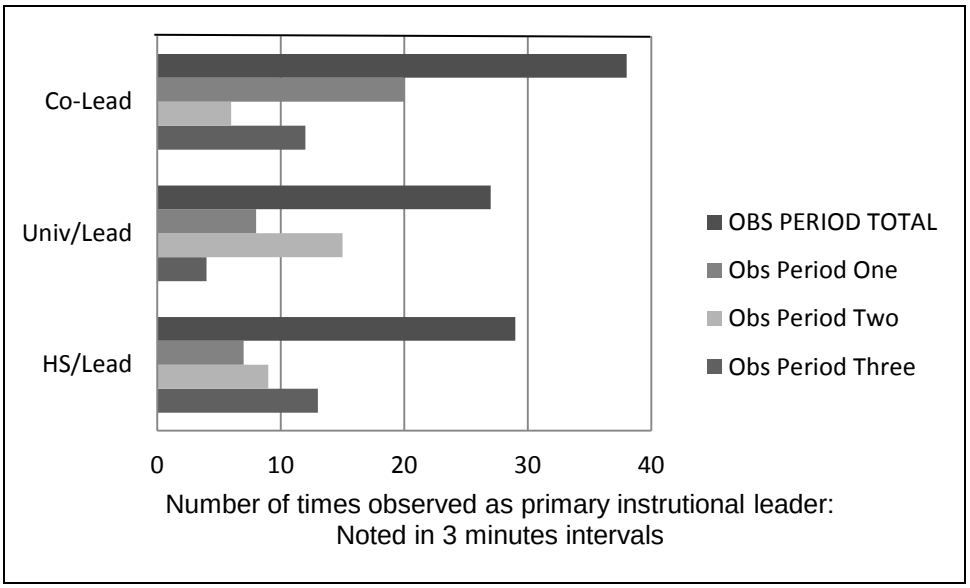

Figure 6. Cohort 2A: Observed instructional role in classroom.

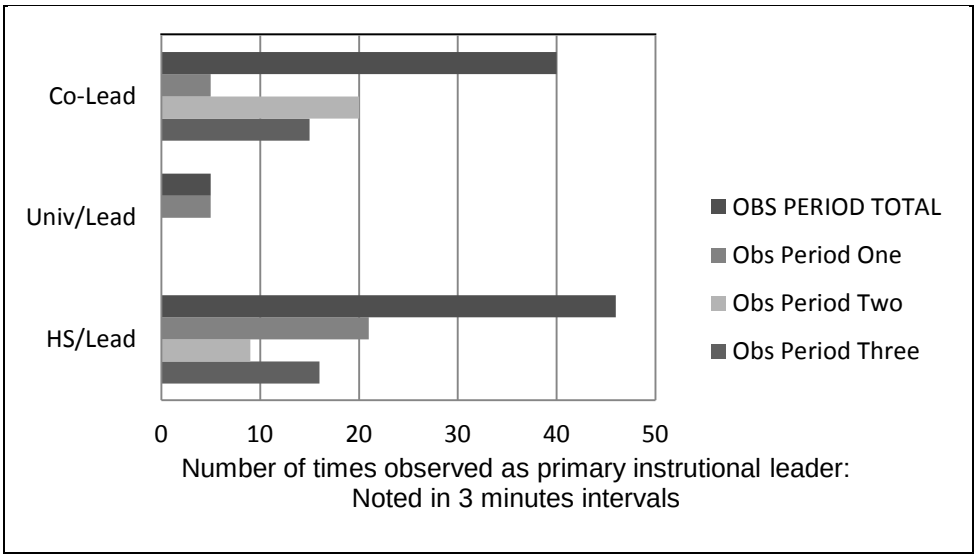

Figure 7. Cohort 2B: Observed instructional role in classroom.

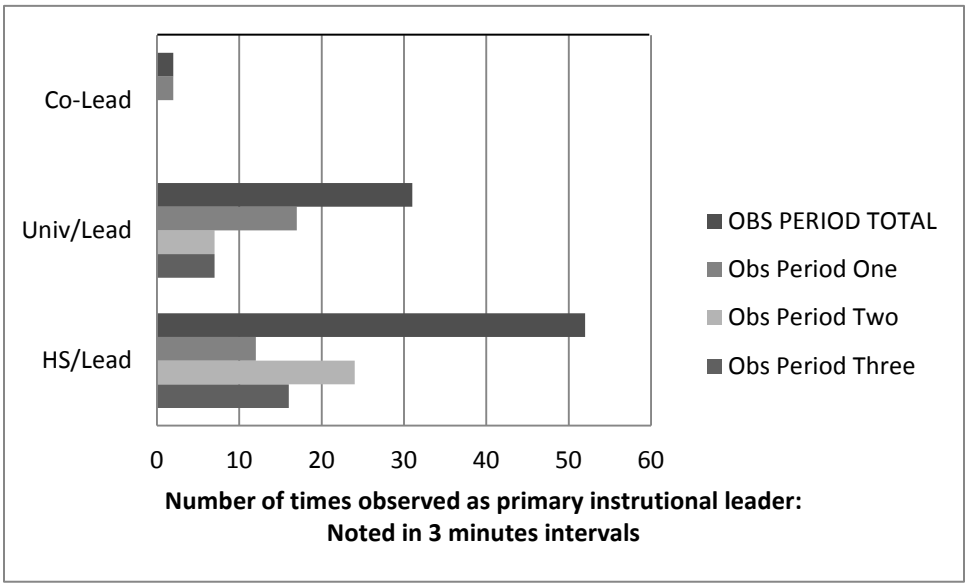

Figure 8. Cohort 3A: Observed instructional role in classroom.

Even with the instructional leader in place, in most classes the non-primary instructor added active commentary. These interactions are noted in Table 3

Table 3

Number and Percentage of Interjections by Non-Instructional Leader during Classroom Observations

Cohort / Instructor	Total number of times not in the lead-instructor role	Total number of times interjection is made while not in the lead-instructor role	Percentage of interjections made while not in the lead-instructor role
1A/University Instructor	9	3	33%
1A/High school Instructor	42	27	64%
1B/University Instructor	26	10	39%
1B/High school Instructor	61	30	49%
2A/University Instructor	29	9	39%
2A/High school Instructor	27	11	41%
2B/University Instructor	46	11	24%
2B/High school Instructor	5	0	0%
3A/University Instructor	52	13	25%
3A/High school Instructor	31	8	25%

An exception to this was noted in Cohort 2B. As noted previously, the high school teacher served as the primary instructional leader more often than the university instructor. However, he did not interrupt or add commentary whenever the university instructor served as the primary instructional leader.

Information gleamed from high school instructors' 2010 program year journals reported similar roles as observed in class. Part of the journal's daily protocol was to state what role(s) they played in the class on a given day. Figure 9 reports the combined percentages from all of the cohorts for the types of instructional roles undertaken each day during the three weeks.

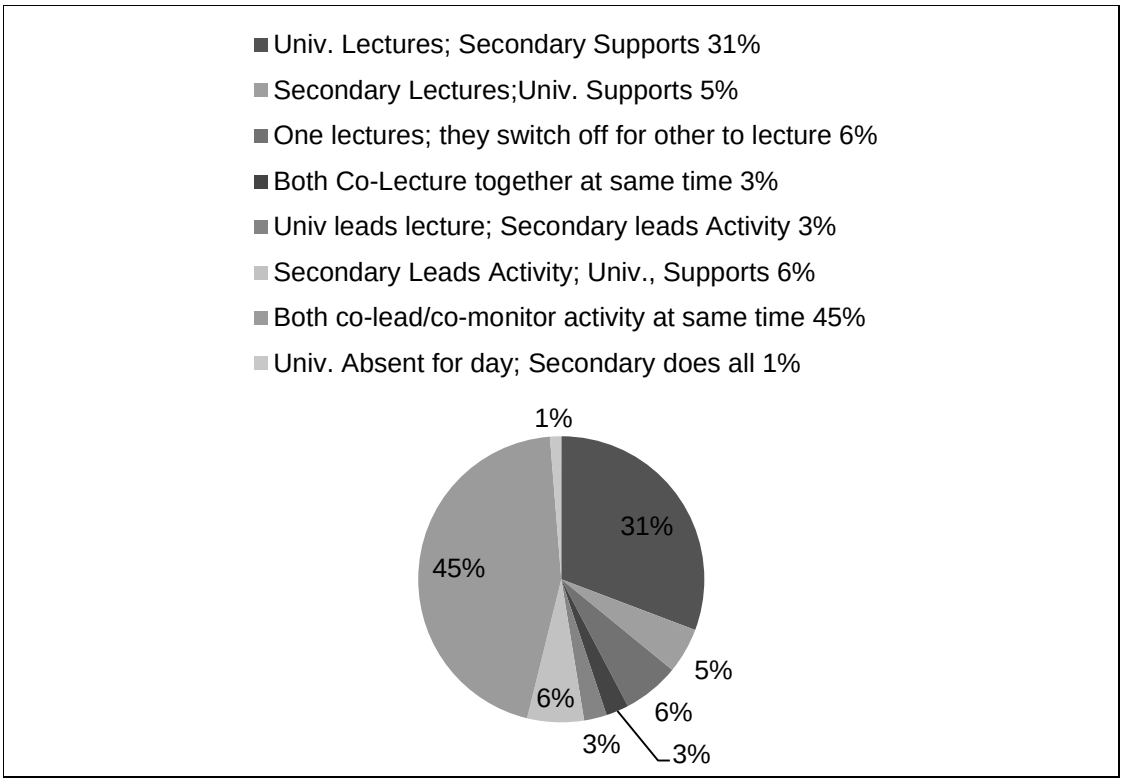

Figure 9. Instructional roles reported in high school instructors 2010 program year journal: Combined totals from all cohorts.

Data show a predominance of co-leading/co-monitoring activities (45% of the time), followed by the university instructor leading with the secondary teacher supporting (31% of the time).

Data for Research Question 3

Research Question 3: What perceptions do team members have of the types and significance of problems that arose (if any) and how each member worked to resolve the problem?

Data for this question are divided by cohort in terms of each participant's response as to how they normally respond to problems, how problems were handled if

they arose at TGS, and examples of specific TGS problems and their resolutions, if any examples were given by the participants. Also related to this question are the results from the Myers-Briggs Type Indicator (MBTI) completed by the instructors. As stated in Chapter 1, the functions thinking/feeling and judging/perceiving are specifically linked to how people perceive and react to conflict. The results from these components of the participants' MBTI are listed in Table 4.

Table 4

Instructor's Myers-Briggs Type Indicator (MBTI) Results

Cohort	High school Instructor	MBTI Result	University Instructor	MBTI Result
1A	HS 1A	ENTP	UNIV 1A	ENTJ
1B	HS 1B	INFP	UNIV 1B	ESTJ
2A	HS 2A	ISTJ	UNIV 2A	INTP
2B	HS 2B	INFJ	UNIV 2B	INTP
3A	HS 3A	ESTP	UNIV 3A	ENTJ

The Myers-Briggs functions, thinking/feeling and judging/perceiving, are specifically linked to how people perceive and react to conflict as they provide insight into how a person prefers to make decisions (thinking/feeling) and how one prefers to deal with the outer world (judging/perceiving) (Killen & Murphy, 2003).

The results from the MBTI (Table 4) for the thinking/feeling categories are as follows: three of the high school instructors scored "T" and two scored "F." However all of the university instructors scored "T." Three of the high school teachers scored as "P," while two scored as "J." Results for the university faculty members resulted with three scoring "J" and two scoring "P." Interestingly, each cohort (high school/university team)

scored opposite from one another in the area of judging/perceiving. This presents teams in which one (J) prefers to get things decided, while the other (P) is open to additional exploration and information (Myers & Briggs Foundation, 2003).

Cohort 1A: HS 1A and UNIV 1A

HS 1A believes conflict can be minimized when one is up front with one's expectations. HS 1A thinks there are no real issues in terms of working with UNIV 1A. He equates this to the fact that they are both "easy-going." "If I think it's important, he'll think that it is important. And if he feels there is a topic, I know it will help their success as well" (Individual interview, January 27, 2011).

When it comes to problems or conflict, UNIV 1A tries not to put so much "self" into every situation. If something doesn't directly affect him, UNIV 1A lets it go and moves on. When working together, UNIV 1A reports that "both of us are very respectful of each other and each other's time when we are trying to discuss together…We have never talked over each other" (Individual interview, February 17, 2011). When asked if he recalls a problem that they had to solve, he reports that there was never any "real conflict." He credits this in part to HS 1A, as he considers that HS 1A gives him a lot of "leeway," pulling back and allowing UNIV 1A to guide the lecture and class. However, when HS 1A sees that perhaps students are struggling, he will inform UNIV 1A that "I think that is where it falls on UNIV 1A to try and go back after class and say you had this question, and I think where you are coming from is this, then we spend 10-15 minutes talking about it, and then kind of let it go" (Individual interview, February 1, 2011).

HS 1A's MBTI results of ENTP measured very closed to UNIV 1A's results of ENTJ. This presents two very similar personalities with one indicator difference. The

Judging/perceiving results may suggest that HS1A prefers to interact with the people and situations in a flexible manner, whereas UNIV 1A prefers a more statured approach towards problem solving (Myers & Briggs Foundation, 2003).

Cohort 1B: HS 1B and UNIV 1B

UNIV 1B reports that they regularly talk things through with one another. In short conversations about upcoming activities for the day, they remind one another what has and has not worked well in the past. UNIV 1B does not recall a time where "…we ever we say, 'No, I don't think that will work'" (Individual interview, March 1, 2011).

HS 1B reports that there is mutual respect between the two of them. When asked about problem solving, HS 1B explained, "I work with people to where there is no conflict. I present my concerns in a non-confrontational manner. It's a balancing act, it's how I approach him (UNIV 1B) with the problem ...'Hey UNIV 1B, you've lost the kids', where I am not causing a conflict; I believe we don't have many conflicts" (Individual interview, January 28, 2011).

MBTI results for HS1B resulted in INFP and in ESTJ for UNIV 1B. Interestingly, each indicator is the exact opposite from one another, a fact that both of them found amusing. They commented that perhaps they balance each other out. The judging and perceiving indicators (the ones of interest concerning problem or conflict resolution) may suggest that HS1B is more flexible when approaching problems, where as approach situations with logic (Myers & Briggs Foundation, 2003).

Cohort 2A: HS 2A and UNIV 2A

When there is a problem, UNIV 2A reports that HS 2A might say, "This isn't working, and I say, 'Yeah, this isn't working.' It doesn't really illustrate a difference of

opinion, but it does illustrate how we handle things…We move on" (Individual interview, March 8, 2011).

HS 2A reports that over the years she has learned "… to look for middle ground, because I know that when you insist on one way - it's your way or the highway - all you do is make people feel bad...I think I am more diplomatic than I once was" (Individual interview, March 5, 2011). HS 2A reports that she and UNIV 2A have never really had any difference of opinion on how things should be accomplished. In her words, "…I am not sure how we decide, but mostly we integrate. It's not my way or his way. Usually we bit and piece it" (Individual interview, March 5, 2011).

The results for HS 2A were ISTJ, while the results for UNIV 2A were INTP. In terms of approaches in life and problems both do so in a logical manner. Base upon the MBTI indicator, HS 2A is apt to be less flexible that UNIV 2A when it comes to decision making (Myers & Briggs Foundation, 2003).

Cohort 2B: HS 2B and UNIV 2B

In terms of sorting out their differences, UNIV 2B reports it really is not an issue, as "HS 2B is really laid back, and I am really a calm sort of person" (Individual interview, January 29, 2011). HS 2B reasoned that due to their ties as in-laws, they have had time to work out differences. "We are on the same page, certainly, even when we decide what to do it is more brainstorming than choosing one…"(Individual interview, February 3, 2011). When UNIV 2B was asked if they had incurred any problems, he replied, "Nope, not had any. As far as difference of approaches or ideas...I think we are both collaborative…there just have not been any frictions" (Individual interview, January 29, 2011).

MBTI results for HS 2B INFJ and INTP for UNIV 2B. Based on the results, INFJ gives consideration to people and situations when processing problems. Interestingly, as a INTP, UNIV3A approaches problems with more of an analytical or critical sense (Myers & Briggs Foundation, 2003).

Cohort 3A: HS 3A and UNIV 3A

In terms of dealing with problems, UNIV 3A explains that he is very open and states the facts. He goes on to elaborate that "…I am passionate about what I do...When I am doing I want to take it to logical conclusion. I want to see whether my hypothesis is correct." When asked if there were any problems during the last program year, UNIV 3A replied, "If we have different positions, there were very few, then we just talked. Why I said what I said, and why he said what he said." He later added, "We never did come across where either one or the other disagreed with the other person's position because the explanations made sense. I don't recall any situation where we said, 'You are entitled to your opinion, and I am entitled to mine'; it has never come to that at all" (Individual interview, January 30, 2011).

When asked how he handles problems when they arise, HS 3A explained, "I find hard to be out of the box to other colleagues and students. I like to candy-coat and be diplomatic in the way I handle those types of situations" (Individual interview, March 2, 2011). In terms of problems occurring during the previous TGS program, HS 3A reported that he and UNIV 3A"…got together really well - no conflicts that I can think of." The only disagreement, so-to-speak, that HS 3A recalls is when UNIV 3A disagreed with the data that HS 3A presented and quickly stated so in class. Post class HS 3A located the article and shared with UNIV 3A, but discussion went no further than two

people discussing what they individually read. HS 3A thinks overall they have worked really well together. HS 3A attributes this to “starting off so well” and having “such laid back personalities" (Individual interview, March 2, 2011).

HS 3A’s results of ESTP suggest that he tends to focus on the here and know. He is flexible when it comes to planning, UNIV 3A reports to be a more enjoys long term planning, but can be forceful in his approach (Myers & Briggs Foundation, 2003). This could impact how decisions are made between this cohort should he choose to be overly influential in the entire decision making process.

Data for Research Question 4

Research Question 4: What perceptions do team members have of the strengths and weaknesses of the STEM/TGS program, in general, and of the collegial teaching team approach, in particular?

Data for this question are divided by cohort and follow the question in terms of each participant’s response about perceived strengths and weakness of TGS and collegial-team teaching.

Cohort 1A: HS 1A and UNIV 1A

HS 1A reports that an up-side to team teaching is that it provides him “…the opportunity to do things that I do not get to do throughout the course of my year; it lets me tie the stuff they are familiar with to what UNIV 1A is doing in the college classes he is teaching" (Individual interview, January 27, 2011). HS 1A goes on to explain that through collaborating with UNIV 1A, they are both able to bring their own experiences to the TGS classroom. UNIV 1A offers real life application from the perspective of a

researcher and university instructor, while HS 1A offers a high school perspective. HS 1A thinks both are equally needed, for a while UNIV 1A is able to add higher content insight to the class, "UNIV 1A sometimes struggles to get it across to the high school student, but that is where I come in real handy" (Individual interview, January 27, 2011). Together they are able “to nicely cover things and the kids tend to get the content really well" (Individual interview, January 27, 2011).

In terms of the positive effects of teaming with a high school instructor, UNIV 1A first refers to the factor of time. Because of the extended teaching relationship that the two of them have established over the past four years, UNIV 1A reports, "HS 1A has gone over and over this cycle with me, and he has learned it all.” UNIV 1A further states that because of what each instructor offers, "Without the collaboration, this (TGS) experience would not be possible" (Individual interview, February 17, 2011).

When asked about weaknesses of TGS or teaming, HS 1A identified what he saw as not a weakness but a difference of livelihood, a different frame of reference. UNIV 1A is fighting for dollars for research to be able to create new ideas and apparatuses. HS 1A's job is to "facilitate the love of learning and facilitate real enjoyment of what happens around us" (Individual interview, January 27, 2011). "UNIV 1A is a technology guru. He likes to dive in and mess with it. I like to understand and then show other people how to understand it - I don't have time to figure out the technology" (Individual interview, January 27, 2011). He believes this difference actually enhances the program. UNIV 1A expresses a similar idea concerning perspective in a different manner. When asked the same question, UNIV 1A replies that because of what each instructor offers in terms of each person’s individual talents, it balances his

own weaknesses. His talent is not classroom management and, "I think most professors would be frustrated; I couldn't do this by myself; there are too many kids" (Individual interview, February 17, 2011).

Cohort 1B: HS 1B and UNIV 1B

Asked about the strengths of TGS in general and teaming in particular, HS 1B stated that central to the idea of strength in team teaching is the idea of respect. UNIV 1B has had respect for HS 1B's contributions. "What I brought in we worked and hammered together…UNIV 1B respected my part of the contributions and let me teach the ways that I felt were best for the kids" (Individual interview, February 24, 2011). Similarly, when UNIV 1B was asked about the strengths of TGS and teaming, UNIV 1B reflected upon the aspect of respect. "We appreciate each other...he appreciates what I go through in my academic career, and I appreciate his. I think if either one of us was stubborn it would not work out" (Individual interview, March 1, 2011).

Another strength that UNIV 1B reported is HS 1B's ability to jump in and say something funny and help the students remember something that they have learned previously in their high school class. "I need HS 1B there, and I need a funny guy; a person that can communicate with the high school kids. If it was only me there, the class would be chaos; I am pretty sure about that" (Individual interview, March 1, 2011).

UNIV 1B also acknowledges the language gap between himself and the students due to the jargon in his field. Similarly, UNIV 1B does not understand some of their language such as *ninja*, or someone that is quick and stealth. Tim is able to bridge the language gap both ways. UNIV 1B believes teaming is beneficial in the friendship with HS 1B. He is able to learn from friends with no pressure, able to learn information, and

thinks this is more sustainable than listening to lectures, going to lecture, taking notes, as those may not be sustainable for too long.

When asked about the weaknesses of teaming, HS 1B replies that it has to do with things in the classroom; "Just the normal issues…things that UNIV 1B and I understand…when the lecture goes too long, when ideas get too abstract. But those are far and few between…we have hammered those out." He also adds that he could see problems arising if teams did not have respect as he and UNIV 1B do. “It’s just the comfort and the trust....does the team have enough respect to recognize what each person brings to the table” (Individual interview, February 24, 2011).

UNIV 1B notes that a possible weakness is newer university faculty who do not have tenure would be less likely to undertake an opportunity such as TGS because they might lose the time to research or write over the summer. Yet, the opportunity is clearly beneficial to him. "I am talking to the kids; I am sharpening my skills to give presentations…it is a win-win situation, and it is sustainable…I think that is why I continue to come back, and why the team works, why the students are happy, and we are happy...I think it is all tied together" (Individual interview, March 1, 2011).

Cohort 2A: HS 2A and UNIV 2A

According to HS 2A, a positive aspect of teaming is that the students enjoy multiple perspectives. "I think they like the idea that both people have different areas of expertise." While the faculty members' high-level of content knowledge is valuable, equally valuable is HS 2A's "understanding for teenagers and classroom management stuff; the university instructors had no idea" (Individual interview, March 5, 2011). UNIV 2A noted the advantage of the use of teaming in terms of the student-teacher ratio. "Two teachers in the classroom work really well because the student-teacher ratio is so much more in the favor of the students. I guess I wouldn't want to do the hands-on component myself because that is just a lot of students to get to" (Individual interview, March 8, 2011). UNIV 2A further added that he would not have attempted as many fieldtrips or field experiences if he had not had a colleague to assist him.

HS 2A did comment that in the past program reviews a few students had commented that "Sometimes they get aggravated with me, and some kids have even commented in their evaluation that I am superfluous. I don't need to be there" (Individual interview, March 5, 2011). She thinks this may be in part due to her role as the disciplinarian at times in the classroom. This perhaps frustrated them, creating the response in the evaluation. However, overall, she feels most students appreciate her presence in the classroom.

Cohort 2B: HS 2B and UNIV 2B

The familiarity with high school students is a positive aspect to teaming noted by HS 2B. He suggests the university faculty members "… would have struggled without having a high school teacher there because they really wouldn't know what the high

school students have had, what their backgrounds are because their backgrounds are all different…It takes a high school teacher to put that all together...especially mathematics" (Individual interview, February 3, 2011). HS 2B also thinks the students enjoy having two teachers in the room and are able to observe the “back and forth” that creates a fun learning environment.

When asked about the negatives of teaming, HS 2B’s only comment was that "UNIV 2B tells me he feels guilty because I am doing all of the work, but that is not really true" (Individual interview, February 3, 2011). UNIV 2B could not name any negatives.

Cohort 3A: HS 3A and UNIV 3A

UNIV 3A considers it positive to use teaming at TGS. He admits that he can at times “become very professorial.” By having a high school teacher present, UNIV 3A thinks they are better able to “hold the attention of the students" (Individual interview, January 30, 2011). UNIV 3A later indicated that in terms of weakness, he was more “nervous about how he will be perceived by the students.” However, having a high school teacher in the classroom was good for UNIV 3A, as it has helped him communicate in a “simpler language.” In turn, UNIV 3A thinks he has been able to share his own content knowledge with HS 3A. (Individual interview, January 30, 2011. HS 3A comments he and UNIV 3A have a good working relationship, but "could see if you had a bad partner, it would not work as well" (Individual interview, March 2, 2011).

Data for Research Question 5

Research Question 5: What perceptions do team members have of their own professional growth (in content knowledge and pedagogical knowledge/skills) as a result of participating in a collaborative teaching experience?

Data for this question are divided by cohort and participant, capturing their responses to insights about their own professional growth in content knowledge and/or pedagogical knowledge/skills.

Cohort 1A: HS 1A and UNIV 1A

A benefit of TGS noted by HS 1A is that it puts him in contact with “like-minded individuals and with the professors.” He has found that this contact has provided him the opportunity to engage in a variety of conversations, “whether it is philosophical, whether it is the curriculum, they will discuss it with you” (Individual interview, January 27). He further elaborated that these conversations are often at a high level. He believes these are more valuable than some of the professional development training that he receives. The level of the material and the ideas gained at TGS help motivate him, which in turn helps him motivate his students.

In terms of professional growth, UNIV 1A reports he found some of the questions he is asked by TGS students are a challenge. He comments that “… they ask questions that I have not really thought of and then I either have to make a connection, or I have to go and figure it out" (Individual interview, February 17, 2011). He further elaborates that due to the interactions with the TGS students who come with a variety of educational experiences, he has a better appreciation for the differences of content

knowledge that they possess. This in return has given him insight and a better understanding that his undergraduate students may have gaps in their educational foundation for chemistry. He observed how HS 1A filled in the gaps of the TGS students during the lectures and labs, and he has adapted such measures to assist his students better. He reports that he is "more tolerant and compassionate, and much of that has been from working with TGS. I wouldn't have done this before, and my life would still be pretty black and white, which is OK…but now I have some gray" (Individual interview, February 17, 2011).

Cohort 1B: HS 1B and UNIV 1B

When asked if he thought TGS has had any impact on his own professional development, HS 1B gave a laugh followed by a resounding “Yes!” He then went on to explain how working with UNIV 1B has given him validation for what he does as a teacher day-in and day-out in his classroom. "It has given me the confidence to do my thing. To have someone of UNIV 1B's caliber to work with and be able to say what we can do with this and talk to me on a professional level as to what we plan to do, it's given me a confidence in my abilities and teaching style" (Individual interview, February 24, 2011).

In terms of working with UNIV 1B in the area of nanotechnology, HS 1B states he has seen how UNIV 1B demonstrates things that we interact with each day, such as the iPhone® can be used to explain the intricate technology of the field. Now HS 1B has an appreciation for the "…application of the information; we take something that everyone already knows, and find a new way to put it to use…It is not the content, but the application of the content…When we are talking about circuits, we then are able to talk

about so many applications of things...I mean, you normally don't get that type of information" (Individual interview, February 24, 2011). He found that he is then able to take this new understanding back into the classroom and make physics a more applicable subject to his high school students.

UNIV 1B also reports professional development benefits from working with HS 1B. He states that he has learned a lot from HS 1B, and HS 1B has learned a lot from him. By working together, he has learned a lot about communicating with high school students and has applied this knowledge to talking to people in general who are less familiar with the fields of nano- and micro-technology. He has also gained a variety of techniques about getting people to talk about themselves and what they want to know from HS 1B. He sees application for this in the marketing that he must do with his nano and micro technology. UNIV 1B thinks this “gaining of insights” is a direct result of working one-on-one with a partner, and would not have occurred in training that was a workshop, lecture, and so forth (Individual interview, March 1, 2011).

Cohort 2A: HS 2A and UNIV 2A

HS 2A thinks TGS has impacted her professional development. She says that "In professional development it is hardly ever practical things that you try, so there's that benefit. This is what I am doing. And then you get immediate feedback...if you have an idea, you can try it, the kids will like it or see if it will get an idea across, you find out immediately” (Individual interview, March 5, 2011). She elaborates further by explaining that she is allowed to do the type of education that she would love to do in her classroom each day; this centers around asking the students, “What do you think” and “How do you think that is going to work.” Specific content knowledge that she has

gained from UNIV 2A through TGS includes plant life ecology and the impact of flora on the environment.

For UNIV 2A, the professional development that he has experienced centers namely on pedagogical practice. Working with HS 2A and the TGS students has given UNIV 2A insight into the limited access that the high school student may have for equipment. In return, he states that in some of the undergraduate courses he now has "spent more time going over how things should be used and what they can be used for rather than assuming that the students have already had access to them. But I try and do so sensitively" (Individual interview, March 8, 2011). In terms of content, he did learn about paper making, which may be an area to explore in his undergraduate classes. Beyond that, UNIV 2A reports that he has not particularly deviated from the content that he normally covers in his university classes. He did add that he thinks TGS is not advancing his career as it focuses on research and writing, "but this has the paycheck, and the work with the kids is a nice break from what we normally do."

Cohort 2B: HS 2B and UNIV 2B

In terms of gains in the area of professional development, HS 2B reports that he has learned about “building an interval from scratch; his continuous fractal lesson that he does…gained from watching him do it." He thinks he has not made any gains in his professional growth due to teaming in the area of pedagogical practice. HS 2B reports that both university faculty members are lecture driven, and he already knows how to lecture. Adversely, he believes he has impacted both of the university faculty members with whom he has worked as he was able to model different instructional styles beyond lecture.

UNIV 2B thinks he has grown professionally through his involvement in TGS. Without the task of assigning grades, he has become more in-depth at “motivational teaching” in which he can encourage enthusiasm for learning simply for the sake of learning. It has also provided him the opportunity to become more familiar with how the high school students are acting and what they know. It has helped him affirm an understanding that as a university faculty member he can reach across to the high school teacher. The high school teacher helps provide a more realistic view of the mathematical backgrounds of the students.

In terms of instructional pedagogy, UNIV 2B says that he has been teaching so long that he has already tried everything under the sun. However, teaching at TGS has given him exposure to and a new appreciation for different types of students, as the TGS population is more diverse in terms of cultures, ethnicities, and socio-economic status than the university population of the students with whom he normally teaches. In addition, UNIV 2B states that he has “"…learned to deal with different types of people. Dealing with the kids at this age and in this kind of setting, I think, has caused me to modify my attitudes, modify my approaches to teaching in particular." He offers a more philosophical wisdom to the TGS students; a motivational approach to engage them and get them excited about math. He further reports that "this has been good for my perception, my acceptance of the diversity of populations" (Individual interview, January 29, 2011).

Cohort 3A: HS 3A and UNIV 3A

HS 3A has gained content knowledge about energy and the future through TGS. He also notes that the TGS experience has reinforced what he was already hearing in

terms that students are “…not as academically prepared as prior generations." That has inspired him to "redouble his efforts" and "hopefully better train high school kids, giving them a more realistic expectation of what is coming up" (Individual interview, March 2, 2011).

UNIV 3A states that he has grown professionally in terms of “classroom management." He has had the opportunity to see how the high school teachers keep the students engaged in the lesson. One such method that he has attempted in his university classes is trying different analogies to teach the students" (Individual interview, January 30, 2011).

Data for Research Question 6

Research Question 6: What perceptions do team members have of the impact of their collaborative experience on their own teaching inside and outside of TGS?

Data for this question are divided by cohort and follow the question in terms of each participant’s response about perceived impacts of their collaborative experience on their own teaching inside and outside TGS.

Cohort 1A: HS 1A and UNIV 1A

Inside TGS, HS 1A indicates he has time at TGS to expand upon concepts that he likes to utilize in the Advanced Placement (AP) classroom but is not able to due to the time constraints presented in the high school setting. One example given was not having the time to slow down and really cover in-depth or the details of electrophoresis, a topic explored in depth at TGS.

Outside TGS, HS 1A found validation of what he is doing in his own AP classroom. He holds high expectations for his AP students and challenges them to scientific exploration by presenting a problem, having them hypothesize what the solution might be, and then allowing the students to test their hypothesis. He believes he is exposing his students to what is needed at the post-secondary level. He has observed that UNIV 1A uses this method not only with the TGS students, but also the undergraduate and graduate students. In addition, being with UNIV 1A in a working laboratory has assisted HS 1A in framing the AP students' thinking because "… it's been 15 years since I was in college, and this is much more current seeing what university researchers are doing in there…I have changed in terms of my labs. My labs are much more student and data driven than they ever were before" (Individual interview, January 27, 2011).

UNIV 1A says that within the TGS classroom he finds a renewed energy that he does not find in the university classroom. The enthusiasm and tenacity of the students make them enjoyable and a challenge to teach. He reports that each year at the end TGS, while he is physically fatigued, he has a renewed spirit. He is physically tired but not emotionally tired.

When asked about any impacts on his own teaching outside of TGS, UNIV 1A reports more tolerance for his undergraduate students. He reports that "I realize that my sophomores are going through the same learning process that the sophomores in high school are going through" (Individual interview, February 17, 2011). He elaborates further by explaining that while he maintains high expectation levels, he now points students to resources that might reinforce or fill the gaps in their own learning. He

further states that he thinks this approach is reflective in his end-of-course evaluations. Prior to TGS involvement he had low ratings, but since his involvement in TGS, they have progressively gone up.

Another reported impact is the continued contact with a few of the TGS students, with some enrolling in the University of North Texas (UNT) to study under him and conduct research with him. He has also worked with part of the TGS students who went on to enter the Texas Academy of Math and Science (TAMS) program at UNT. In the future he plans to explore collaboration with HS 1A for his AP classes, as the university and high school are in close proximity to one another.

Cohort 1B: HS 1B and UNIV 1B

Because TGS does not require exams or other types of student demands, HS 1B thinks he is in an environment where he can just teach and students are able to learn without pressure or stress. In terms of impacts outside of TGS, HS 1B considers it is not necessarily the content but the application of the content. He now challenges his students to think about where and how they see the application of different concepts using such accessible items such as his iPhone®. In terms of one-on-one collaboration with UNIV 1B, HS 1B reports that it is too busy, and “there is not a lot of time for collaboration" (Individual interview, February 24, 2011). UNIV 1B has attempted to embed jokes into his university lectures as he does at TGS, but they have not been successful.

UNIV 1B does attribute a change of perspective to TGS. He no longer assumes that everyone in his audience or business encounters knows what he is talking about. He has picked up how to "speak to layman in layman's terms to the public" and has

sharpened his skills as a salesman who is able to connect with the customer (Individual interview, March 1, 2011). He engages them in talking about themselves and then is able to access what they already know and need to know. He has learned this by observing HS 1B ask students questions that assist him in ascertaining exactly what the students know and what they want to know. UNIV 1B states that he will utilize this technique if he starts a company one day.

UNIV 1B has assisted high school students from TGS in his lab. UNIV 1B explains that if he had not observed the superior potential of the students during TGS, he would not have been open to the possibility of allowing them into his research laboratory.

In terms of team teaching, UNIV 1B does not think such collaboration would be successful because the time frames would not allow full coverage of material needed for the semester. As he explained, "…you cannot cover 90 minutes of material in 90 minutes while team teaching; rather you can only cover about 30 minutes of material in 90 minutes" (Individual interview, March 1, 2011).

Cohort 2A: HS 2A and UNIV 2A

Inside TGS, HS 2A reports that the collaboration she has engaged in at TGS has provided more content knowledge about botany as well as insights about the incorporation of more elaborate methods of using PowerPoint®. She has also gained awareness that things do not have to be planned down to the minute, or even to the hour. Outside TGS, HS 2A has independently researched botany on her own and is able to integrate it into her high school class. She is now able to answer questions in class that she was not able to address in the past. She further feels she is a little more

relaxed in the lab. She is more willing to step back and let students do their thing, not only as a directive. She will make suggestions but not begin by simply telling them "how". Finally, HS 2A has come to realize that students are expected to have a lot more knowledge than they do coming into college. A big one is the "ability to reason."

One area lacking incorporation from TGS into HS 2A's classroom centers on methods she has explored with the microscopes. She states "...we are so constrained in the classroom about what needs to be covered and by when; there is no time, and there are so many kids. There's no time to say, 'Hey, blow off the day' or to try and set up stations with the microscopes" (Individual interview, March 5, 2011).

At present, UNIV 2A has not incorporated a lot from TGS into his university classes. His classes remain more equally balanced between lecture and lab than the TGS class that is predominantly labs. "Some of these activities or exercises may find their way into the plant ecology course….really interesting is the trip up to the nursery…some of the videos that we have shown, it is good to see how these (TGS) students react, so we can gauge how our (university) students will react" (Individual interview, March 8, 2011).

Cohort 2B: HS 2B and UNIV 2B

HS 2B thinks collaboration has not impacted his teaching style because his co-teacher already knew his style and "defaulted: the high school curriculum to him." Often he would tell UNIV 2B what they were going to do (Individual interview February 3, 2011).

During his individual interview, HS 2B indicated that he did not include the materials into his high school classes because it's not "AP status" and he "just does not have enough time" to incorporate it (February 3, 2011).

UNIV 2B believes he has carried a motivational spirit gained from HS 2B into the classes he teaches at the university. He tries to explore mathematics more in-depth, making connections to real-life applications (Individual interview, January 29, 2011). HS 2B addressed some of the aspects of "motivation" that UNIV 2B had observed. HS 2B commented he thinks that in reality the instructional delivery at the college level is far less creative than high school due to the type of straightforward content that is covered. Even at the high school level HS 2B struggles to be innovative and not boring. He tries to find something from the book and somehow make an application that is cool and interesting (Individual interview, February 3, 2011). It is this methodology that UNIV 2B had been a part of at TGS and now seeks to replicate in his own university classes.

Cohort 3A: HS 3A and UNIV 3A

Within the TGS classroom, HS 3A enjoys the ability to collaborate with another instructor and "…really cover material, cover ground" with the students (Individual interview, March 2, 2011). This does not occur in his high school classroom.

Beyond TGS, HS 3A reports that this experience has given him the chance to reflect on how he relays information to his high school students. On occasion in the past, he had not recalled all facts correctly while presenting during class, and students would later come back and correct him. However, after working with UNIV 3A, he found the need to have the data entirely accurate. This has resulted in HS 3A being more apt to tell the students he is not sure at present and that he will get back with them.

One additional impact HS 3A noted is the utilization of people and resources gained through contacts made at TGS. He has taken a field trip with his AP classes to the university's science research park based upon contacts made with UNIV 3A and other university faculty members from the program.

Summary

The collaboration between a secondary teacher and university instructor as a collegial teaching team during a three-week mathematics and science residential program for high-ability learners provided an environment of mutual cooperation in which instructors were able to plan, implement, and assess challenging STEM related curriculum. This varied from what the instructors normally did in their high school or university classrooms in terms of content and instructional delivery. In general, this variance proved to provide satisfaction and enthusiasm amongst the instructional cohorts.

It appears that the collaboration did positively impact each team member's professional growth in content knowledge and/or pedagogical knowledge/skills. Overall, each team member's instructional practices inside reportedly changed to a greater extent than their practices outside of the TGS program. What is suggested is that the collegial teaming of high school and university instructors in a program like TGS is conducive and can serve as a model for professional development of both team members.

Themes that emerged from the data further assist in understanding and supporting the findings in formulating answers to the research questions. These themes, reciprocity, respect, flexibility, and time, aid in a more in-depth exploration of

what has occurred in the collegial teaming experience and how it supports this model for professional development and is further explored in the subsequent chapter.

CHAPTER 5

DISCUSSION

The purpose of this multi-case study was an examination of (1) the collaboration between a secondary teacher and university instructor as a collegial teaching team during a three-week mathematics and science residential program for high-ability learners and (2) the perceived impact of that collaboration on each team member's professional growth in content knowledge, pedagogical knowledge/skills, and on each team member's instructional practices inside and outside of the TGS program. The final chapter of this dissertation provides discussion of how the research questions relate to the themes of reciprocity, respect, flexibility and time that emerged from the data in this study and are, in some cases, supported by the literature. Recommendations for future studies are also given.

In this study, the research questions are:

1. What perceptions do team members have of themselves and each other (in terms of personality type, working style, teaching style, conflict resolution style, relative strengths and weaknesses in content knowledge and pedagogical knowledge/skills that each brought to the program)?
2. What perceptions do team members have of the roles that each team member played during the collaborative process (in curriculum/lesson/unit planning, instructional delivery, and assessment)?
3. What perceptions do team members have of the types and significance of problems that arose (if any) and how each member worked to resolve the problems?

4. What perceptions do team members have of the strengths and weaknesses of the STEM/TGS program, in general, and of the collegial teaching team approach, in particular?
5. What perceptions do team members have of their own professional growth (in content knowledge and pedagogical knowledge/skills) as a result of participating in a collaborative teaching experience?
6. What perceptions do team members have of the impact of their collaborative experience on their own teaching inside and outside of TGS?

Interpretation of the Findings

Data collected were coded, examined, and an analytical framework for this study was developed. What emerged were the four themes: reciprocity, respect, flexibility, and time. These themes assisted in exploring in depth the similarities and differences between collegial-teams' (a) perceived change in individual participants' thinking about their own planning/teaching inside and outside of TGS and (b) perceived change to individual participants' professional growth/development.

Each of the six research questions are individually addressed and related to the applicable themes. For the sake of discussion, figures that capture specific statements from the narrative reported in a larger body of data found in Chapter 4 have been used to illustrate and support statements of analysis found in Chapter 5. When relevant, references are made to research from the literature found in Chapter 2.

Research Question 1

What perceptions do team members have of themselves and each other (in terms of personality type, working style, teaching style, conflict resolution style, relative strengths and weaknesses in content knowledge, and pedagogical knowledge/skills that each brought to the program)?

To begin to understand the themes of this research, an understanding of the participants' perception of themselves, and their teaching partner was needed. In most areas individual qualities aligned with what the literature said about highly-qualified teachers of the gifted. Tables 5 and 6 demonstrate alignment of traits and behaviors of the highly-qualified teacher of the gifted with the instructors of TGS. Data for the tables were compiled by the researcher based upon observation and interviews with the participants of the study. The instructors may possess some of the other characteristics of highly-qualified teachers of the gifted, but characteristics were only included if they were demonstrated during the study.

All of the instructors possess the qualities needed to work with gifted students such as the high-ability high school students who attend TGS. However, the traits and behaviors listed in the tables are also reflective of good teachers in classrooms where they are the sole instructor.

Table 5

Traits and Behaviors of the Highly-Qualified Teacher of the Gifted High school Instructor

Traits & Behaviors of the Highly-Qualified Teacher of the Gifted	High school Instructors				
	HS 1A	HS 1B	HS 2A	HS 2B	HS 3A
High Intellectual Capacity (Robinson, Shore, & Enersen, 2007; Goodhew, 2009; Borland, 1989; Seely, 1989).	X	X	X	X	X
Personal Goals/High Achievement (Goodhew, 2009).	X	X	X	X	X
Passion for Learning (Goodhew, 2009).	X	X	X	X	X
Intrinsic Enthusiasm for Learning/Extensive Knowledge of their Field (Goodhew, 2009; Robinson et al., 2007; Borland 1989).	X	X	X	X	X
High Standards and Expectations for Students (Goodhew, 2009; Tomlinson, 1995; Wendel & Heiser, 1989).	X	X	X	X	X
Flexibility of Activity and Thought (Wallace, Leyden, Montgomery, Winstanley, Pomerantz, & Fitton, 2010; Goodhew, 2009; Tomlinson, 1995)	X	X	X	X	X
Environment Encourages Freedom of Thought and Expression (Turncliffe, 2010; Goodhew, 2009)	X	X	X		
Facilitator or Guide (Goodhew, 2009; Tomlinson, 1995)	X	X	X	X	
Tolerant of Diverse Answers and Theories (Goodhew, 2009; Tomlinson, 1995).		X			X

Note: The characteristics marked in the chart are the result of research interviews and observations.

Table 6

Traits and Behaviors of the Highly-Qualified Teacher of the Gifted University Instructor

Traits & Behaviors of the Highly-Qualified Teacher of the Gifted	University Instructors				
	UNIV 1A	UNIV 1B	UNIV 2A	UNIV 2B	UNIV 3A
High Intellectual Capacity (Robinson, Shore, & Enersen, 2007; Goodhew, 2009; Borland, 1989; Seely, 1989).	X	X	X	X	X
Personal Goals/High Achievement (Goodhew, 2009).	X	X	X	X	X
Passion for Learning (Goodhew, 2009).	X	X	X	X	X
Intrinsic Enthusiasm for Learning/Extensive Knowledge of their Field (Goodhew, 2009; Robinson et al., 2007; Borland 1989).	X	X	X	X	X
High Standards and Expectations for Students (Goodhew, 2009; Tomlinson, 1995; Wendel & Heiser, 1989).	X	X		X	X
Flexibility of Activity and Thought (Wallace, Leyden, Montgomery, Winstanley, Pomerantz, & Fitton, 2010; Goodhew, 2009; Tomlinson, 1995)	X	X	X		
Environment Encourages Freedom of Thought and Expression (Turncliffe, 2010; Goodhew, 2009)	X	X	X		X
Facilitator or Guide (Goodhew, 2009; Tomlinson, 1995)	X	X	X	X	
Tolerant of Diverse Answers and Theories (Goodhew, 2009; Tomlinson, 1995).		X			X

Note: The characteristics marked in the chart are demonstrated from research interviews and observations.

Co-teaching added an additional element to the quality of teaching in these classrooms. The additional factors of personality type, working style, teaching style,

conflict resolution style, relative strengths and weaknesses in content knowledge and pedagogical knowledge/skills present in the instructors who co-taught at TGS also influenced the quality of their teaching. In terms of Research Question 1, qualities emerged from the data that followed the themes of reciprocity, flexibility, and respect.

Reciprocity, with regard to having a mindset that is open to the association with another person for the purpose of exchanging ideas, appears to be a major factor in the amount and quality of the collaboration occurring among the instructors. The data in this research supported the conclusion that reciprocity in exchanging ideas occurred in each of the teams. Table 7 summarizes the data described in Chapter 4.

Table 7

Research Question 1 - Thematic Reference: Reciprocity

Participant	Quote
HS 1A	Is able to conceptualize for the students and "bridge the gaps" in understanding the content presented by his teaching partner
HS 1B	Reports that he and UNIV 1B work well and collaborate together and not as two egos battling one another
HS 1B	Both tend to be "critical" of themselves, but these high expectations resulted in each adapting parts of the course back in their own teaching settings
HS 2A	Focus their insights and work together to accomplish the task of curriculum development
HS 2A	Has come to understand U2A's limited knowledge of teenagers and their behaviors. U2A has a dislike for administrative responsibilities. HS2A handles these duties
HS 3A	Initially had apprehensions about his own content knowledge… noted that over time and with work with his partner these apprehensions lessened
UNIV 2B	Feels that he and HS 2B balance one another

Note: Source: Individual interview; Group Interview; Post Observation Interview.

The data in this study suggest these pairs of teachers found an advantage to working together and not allowing one ego to dominate the relationship. Each person added balance to the team with his or her own insights, experiences, and knowledge.

Flexibility in the relationship and the ability to adapt to changing situations or new demands was another quality that emerged from the data. The instructors either described themselves or were described by their partner as people who were flexible (Table 8). Flexibility in this context refers to not being rigid or set in one's ways, but to be more easy-going and willing to work and negotiate together. Terms used to describe this trait included "easy-going," able to "change on the fly," or "adjust quickly."

Table 8

Research Question 1 - Thematic Reference: Flexibility

Participant	Quote
HS 1A	Describes himself as upbeat and easy going
HS 1A	Has the "ability to change on the fly"
HS 1B	States that he is able to adjust quickly
HS 2A	Describes her co-instructor as easy going, making collaboration an achievable task
HS 3A	Tailors his teaching approaches in his classroom
UNIV 1B	Describes HS 1B as easy going and quick on his feet
UNIV 1B	Describes himself as easy going, flexible, able to collaborate with others, and open to new ideas
UNIV 1B	After the first day …ninety minutes of lecture material would not work … immediately began adapting his materials
UNIV 2A	Is willing to deviate from the lesson plans
UNIV 2B	States that advanced classroom preparation is beneficial

Note: Source: Individual interview: Group Interview; Post Observation Interview.

These characteristics of flexibility lend themselves to the teaching pairs adapting and deviating from lesson plans or tailoring teaching approaches to better meet the needs of their students. Most of the teachers in this study saw this as a positive trait, with one participant commenting on the need for advanced preparation to accomplish classroom goals. This matches other comments from various interviews that groups have a lesson plan in place as a guide for their classes.

A theme of mutual respect also emerged. This respect was in terms of how the teachers felt respected by their partner or as a desire to be more respected by that person (Table 9).

Table 9

Research Question 1 - Thematic Reference: Respect

Participant	Quote
HS 1A	Both instructors are respectful of each other and each other's time
HS 1B	UNIV 1B "…has respect for my contributions and let me teach the way that I felt were best for the kids."
HS2A	Feels that both instructors have mutual respect and recognition of one another's talents
HS 3A	Likes to work with mutual respect for one another, each appreciating one another's input
UNIV 1B	"We appreciate each other…he appreciates what I go through in my academia career and I appreciate his."
UNIV 2B	Colleagues relate to him with respect, like the "Oriental respect for the older guy"

Note: Source: Individual interview; Group Interview.

Several instructors noted both being respected and respecting their collegial partner for their contributions to the courses. One of the participants, who happens to be

the oldest and had the longest academic career, sensed that people who encountered him treated him with respect. The participant newest to TGS expressed the desire for mutual respect. Recognition and respect for mutual talents is essential for team members to effectively engage in collegial teaming.

The emergence of the themes of reciprocity, flexibility, and respect from the data and their relationship with Question 1 of this study aligned with the findings from the literature review. A mindset that embraces the reciprocal aspects of teaming is crucial for success in forming a viable team (Villa, Thousand, & Nevin, 2008). Teaching partners need to have a flexible attitude in order to meet the challenges they encounter in the teaming process (Duhardt, Marlow, Inman, Christensen, & Reeves, 1999). A feeling of respect is essential in terms of the instructors feeling they are a valued member of the teaming process (Cohen & DeLouis, 2001; Harris & Harvey, 2000). An understanding of the components that make up the team members' concepts of themselves and their partner is important in understanding the characteristics of the instructors and how they work as a team. While this study found that the instructors possessed many of the traits of highly-qualified instructors of the gifted, it also found that they have additional factors that are included in common lists of characteristics of good gifted teachers. These factors include not becoming entrapped by their own ego, respecting and accepting the input of others, flexibility and openness to new ideas, and having a sense of being respected, and being respectful of their partner. Instructors who were successful in the collegial teaming placed value on their own insights and knowledge, but also valued the insights, experiences, and knowledge of their partners. Their flexibility and openness to the exchange of ideas sets the tone for the

collaborative process and led to professional growth and development of both instructors.

Research Question 2

What perceptions do team members have of the roles that each team member played during the collaborative process (in curriculum/lesson/unit planning, instructional delivery, and assessment)?

The second research question for this project explored the perceptions team members had of the roles that each instructor played during the collaborative process. Data for Research Question 2 supported the themes of reciprocity, flexibility, respect, and time. The explanation of each theme is stated, followed by research support and is compiled from the illustrative narrative found in Chapter 4.

Reciprocity is the mutual give-and-take that occurs in collaboration. Instructors must be receptive to reciprocity in order for collaboration to occur (Villa, Thousand, & Nevin, 2008). Table 10 shows that reciprocity was evident and instrumental to the instructors in the various components of the collaborative process for their courses.

Table 10

Research Question 2 - Thematic Reference: Reciprocity

Participant	Quote
All	Mutual agreement of goals with their partner
HS 1A	The instructors shared concepts high-level kids might want to talk about; HS 1A provided a high school perspective
HS 1B	Year one UNIV B led the classroom instruction. Together they developed a basic outline of topics from information
HS 2A	University faculty member was not comfortable with the concept of high school students making use of the university laboratory
HS 2A	Teaching partner has been willing to teach her new content information
HS 2B	Lesson ideas originated from three family members, each a mathematician, discussing mathematical theories
UNIV 1B/HS 1B	Both contributed equally to conversation and mutually agree upon a plan
UNIV 3A/HS 3A	UNIV 3A explains that he is taking the lead on content selection …HS 3A points to UNIV 3A as the person who leads
UNIV 1A	Instructors meet together to plan and re-write the lesson plans
UNIV 1A	Planning is less formal; more of “a talk right after or before the class starts”
UNIV 1B	the “passing-off” of instructional delivery is effective
UNIV 1B	Instructors get into a "rhythm" of teaching during class and problems are discussed post class
UNIV 2A	“Tag-teaming” by both instructors; switching the role of lead instructor during class
UNIV 2A	Instructors talk at lunch about what did and did not work earlier in classroom
UNIV 2B	Instructors bring knowledge of subject matter and teaching skills
UNIV 2B	Exchanges are like instructional banter

Note: Source: Individual interview Group Interview: Post Observation Interview.

All teaching pairs reported developing the courses together. One pair indicated that the university faculty member took the lead in selection of the content. Another team reported that the high school teacher was able to insert a high school perspective into the college level content while another cohort stated that the university instructor was willing to teach the high school teacher information that was later presented in the class. Ongoing assessment for the revision or adaptation of materials, both prior to programming and during programming were mutually agreed upon by each team. A team member noted that if the university faculty member was not comfortable with adolescents, collaboration would not work. This was viewed as a deterrent to successful lesson implementation because the faculty member was not comfortable with the high school students' use of university facilities. Reciprocity as the mutual exchange of knowledge and pedagogy for the development of courses is a crucial element for the success of the TGS program model.

A common phenomenon both reported and observed was the "tag-teaming" or "passing off" of the role of lead instructor during the course of the class period. "Tag-teaming" illustrates the crucial element that reciprocity plays during instructional delivery and in the success of collegial collaboration. This construct of reciprocity aligns with the concept of "two-heads-are-better-than-one" (Villa, Thousand, & Nevin, 2008).

In Question 2, a key element related to the theme of flexibility was the development of an outline for lessons over the three-week program. The plans served as a guide, but did not necessarily dictate the flow of what occurred throughout instruction. Table 11 illustrates different ways this type of flexibility did and did not occur.

Table 11

Research Question 2 - Thematic Reference: Flexibility

Participant	Quote
HS 1A	Narrowed the focus as we moved through the session
HS 1B	Basically we whisper to each other during class, 'OK what's next?'
HS 2A	Previous university instructor not comfortable with the concept of high school students making use of the university laboratory…UNIV 2A is open to the use of labs.
HS 2B	"With our lessons, we don't just sit down and decide these are the ones we are going to do; we're just going to let it happen."
UNIV 1B	Quickly changed into project oriented content
UNIV 2A	Purposely do not rush the students, giving them the opportunity to "…stick with the parts of the exercises"

Note: Source: Individual interview; Group Interview; Post Observation Interview.

The instructors remained flexible in response to student engagement and revised what would occur during classroom instruction. Revision might occur after a fast whisper during class or during a post-class discussion when preparing for the following day (Table 11). This reorganization of instruction is a common characteristic of teaming (Griffith, 1973).

Time was another thematic factor that arose for this research question. Factor one was the physical time needed for developing and revising the course. Instructors reported that initially a large amount of planning time was needed in formatting the course (Table 12). This finding is consistent with the need for time to plan noted in the literature (Cohen & DeLouis, 2001; Duhardt, Marlow, Inman, Christensen, & Reeves, 1999; Harris & Harvey, 2000; Dieker, 2001). However, in the TGS program once the course was established and initial planning completed, less time was required for the

developing lesson plans. The post-class discussions between instructors took on a less formal format and occurred “on the fly” or “right after or before class starts (Table 12). This is contrary to Villa, Thousand, and Nevin (2008) who note that time is needed for continued planning. This may be due to the fact that the teaming referred to in this literature was aimed at a school-based, year-long program unlike the one-time attendance at TGS.

The second factor relates to the passage of time. This is important in how teams learned to operate and interact with one another in the classroom regarding instructional delivery since they have worked together multiple program years. Time also cements instructors feeling of self-worth and builds a sense of reciprocity and mutual respect needed for the teams to be successful.

Table 12

Research Question 2 - Thematic Reference: Time

Participant	Quote
HS 1A	This team of instructors often worked “…off the fly”
HS 1A	Planning is less formal and more of “a talk right after or before the class starts”
HS 1B	They “…pretty much went on the fly”
HS 2B	Interesting lessons were contained within a 90-minute time frame
HS 2B	At lunch we're just saying what we should do tomorrow
UNIV 2A	Planning ... bit rough due to the short amount of time before the program started…subsequent planning has been easier
UNIV 1A	Second year…meet together to plan and re-write the lesson plans

Note: Source: Individual interview; Group Interview; Post Observation Interview.

Respect is the next theme that emerged from the data for this research question. For effective co-teaming to occur the instructors indicated that mutual respect must be present. In Table 13 four out of the five cohorts gave credit to one another's talents and recognized the worth of each other. Working multiple years together as a team allows team members to more readily recognize their strengths and weaknesses. This is consistent with what was reported in the literature review in that the existence of mutual respect for one another's strengths was needed for effective teaming to occur.

Table 13

Research Question 2 - Thematic Reference: Respect

Participant	Quote
HS 1A	Is respectful that course content is UNIV 1A's territory…he feels it is proper that UNIV 1A takes the lead.
HS 1B	HS 1B follows UNIV 1B's lead in terms of content as "I'm still learning…"
HS 2A	… mutual respect and recognition that they share for one another's knowledge and the openness … exchange of ideas
UNIV 1B	"…HS 1B contributed ideas for involving the students and took on a more active role in the classroom…"
UNIV 1B	Is planning to add a lesson that originated from an activity that (HS 1B) does
UNIV 2A	HS 2A is more direct in dealing with student behavior and relies upon her to address such…
UNIV 2B	"...our course is the experience that both of us bring from the subject matter and from teaching."

Note: Source: Individual interview; Group Interview.

In terms of planning, instructional delivery, and assessment, the various interview data and the classroom observational data pointed to co-teaching approaches that fell within the categories of complimentary and team-teaching (Table 1). Both

teachers were equally involved in planning and assessment and participating while participating in hands-on activities such as labs the true co-teaching was in place. During lecture, a complementary model was followed with the university faculty member teaching the content and the high school teacher clarifying information. This format reportedly worked well, with both instructors believing that helped to “bridge” and “fill the gaps” for the students. Key to the concept of respect was that both instructors valued the input and role of one another. There were no superior/subordinate roles; each valued what the other offered to the class environment and saw each role as equally important to the overall success of the course and students. Such sharing is consistent with the concept of authentic collaboration described in the literature (Wild, Mayeaux, and Edmunds, 2008).

The interviews of the instructors reported an atmosphere of mutual collaboration and exchange during the instructional delivery. Both the classroom observational data and reports from the high school instructors’ journals assisted in substantiating these claims. The following table shows a compilation of this data shown in Chapter 4.

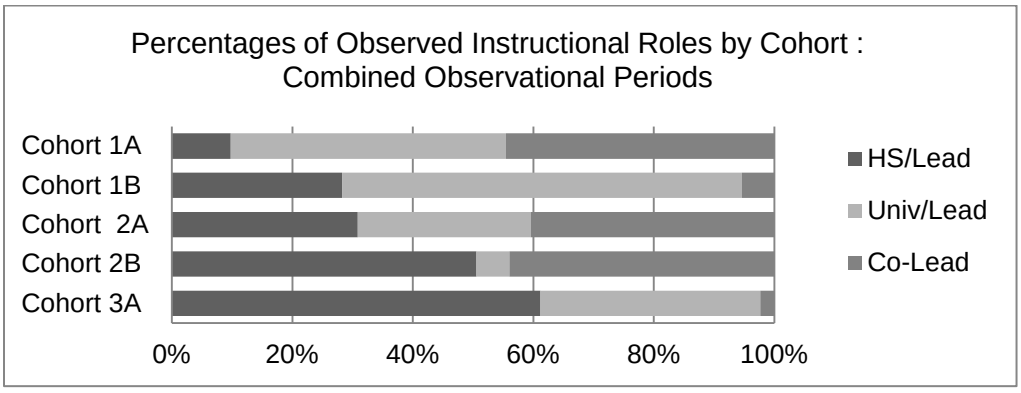

Figure 10. Percentages of observed instructional roles by cohort: Combined observational roles.

Figure 10 revealed that during these observational periods, opportunities existed for varying lead instructional roles within the cohort teams. The amount of time spent in specific roles varied between classes. Similarly, Figure 9 in Chapter 4 also revealed a variety of roles as reported by the high school instructors in their journal notes. In the majority of the classrooms while one instructor might be in the instructional leader role, the other instructor did not remain passive or non-involved, but felt free to add occasional commentary (Figure 3). This supports what was revealed through the narrative for this research question concerning reciprocity, mutual respect, and flexibility: the instructors believed that each of these factors must exist in their relationships as collegial-team members within a cohort.

All of the data related to this question showed that each team member perceived themselves as a part of a collaborative process which is also supported by the literature. In a program like TGS, instructors engaged in the collaborative process (in curriculum planning, instructional delivery, and assessment) are successful when they maintain an open-mind set and are able to remain flexible with one another. Initially, instructors need more time at the beginning of the planning stage, with less time as they repeated the course over multiple years. Time assisted them in establishing a working relationship and a strong curricular framework. Finally, a necessary element to positive collaboration was respect and recognition of each team member's strengths and weaknesses. It assisted them in developing reciprocity, respect, and flexibility as they instructed the high school students. This respect and recognition establishes an atmosphere in which collegial exchange and observation assisted in professional growth as instructors learned from one another.

Research Question 3

What perceptions do team members have of the types and significance of problems that arose (if any) and how each member worked to resolve the problem?

The themes of reciprocity, flexibility, and respect emerged from the data in reference to Research Question 3. The themes, supported by evidence of the data charted from Chapter 4, provided a clearer understanding of how teams dealt with the challenges they sometimes faced.

Reciprocity for this question referred to the types of actions or results occurring when the group members encountered and tackled problems that arose while working together. Excerpts found in Table 14 demonstrate the ways in which groups resolve any issues.

Table 14

Research Question 3 - Thematic Reference: Reciprocity

Participant	Quote
HS 1A	“If I think it’s important, he’ll think it is important”
HS 1A	If HS 1A sees that students are struggling, he will inform UNIV 1A
HS 2A	“…more diplomatic than I once was.”
HS 2A	“…mostly we integrate. It’s not my way or his way.”
HS 2B	“We are on the same page…”
HS 2B	“…we decide…more brainstorming than choosing one…”
HS 3A	“…went no further than two people discussing…”
UNIV 1B	They regularly talk through things with one another
UNIV 1B	They remind one another what has and has not worked well
UNIV 2A	“This isn’t working and I say, ‘yeah, this isn’t working’”

Note: Source: Individual interview.

Observations in the classrooms, often initiated by the high school teachers, assisted dialogue in which problems were identified, discussed and observed. The most commonly discussed problems centered on struggling students or student engagement. For example, Cohort 3A reported an extended problem situation. When UNIV 3A confronted HS 3A during class, HS 3A followed up the conversation by bringing research articles to UNIV 3A the following day. A discussion ensued, both viewpoints were discussed, and the issue was dropped. UNIV 3A and HS 3A both indicated it was a friendly exchange of information and HS 3A recognized and responded to UNIV 3A's desire to have the facts and logically discuss the situation. Due to the fact that they were new to working together, it is logical that this team was the only one who could recall a specific problem.

For the cohorts that had been together three and four years, issues of curriculum had been resolved. Interestingly, these same groups could not cite specific examples of what problems had occurred; rather, responses were more generic with cohorts reporting a casual approach of talking through the situation. The cohort who was a first-year team member was able to give a specific incident and relay how it was resolved. The reciprocal mode of operation, in which problems are quickly solved together, occurs once working relationships have solidified and become mutually established.

Responses from instructors contributed to the theme of flexibility as the team members engaged in a mutual give and take to resolve problems as they arose. Table 15 supplies data to support the discussion.

Table 15

Research Question 3 - Thematic Reference: Flexibility

Participant	Quote
HS 1B	"…present my concerns in a non-confrontational manner."
HS 2B	"…we decide…more brainstorming than choosing one…"
HS 3A	"I like to candy-coat and be diplomatic in the way that I handle those situations."
UNIV 1A	HS 1A gives him a lot of "leeway"
UNIV 1A	"…we just let it go"
UNIV 2A	"…we handle things…we move on"
UNIV 3A	"…we just talked…why I said what I said, and he said what he said."

Note: Source: Individual interview.

The majority of the cohorts readily addressed problems in a non-confrontational manner, instantaneous decisions were made, and the groups moved forward. Given the fact that the instructors came into the collegial teaming process with different points of view, teaching environments, and depth of content knowledge, the ability to reconcile differences quickly is a crucial element for effective collaborative programming to occur.

The theme of respect also emerged in relation to Question 3. Mutual respect or the sincere regard for what each person brought to the table was a factor in how teams resolved problems. Table 16 indicates that all groups realize that both members offer insight and value to the cohort.

Table 16

Research Question 3 - Thematic Reference: Respect

Participant	Quote
HS 1A	“If I think it’s important, he’ll think it is important”
UNIV 1A	“Both … respectful of each other & each other’s time”
UNIV 1A	“Never talk over each other”
HS 1B	“Mutual respect between the two of them”
HS 1B	“…balancing act. It’s how I approach him with a problem”
HS 2A	“…more diplomatic than I once was.”
HS 3A	“…hard to be…mean to other colleagues.”
HS 3A	“…diplomatic in the way I handle those types of situations.”

Note: Source: Individual interview.

This respect plays into the interactions that occur when handling challenges or problems that arise. Due to the trust and respect in one another’s abilities, opinions are mutually valued, and problem solving leading to plans of action or resolution are quickly derived. Again, more occurrence of this phenomenon was reported with the more established cohorts where respect and trust had developed as opposed to the newer cohort where they were still learning to work together.

Table 4 shows results from the Myers-Briggs Type Indicator (MBTI). In terms of approaching conflict through logical analysis, eight of the 10 instructors were labeled “T” for thinking and two of the 10 were labeled “F” for feeling (i.e.: making decisions based on empathy and harmony). This allowed for problem solving to be approached from a logical standpoint rather than an emotional one where problems are quickly considered and resolved as opposed to a prolonged resolution over several class days. Each cohort contained a “J” for judging and a “P” for perceiving which allowed for a balance

between a methodical/systematic solution and a flexible, spontaneous approach when dealing with classroom issues (Killen & Murphy, 2003).

The MBTI personality types had no marked impact in terms of the effectiveness of how cohorts resolved problems. For example, in Cohort 1A and 3A, the high school instructors were both labeled “TP”, and the university instructors were both labeled “TJ”. When interviewed individually, neither member of Cohort 1A could recall any problems involving disagreement, whereas Cohort 3A had one member who distinctly recalled a situation with the other in which they relayed the facts to one another. Whereas Cohort 1A indicated more flow and flexibility in problem solving, Cohort 3A indicated a bit more tension. Thus, while the instructors had the same MBTI types for problem solving, there was no correlation in how the problems were resolved. All five cohorts spoke of talking through problems, reaching quick consensus to the situation, and moving on. This would be in line with approaching conflict through a logical analysis mode of operation, suggested by type “T” (thinking) of the MBTI.

While the MBTI gives indications of how the participants might respond to problems that arose, better indicators of how problems were resolved lie in the ideas found in the thematic areas that emerged from the data as discussed above. The traits of being flexible or respectful better served as indicators of how the instructors responded to one another when differences of ideas or problems arose.

The data for this question revealed that team members who had worked together for an extended time had difficulty identifying specific examples of problems that had occurred. Having worked together longer periods of time allowed the teams to develop a rapport and working relationship with and has provided the time to work out

most problems. The group that had worked a shorter amount of time together could recall a specific event. However, due to mutual respect and a pattern of reciprocity, all cohorts could easily discuss and resolve any situation that arose in a cordial manner.

A factor for the success of the TGS collegial teaming model is the ability for both instructors to resolve problems in an amicable manner. The qualities of being able to quickly identify and resolve problems in a congenial manner assist in effective problem resolution for instructors. The ability to be open and respectful of the other team member's perspectives and insights also assists in effective problem solving by the teams.

Research Question 4

What perceptions do team members have of the strengths and weaknesses of the STEM/TGS program, in general, and of the collegial teaching team approach, in particular?

The data from Research Question 4 showed few weaknesses and more strengths from participating in the program. The themes of reciprocity, respect, and time emerged from the data. These themes are again supported by charts noting specific examples from the narrative revealed in Chapter 4. They address the perceptions that team members have about the strengths and Texas Governor's School (TGS) program in general, and of the collegial teaching team approach, in particular. Responses from the study participants are generally positive regarding the use of teaming.

Reciprocity as applied to this question refers to the state of being reciprocal (i.e. mutual dependence to make the course flow). All members focused on the strength of

the program centered on the use of two instructors in the classroom and the valuable individual knowledge contributed by each teacher. This ultimately strengthens the course and the overall TGS program. Table 17 reveals specific insights into these phenomena**.**

Table 17

Research Question 4 - Thematic Reference: Reciprocity

Participant	Quote
HS 1A	"…lets me tie stuff that (the HS students) are familiar with to what UNIV 1A is doing in the (college) classes…"
HS 1B	"What I brought in we worked and hammered together."
HS 2A	"…both people have different areas of expertise…"
HS 2B	Two teachers in the room creates a "back and forth"…fun learning environment
UNIV 1A	"HS 1A has gone over…cycle with me …has learned it all."
UNIV 1B	"HS 1B is able to bridge the language gap both ways."
UNIV 2A	"Two teachers…really works out well…student-teacher ratio..."
UNIV 3A	Having high school teacher helps them "better hold the attention of the students."
UNIV 3A	Helps him communicate in a "simpler language"

Note: Source: Individual interview.

In the classroom university instructors were able to provide higher-level concepts while the high school teachers were able to bridge the understanding and comprehension of the students. Exchanges between instructors and varying areas of expertise were also included as examples of positive mutual reliance and interaction that in turn assisted in bridging the students' understanding of course content. This finding is akin to what the literature reported in terms of the ability to capitalize on one

another's skills and use innovative methods to meet the needs of the learners in their classrooms (Bauwens, Hourcade, & Friend, 1989; Hourade & Bauwens, 2002; Thousand, Villa, Nevin, & Paolucci-Whitcomb, 1995).

A second theme that emerged concerning research Question 4 was respect. Defined in terms of strengths and weaknesses of the program and its teaching teams, respect was the clear regard by each instructor in a team for the mutual contributions of their partner for the program and their course. The team made their course what it was for the program. There was a mutual partnership at work.

All cohorts acknowledged the need for each other. Key remarks in Table 18 illustrate their respect for one another.

Table 18

Research Question 4 - Thematic Reference: Respect

Participant	Quote
HS 1A	Both are equally needed, when "UNIV 1A struggles…I come in real handy"
UNIV 1A	"I couldn't do this myself; there are too many kids."
HS 1B	"UNIV 1B respected my part of the contributions; let me teach how I thought was best…"
UNIV 1B	"…he appreciated what I go through in my academia career and I appreciate his."
HS 2A	University faculty members' high level of content knowledge is valuable, equally valuable is HS 2A's" understanding for teenagers and classroom management…"
UNIV 2A	"Two teachers…really works out well…student-teacher ratio."
HS 2B	The faculty members "… would have struggled without having a HS teacher there…"
UNIV 3A	Having high school teacher helps them "better hold the attention of the students."
UNIV 3A	Helps him communicate in a "simpler language"

Note: Source: Individual interview

Some comments acknowledge the importance of the other team member; other comments reflect the participants' perception that they are appreciated by their partner. This mutual understanding of each instructor's shared worth is a key component for team effectiveness. It assists the team member in establishing a mutual respect in which s/he feels her/his contributions are of value and acknowledges the importance of her/his partner's contributions. Together they formed a team that effectively incorporated each member's strengths and supported each member's weakness. This understanding of the value of more than one perspective and the ability to capitalize on individual skills and knowledge align with what was found in the literature in terms of benefits noted by collegial-team members (Villa, Thousand, & Nevin, 2008; Bauwens, Hourcade, & Friend, 1989; Hourade & Bauwens, 2002; Duhardt, Marlow, Inman, Christensen, & Reeves, 1999).

The final theme that emerged from the data pertaining to this question dealt with time. Time, in this instance, centered on the three weeks of the program and what it offered the instructors beyond what they normally experience in their own classrooms. Table 19 highlights specific examples from the narrative found in Chapter 4.

Table 19

Research Question 4 - Thematic Reference: Time

Participant	Quote
HS 1A	Provides him "…the opportunity to do things that I do not get to do throughout the course of my year "
HS 1B	far and few between…we have hammered those out
UNIV 1A	The extended teaching relationship that the two of them have established over time
UNIV 1B	"… teaming is beneficial in the friendship with HS 1B. He is able to learn from friends with no pressure."
UNIV 1B	…newer university faculty members that did not have tenure would be less likely to be able to undertake an opportunity…

Note: Source: Individual interview.

The program allowed instructors to present lessons with another instructor which they would not have had time for in their regular class routine outside TGS due to the pressures of course syllabi and rigid curriculum designed to meet the needs of standardized testing. At TGS, they had time to build a collegial relationship with another professional. They had periods of time in which they were able to develop and contribute ideas for the course with one another. This necessity for scheduled time for productive planning is a key element noted in previous research (Cohen & DeLouis, 2001; Duhardt, Marlow, Inman, Christensen, & Reeves, 1999; Harris & Harvey, 2000; Dieker, 2001). TGS required an extensive month-long time commitment during the summer program from its instructors. UNIV 1B did cite this commitment as a negative. Due to the amount of time the TGS university faculty members must be away from their research in the summer this experience might not be optimum for the faculty member needing to do research for tenure.

The concept of the TGS collegial teaming model was perceived as an integral element in the success of the program. Vital to this process was the reciprocal relationship of the instructors, the high opinion they held for each other's contributions to their course, and the time needed to build working relationships and develop curriculum. These relationships provide the bases in which exchange between instructors can assist in professional growth and development for both instructors.

Weakness noted in the TGS collegial teaming model occurred when partners did not share common curricular visions. In this situation, effective programming did not occur and the partnership did not continue into subsequent years. There was a feeling that the program would not be advisable for the professional growth of a university

member who was seeking tenure because of the time during the summer necessary to commit to the TGS programming. This could infringe upon time needed for research and laboratory work.

Research Question 5

What perceptions do team members have of their own professional growth (in content knowledge and pedagogical knowledge/skills) as a result of participating in a collaborative teaching experience?

Question 5 sought to explore what new content and pedagogical knowledge instructors had gained through observing and working with their collegial-team member. In reviewing the data about the perceptions that team members had of their own professional growth as a result of participating in a collaborative teaching experience, both the high school teachers and the university instructors reported gains in the areas of content knowledge and pedagogical knowledge/skills. The theme related to professional growth that emerged from the data centered on reciprocity. This was seen in terms of growth gains due to the collegial exchanges and the ability to learn from each other. The teaching teams reported that the TGS environment allowed both the high school secondary teachers and university instructors to observe and experience the various content and pedagogical practices that their corresponding team member had to offer. The predominant gain by the high school teachers was in the area of content knowledge whereas the university instructors noted their gains in the pedagogical skills area. Table 20 contains relevant excerpts from the Chapter 4 narrative and illustrates what the instructors reported.

Table 20

Research Question 5 - Thematic Reference: Reciprocity

Participant	Quote
HS 1A	Contact has provided…opportunity to engage in a variety of conversations…at a high level
HS 1A	Level of material…ideas gained at TGS…motivates him…helps him motivate students
HS 1B	Is appreciative of UNIV 1B's caliber of research work and enjoys talking with him on a professional level
HS 2A	HS 2A has gained a better understanding of plant life in ecology, especially the impact of flora from UNIV 2A
HS 2B	" …learned about "building an interval from scratch"
HS 2B	"not made any gains… pedagogical practice…"
UNIV 1A	…observed how HS 1A filled the gaps…has adapted measures to better assist his students
UNIV 1B	…techniques about getting people to talk about themselves…from HS 1B
UNIV 2A	Learned about HS students' limited access to quality equipment
UNIV 2B	more familiar with how the high school adolescent behavior

Note: Source: Individual interview.

In terms of learning advanced content material, four of the five high school teachers reported that exposure to the higher-level content material had direct application to the subject matter covered in their AP classes. A university instructor learned a new content concept applicable to one of his undergraduate classes.

All of the university faculty members reported learning new teaching methods. Two reported that having a better understanding of what content is covered in the high school classroom gave them a greater insight into the knowledge bases of their undergraduate students. One university faculty member reported a better understanding of typical adolescent behavior and knowledge base. University faculty

also had the opportunity to observe how the high school teachers bridged the knowledge gap for the students. Two other university faculty members stated instances their own communication skills improved due to observing the high school teachers. Another observed how the high school partner applied layman's vocabulary to explain research to the students who were less familiar with the scientific field.

The growth in content knowledge and pedagogical practices reported was possible due to the openness each instructor had within the individual cohorts to learning from one another. This exchange creates the unique environment that allowed them to learn from fellow educators as noted by Harris and Harvey (2000). It has fostered an environment that allowed dialogue, self-reflection, and a sense of increased collegiality. These are akin to the relationships noted by Skoog's (1993) research on improvement of university faculty instructional effectiveness through peer coaching.

The data pertinent to this question revealed that both the university and high school teachers acknowledged professional growth through their experience at TGS due to a collegial environment created by pairing a high school and university instructor. The grouping provided a unique context in which both instructors were able to acquire new knowledge benefiting their own professional growth. The data shows that both the high school instructor and the university instructor did report professional growth, new pedagogical skills and /or acquiring new content knowledge. They credited these growths through reciprocal exchanges afforded them by the TGS collegial teaming model.

Research Question 6

What perceptions do team members have of the impact of their collaborative experience on their own teaching inside and outside of TGS?

While Question 5 discussed professional growth in the areas of content and pedagogical knowledge, Question 6 explores how the collegial teaming experience actually impacted their classrooms and how these practices were implemented into their teaching, both inside and outside of TGS. The themes of reciprocity and time are relevant to the findings related to Question 6 (i.e.: the perceptions team members have of the impact of their collaborative experience on their own teaching inside and outside of TGS). Examples from narratives in Chapter 4 have been formatted into Tables 21 and Table 22.

Reciprocity in this context related to the reported ability of mutual influence created by collegial teaming that impacted an instructor's teaching both inside and outside the TGS classroom. Table 21 provides excerpts related to this theme.

Table 21

Research Question 6 - Thematic Reference: Reciprocity

Participant	Quote
HS 1A	"…found validation of what he is doing in own AP classroom."
HS 1A	"…seeing what (researchers) are doing…changed (content) in my labs."
HS 1B	Improvements in the "…application of the content" in AP class
HS 2A	Changed the structures in HS labs to incorporate more opportunities to use critical analysis and reasoning
HS 2B	Collaboration has not impacted his teaching style

(*table continues)*

Table 21 (*continued).*

Participant	Quote
HS 3A	"…chance to reflect on how he relays info to HS students
HS 3A	Utilization of people and resources; visits to research park
UNIV 1A	"…more tolerance for undergraduate students."
UNIV 1A	"…plans to explore collaboration with HS 1A's AP classes."
UNIV 1B	Attempted to embed jokes in lectures at university; not successful
UNIV 1B	Change of perspective; "speak to layman in layman's terms"
UNIV 2A	Because of exposure to limited knowledge of HS"…now has "spent more time going over how things should be used…"with undergraduates
UNIV 2A	"…has not incorporated a lot from TGS into university classes."
UNIV 2B	…has carried a motivational spirit gained from HS 2B
UNIV 3A	Use of analogies; course evaluation scores have gone up

Note: Source: Individual interview.

Content gained from information presented by the university faculty member was absorbed and periodically reinstructed by the high school teacher which impacted their knowledge base for both the TGS program and their high school classroom. Examples include not only specific content such as botany, but also "real-world" application for content and more use of reasoning skills. Although the high school teachers did not see impacts on their style of teaching, HS 1A and HS 1B reported feeling validated by their co-instructors for their teaching styles which are the same inside TGS as they were outside TGS.

The university instructors reported insights into teaching approaches which were due to observing a variety of techniques from their co-instructors during TGS. A few of

these approaches included the use of humor, motivational spirit, and analogy. One instructor employed analogies in his university classes after seeing his partner use them. Another applied layman's vocabulary when explaining research to people less familiar with his scientific field. Several had observed how the in high school partner utilized these techniques in the TGS classroom. Two university faculty members reported marked success, equating the techniques that they had acquired from TGS as resulting in improvements in their university student course evaluations. One reported that while the use of jokes in the TGS classroom was successful, it was not successful in the university setting.

There was more impact on the use of content from the collaborative experience for the high school instructors both inside and outside TGS. Additionally, the university instructors expanded their pedagogical techniques inside and outside TGS. The acknowledgement of growth in the areas of content for the high school teachers and pedagogical practices by the university instructors corresponds to other research that notes the mutual recognition of another professional's strengths and mutual benefits in terms of professional growth, gained from teaming together (Shaplin & Olds, 1964; Synder & Anderson, 1986; Ravid & Handler, 2001; Carless, 2006; Gray & Harrison, 2003).

Time as a measurable period in which certain conditions exist emerged as a theme in understanding aspects of the impacts of the instructors' collaborative experience, as demonstrated in Table 22.

Table 22

Research Question 6 - Thematic Reference: Time

Participant	Quote
HS 1A	"…has time at TGS to expand upon concepts"
HS 1A	Can't expand concepts in AP class due to time restraints
HS 1B	Cannot collaborate with UNIV 1B for AP class; too busy
UNIV 1B	Feels co-teaching couldn't be successful at university; too much material to cover
HS 2A	Can't explore part of methods from TGS in AP class "…so constrained…there is no time…"
HS 2B	…because it is not "AP status"…he "just does not have enough time" to incorporate into his HS curriculum
HS 3A	Ability to collaborate…"really cover material, cover ground…This does not occur in his high school classroom."

Note: Source: Individual interview.

Several instructors reported a freedom in the TGS environment not found in a high school or university classrooms due to fewer restraints such as no mandated curriculum or exams. Instructors found that the conditions of deadlines, expected course of study, and the necessity of prescribed lessons, exams, and grades created situations where replicating TGS activities and/or classrooms was difficult, if not impossible. They simply did not have the time or the curricular flexibility to implement all elements fully in their normal classroom settings.

The collegial teaming experience impacted instruction both inside and outside the classroom. As seen from the data relevant to this question, both high school instructors and university faculty members were able to cite various perceptions about the impacts of their collaborative experience on their own teaching, both inside and outside of TGS. Reciprocity provided a means of mutual influence upon one another

while time played a major factor in whether they were or were not able to implement various elements they had observed or acquired.

Because of reciprocal relationships in the TGS classroom, some instructors were able to implement aspects knowledge gained from their collegial teaming partner into the classrooms both inside and outside TGS. A common deterrent to implementing all aspects of knowledge and pedagogy gained was the element of time. Thus, while the data for Question 5 revealed that the instructors felt that new pedagogical practices and content were gained from the TGS collegial teaming experience, the data for Question 6 revealed that the practices and content were not always fully implemented beyond TGS due to externally imposed time restraints.

Summary of Findings

The two-fold purpose of this study was to examine the collaboration between a secondary teacher and university instructor as a collegial teaching team during a three-week mathematics and science residential program for high-ability learners. The perceived impact of that collaboration on each team member's professional growth in content knowledge, pedagogical knowledge/skills, and instructional practices inside and outside of the TGS program was also investigated.

Factors that contributed to successful collaboration included aspects described by the emergent themes of reciprocity, respect, flexibility, and time. It appears that an active interchange, or reciprocity, and mutual respect between partners during curriculum/lesson/unit planning, instructional delivery, and assessment are necessary for effective collaborative instruction to occur. Instructors must also be flexible in terms

willingness to adapt beyond their own preconceived perceptions of what or how a course should evolve or flow. The long-term relationship and flexible personality traits appear to assist in creating a collegial relationship in which ideas are shared and disagreements are minimal. The instructors expressed an overall positive experience with collegial teaming and its value to them as instructors. They believed teaming was an overall positive and vital part of the program's success. In terms of impact of the program, the university instructors reported acquiring and improving upon their own pedagogical skills, while the high school instructors reported gains in terms of obtaining higher-level content knowledge. For several participants, this new ability enabled them to explain direct and marketable application of the scientific theories that they regularly taught. There were a few examples of crossover where the high school teacher obtained additional pedagogical approaches and the university faculty members gained new content insights. For both groups the partnership assisted in bridging insights between the secondary and college arenas. The overall experience provided professional growth and development that would not have occurred without the unique pairing of a high school instructor and a university faculty member.

Implications and Limitations

All of the results (a) answer the research questions and (b) show that this model of collegial teaming may serve as a model for future programs similar to TGS.

Based on the results the unique pairing of a secondary teacher with a university faculty member that occurs in the TGS program provided an environment in which the interactions between the collegial-team fostered professional growth. The elements of

trust and reciprocity established an environment of authentic collaboration; both instructors actively contribute and facilitate challenging experiences for the high-ability learner.

TGS could serve as a model for university summer residential programs as a means for not only aiding the needs of the high-ability learner, but for the professional development of those who teach them. The model provided the Advanced Placement (AP) teachers exposure to rigorous materials applicable to their classrooms and provided insight into the expectations and rigors of the future coursework that their AP students will later encounter in post-secondary education. It also served as way of providing professional development in the area of pedagogical practices to university faculty members, as they are exposed to various modes of instructional delivery.

A limitation to this multi-case study was the small group size of the participants, but the in-depth analysis explored the intricacies of the established relationships among the cohorts. This detailed information could serve as insight for modeling similar programs. This model also lends itself to expansion into longer periods of university and high school partnerships that could establish teaming for the purpose of fostering professional growth in instructors of high-ability students.

Future Research Recommendations

Future research could examine various impacts produced by the collegial teaming described in this study. First, examination of the impact of the co-teaming on the students and their acquisition of knowledge could be explored. Second, the impact of the high school and university instructors' collegial teaming experience on classrooms

beyond TGS could be more fully explored. This could be accomplished through direct observations of changes in the pedagogical practices and content integration into curriculum/lesson/unit planning and assessment as carried out through instructional delivery in their individual classrooms. Finally, the concept of teaming as a means of assisting high school and university instructors in bridging students from the secondary to the post-secondary sector merits examination. Both instructors reported the usefulness of understanding students' current and future educational experiences. These insights were gained through the mutual collaboration that occurred through this collegial experience.

Conclusion

The impetus for this study was the idea that high school and university instructors working as collegial-teams during a three-week summer program could serve as a continual source of personal and professional growth for both instructors. What was found was that collegial teaming is not only beneficial to the education of the high-ability learner, but to the effectiveness of the instructors themselves. The reciprocal relationship empowered both participants to become better educators for the populations they serve. This in-depth analysis showed that high school teachers were able to engage in exchanges in which they learned about current research relevant to their subject matter and teaching. In fact, the high school teachers reported that the collegial teaming experience proved more beneficial for their AP classes than most professional development classes they had attended. University instructors gained not only new insights into pedagogical practices but also a broadened understanding of

what to expect of the entering undergraduate students.

These findings support the belief that the collegial teaming of the Texas Governor's School serves as a model for professional development for both high school and university instructors. In similar summer programs for high-ability students, high school and university instructors could engage in the reciprocal process of collegial teaming. At the high school level this teaming enables teachers to add depth and complexity to their content area while at the university level, it equips university faculty with pedagogical practices that move beyond a teacher-directed, lecture-based classroom. As demonstrated in this research, this exchange can foster partnerships between high schools and universities that will ultimately benefit the students at both levels. The modality of professional development offered by collegial teaming merits further exploration, as it serves as a win-win situation for all that are involved.

APPENDIX A

INTERVIEW QUESTIONS SESSION 1:

TEAM MEMBERS TOGETHER

Session 1: Collegial-team Members Together

(Prior to the Beginning of 3-Week Program)

1. What do you perceive to be the broad goals of STEM courses at TGS? What should high-ability students get out of this 3-week experience? As a collegial teaching team, what do you want to accomplish with these students?
2. How do you plan together as a team?
    a. How do you get yourselves organized? Does one person take the lead or is the leadership shared?
    b. How are content topics selected?
    c. How are teaching strategies/methods selected?
    d. How are teaching/learning activities and materials selected/generated?
    e. How are assessments selected/generated?
    f. How are time-related decisions made?
    g. Why do you plan together in this way?
3. How do you teach together (i.e. deliver instruction) as a team?
    a. How do your plans play out in the classroom? Who does what during the delivery of instruction? Does one person take the lead or is leadership shared?
    b. How do you play off each other during the lesson implementation?
    c. How do you handle the unexpected and the need to alter plans/delivery midstream?

4. What is your curricular/instructional focus for the upcoming summer program? How and why was this focus chosen? Explain your collaborative process in reaching this decision.
5. Describe the current state of your cooperative planning process with respects to the following questions:
    a. What specific role does each team member play in your curriculum/lesson/unit planning efforts (i.e. selection of goals/objectives, content, instructional strategies, lesson activities, etc.?)
    b. What specific role does each team member play in the delivery of instruction? Who handles what? Why? How did these roles evolve to what they are now?
    c. What specific role does each team member play in planning and implementing assessments? Who handles what? Why? How did these roles evolve to what they are now?
6. Which of the following best describes the o-teaching approach you first used? That you are currently using? (Provide visual chart to participants of the co-teaching approaches from Villa, Thousand, & Nevin, 2008).
7. What do you perceive to be the strengths and weaknesses of the program, in general, and the team teaching approach, in particular?
8. Is there anything else that you would like to add about how you work together and why you work together in that way?

Thanks to both for their time and contributions.

APPENDIX B

INTERVIEW QUESTIONS

SESSION 2: TEAM MEMBERS INDIVIDUALLY

Interview Questions & Responses for Session 2—Collegial-team Members Individually (After the 3-Week Program)

1. Would you like to clarify or expand on anything from our previous meeting?
2. Has the way you plan together changed over time? If so, how? Give specific examples from early in the collaboration vs. late in the collaboration.
3. Has the way you teach/deliver instruction together changed over time? If so, how? Give specific examples from early in the collaboration vs. late in the collaboration.
4. How have students responded to the delivery of instruction via team teaching?

What did students respond well to—in terms of what you or your partner did during instruction? What did students not respond well to—in terms of what you or your partner did during instruction?

5. How would you describe your own personality type? Working style? Teaching style? Conflict resolution style?
6. How would you describe your teaching team partner's personality type? Working style?
7. What insights did you gain from your Myers-Briggs results? How did knowledge of your personality type and your partner's personality type influence your collaboration?
8. Did some students respond better to you than others? Did some students respond better to your partner than others? If so, based on your understanding of Myers-Briggs, how might these student responses be

related to students' personality types vs. instructors' personality types?

9. When first embarking on this collegial-team teaching experience, what relative strengths and weaknesses (e.g., content knowledge, pedagogical knowledge/skills, etc.) did you bring to the partnership?
10. When first embarking on this collegial-team teaching experience, what relative strengths and weaknesses (e.g., content knowledge, pedagogical knowledge/skills, etc.) did your partner bring to the team?
11. What, if any, new content knowledge have you gained from the collegial-team teaching experience? How did you gain that knowledge?
12. What, if any, new pedagogical knowledge/skills (e.g., new teaching methods/strategies) have you gained from the collegial-team teaching experience? How did you gain this knowledge/these skills?
13. How has this collegial-team teaching experience impacted your own planning/teaching inside of STEM/TGS? Give some specific examples.
14. How has this collegial-team teaching experience impacted your own planning/teaching outside of STEM/TGS? Give some specific examples.
15. *For university team member*: Based on your collegial-team teaching experience, what insights have you gained about the realities of teaching science in the high school setting? Have these insights resulted in changes in how you plan and deliver instruction for your university students?

For high school team member: Based on your collegial-team teaching experience, what insights have you gained about the realities of teaching science in the university setting? Have these insights resulted in changes in

how you plan and deliver instruction for your high school students?

16. In any kind of collaboration, disagreements and conflict/tension can occur. Give some specific examples. What have been some of the conflicts (if any) that have arisen in your collegial-team teaching experience? How was each conflict handled/resolved? Did these disagreements/conflicts result in anything positive? If so, what?
17. How many years have you been teaching with the STEM/TGS program? Why have you returned each year? What/how do you gain/benefit?

APPENDIX C

TEACHING OBSERVATION PROTOCOL: MAINE CENTER FOR RESEARCH IN STEM EDUCATION

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Teaching Observation Protocol
Maine Center for Research in STEM Education

Note: Sections I, II, IV, V, and VI in this protocol are taken from the Reformed Teaching Observation Protocol (RTOP) by Daiyo Sawada, Michael Piburn, Kathleen Falconer, Jeff Turley, Russell Benford, and Irene Bloom, then with the Arizona Collaborative for Excellence in the Preparation of Teachers, Arizona State University. Other portions are adapted from the Classroom Observation Handbook by Frances Lawrenz, Douglas Huffman, Karen Appeldoorn, and Tao Sun from the College of Education and Human Development at the University of Minnesota and were developed with funding from the National Science Foundation.

BACKGROUND INFORMATION

Name of Teacher _____

Announced Observation _____
(yes, no or explain)

Location of class _____
(district, school, room)

Years of Teaching _____ Teaching Certification _____
(K-8 or 7-12)

Subject Observed _____ Grade Level _____

Observer _____ Date of Observation _____

Start time _____ End time _____

CONTEXTUAL BACKGROUND AND ACTIVITIES

In the space provided below, please give a brief description of the lesson observed, the classroom setting in which the lesson took place (space, seating arrangements, etc.), and any relevant details about the students (number, gender, ethnicity) and teacher that you think are important. Use diagrams if they seem appropriate.

LESSON DESIGN AND IMPLEMENTATION

	Never Occurred				Very Descriptive
1) The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	0	1	2	3	4
2) The lesson was designed to engage students as members of a learning community.	0	1	2	3	4
3) In this lesson, student exploration preceded formal presentation.	0	1	2	3	4
4) This lesson encouraged students to seek and value alternative modes of investigation or of problem solving	0	1	2	3	4

DESCRIPTION OF EVENTS

Time	Description of Events

Codes for Description of Events

Please fill in the instructional strategies (*not* the instructor's actual activities, in case they are correcting papers or something non-instructional), student engagement, and cognitive activity used in each segment of this class. There may be one or more strategies used in each category during each segment. For example, SGD, HOA, and TIS often occur together, but SGD and L do not.

Type of Instruction:

L	lecture/presentation	CL	cooperative learning (roles)
PM	problem modeling	LC	learning center/station
SP	student presentation (formal)	TIS	teacher/faculty interacting w/ student
LWD	lecture with discussion	UT	utilizing digital educational media and/or technology
D	demonstration	A	assessment
CD	class discussion	AD	administrative tasks
WW	writing work (if in groups, add SGD)	OOC	out-of-class experience
RSW	reading seat work (if in groups, add SGD)	I	interruption
HOA	hands-on activity/materials	OTH	Other: please describe
SGD	small group discussion (pairs count)		

Student Engagement:

HE	high engagement, 80% or more of the students engaged
ME	mixed engagement
LE	low engagement, 80% or more of the students off-task

Cognitive Activity:

1	**Receipt of Knowledge** (lectures, worksheets, questions, observing, homework)
2	**Application of Procedural Knowledge** (skill building, performance)
3	**Knowledge Representation** (organizing, describing, categorizing)
4	**Knowledge Construction** (higher order thinking, generating, inventing, solving problems, revising, etc.
0	**Other** (e.g., classroom disruption

APPENDIX D

GUIDE FOR INSTRUCTOR JOURNAL ENTRIES

The purpose of this log is to track the programming as it occurs during the Texas Governor's School (TGS). After you teach each day, make notes in the journal over the three topic areas listed and described below.

ACTIVITIES:

In this topic area list the activity, type of activity (lecture, research, debate, problem solving, etc.) and your instructional role (main presenter, resource leader, etc.)

RESPONSE:

State the student response to the activity (active, disengaged, etc.) Cite specific student feedback (Sue said…; The group discovered that…; etc.)

ROLE:

How did your instructional role (main presenter, resource leader, etc.) enhance the learning process? Did you feel comfortable with the role? With the content?

Please date your entry each day. Use the subheadings described above and write notes for that day's class.

Feel free to add to the journal thoughts about future programming, resources, etc

Please bring the log to the faculty meeting. This information will assist us in noting the progress of TGS in terms of what is working in the program.

APPENDIX E

RESEARCH IDENTITY MEMO

Researcher Identity Memo

The advent of my role as the curriculum Coordinator for Texas Governor's School (TGS) began with a conversation at the annual Cub Scout Pool Party. This event gave an opportunity for two parents/educators (a secondary school teacher and a faculty member of engineering for material sciences) to discuss educating the high-ability learner, professional development for the secondary educator, and partnerships between universities and school districts. We shared similar visions of what education is and should be for our brightest. The faculty member later became the founding director for TGS at the University of North Texas (UNT).

Subsequent to the encounter I was invited to become the TGS curriculum coordinator. The program was at the formation stage and I was able to become an active part of developing the vision of what became TGS. Planning took on a fast pace as we only had three months to prepare before the program went into full operation. Central to academic programming was the concept of teaming a secondary teacher with a university faculty member for the instruction of each course. This team would then be responsible for the design and delivery of the curriculum in their three-week course.

Recruitment of TGS Instructors

Initially the TGS program director handled the majority of the recruitment of the university faculty and I took on the responsibility of recruiting the secondary teachers. We were assisted by suggestions of possible folks by the TGS administrative coordinator (a former high school counselor and diagnostician). We did not advertise, instead we recruited from folks the three of us knew either personally or through professional networks (For example, I used contacts through the metroplex association

of curriculum coordinators, a group of GT coordinators in the north Texas area). Possible instructors were carefully considered in terms content knowledge/what they taught, their reputations with their students and colleagues, and their teaching style. Admittedly we did not know if everyone would mesh when we brought them together that first year; some left the program after the first year and some have remained. Recruitment of instructors has remained by invitation and we are careful to consider if we think personalities and teaching styles will mesh with the program philosophy and the instructor who has remained with the program.

Program Design as Related to Instructor Expectations

Consistently since the inception of the program, instructors have been told the overall goals of TGS are to: provide a course curriculum integrating science and technology that explores their concomitant impacts on society; enhance participant writing skills; create small social groups to enhance discussion and peer-to-peer learning; assist students in developing a plan for their academic future. Programming goals include courses that focus on advances in science and technology and how such advances impact society both now and in the future.

Directives have been given to instructors that lessons are to: be created by teams utilizing both members' expertise and areas of knowledge; give consideration to stated goals and outcomes; incorporate not only lectures, but selected readings, discussion/debate, projects, lab experiments, and so forth.; aim towards higher-level thinking and process oriented activities; provide a detailed outline of lessons for the three weeks; and provide a list of needed materials.

Each year the overall goals, programming goals, and lesson components are reviewed and discussed at our half-day instructor meeting held approximately one month prior to the beginning of the programming. In more recent years, instructors have enjoyed sharing what is occurring in their classes with the other instructors and what they plan to change, tweak, and so forth for the upcoming year. This has been more productive than simply going over the expectations, as the majority of the instructors are returning and have a framework in place for their curriculum. As new instructors are added to replace exiting instructors, the program expectations are explained. This now normally occurs during the hiring process. This approach has helped us explore with the potential instructor whether the TGS program is a good fit for their teaching style.

Course Curriculum Development

Instructors are allowed to collaborate together independently to develop their course curriculum without me present. I do offer make myself available to them if they need me. Few rarely do, and contact is normally about technical aspects such as whether purchases can be made, reservations for field trips taken care of, and so forth. I require lesson plans prior to the TGS start date, but let them know that I am flexible and understand if they need to adjust after programming has begun. I look them over for evidence of activities that will encourage student engagement and higher-level thinking skills.

There have been times when I and/or the Program Director have had to intervene concerning a course's curriculum. This has occurred mid-program as we obtain feedback from students or we observe that a majority of them are not actively engaging in the class. I have noticed that this has typically occurred when the course

was lecture driven. I then worked with the instructors to devise some hands-on or interactive activities they can take to the classroom for instructional delivery. Such intervention has not occurred very often over the longevity of the program. I credit this in part to the instructors selected to be involved with the TGS program.

During the rest of the year we do not require that instructors meet with one another. We do ask in January who is planning on returning and in late March to early April they are asked to send in business paper work, update their bios and course descriptions on the website, and other program maintenance needed issues. In mid-April they are reminded of our two upcoming meetings (our in-service half-day meeting in mid-May and our final organizational meeting at the program start in June). They are also reminded in mid-April to look over the previous year's formal feedback and contact their other team member if they have not already done so.

Formal Feedback to Instructors

One of my duties as coordinator of curriculum is to provide feedback to the instructors. A spreadsheet is compiled containing student pre and post test scores, all comments from student evaluations, and comments from their own evaluations. These are sent out four to six weeks after the end of the program. I believe this gives the instructors time to disengage a bit from the program before going through all of the information that the report provides. Several instructors have said that the feedback is more thorough and helpful than the feedback they get back from their main teaching job. I do ask the instructors to look the reports over and use them as tools to assist in tweaking or fine tuning their courses. I keep it open-ended, not instructing them on the specifics to accomplish. I have found that the instructors seem naturally to respond to

the comments and revise any weaker areas. They often will say, “That did not work last year, so this year we are going to …”

Role of Curriculum Coordinator and Impacts on Current Study

It is easy to infer that I am deeply vested in the TGS Program. This gives me cause to explore both the benefits and the risks of being the primary investigator in this multiple case study. Such exploration will assist in me as I research and begin to look at the data.

One of the benefits is that through my own years of teaching and working with high-ability students, I have an appreciation and understanding of what effective learning environments for these students look like. I know that it can be accomplished for different age levels, in different settings, and in different content areas. Over time I have come to appreciate observing effective teaching techniques that engage the students even if it is not exactly how I might have constructed the lesson. I have grown more appreciative of this fact as I have had the opportunity to observe the various TGS classes over the past four years. It is important to keep that clarity of mind as I observe and consider what is occurring in the various classes that are a part of the study. I cannot let my observations be tainted by what I expect to see; rather I need to accept the flow as it works for the instructors during instructional delivery. Fair, impartial judgment must remain part of my mantra.

The instructors do view me as one of their coordinators. Although we are all congenial and they easily offer me their suggestions as well as criticisms, I am cognizant of the fact that they want to please me. This very well may impact what they report or don’t report to me. To counter such effect, I remained upbeat with

observations, letting them know I was there to see and understand, not judge. Interestingly, most did not seem to really care that I was there and namely I had questions from the students asking what I was doing (My other role as curriculum coordinator is something like an assistant principal…making sure students get to class on time, talking to them for chronic tardiness or exhibited misbehavior in multiple classes such as texting. I think a lot thought I was “spying” for that)! As a result, many conversations with teachers would include not only my research follow-up questions, but also them asking my opinion regarding certain students. Hence, it became a mutual conversation. In terms of the interviews, I tried to remain aware of my role to reduce anxiety. By doing multiple interviews, it was easier to offer times to give different viewpoints or interpretations. As I go through the data I will need to see if any contradictions should occur.

REFERENCES

Anderson, L., & Landy, J. (2006). Team teaching: Benefits and challenges. Speaking of Teaching. *The Center for Teaching and Learning Stanford University*, *16*(1), 1-4. Retrieved from http://www.stanford.edu/dept/CTL/cgi-bin/docs/newsletter/teamteaching.pdf

Ashton, P., & Webb, R. (1986). *Making a difference: Teachers' sense of efficacy and student achievement*. White Plains, NY: Longman.

Austin, V. (2001). Teachers' beliefs about co-teaching. *Remedial and Special Education*, *22*(4), 245-255. Retrieved from http://web.ebscohost.com/ehost/detail?vid=6&hid=19

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*, 191-215.doi: 10.1037/0033-295X,8.2.191

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bauwens, J., Hourade, J., & Friend, M. (1989). Cooperative teaching: A model for general and special education integration. *Remedial and Special Education*, *10*(2), 17-22. Doi: 10.1177/074193258901000205

Binet, A. & Simon, T. (1904). Méthodes nouvelles pour le diagnostic du niveau intellectuel des anormaux. *L'année psychologique, 11*, 191-244. doi: 10.3406/psy.1904.3675

Bloom, B. S. (1982). The role of gifts and markers in the development of talent. *Exceptional Children*, *48*, 510-521. Retrieved from http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=c8bdf75e-70c9-434c-

8f65-c248b442203f%40sessionmgr12&vid=7&hid=19

Borland, J. H. (1989). *Planning and implementing programs for the gifted*. New York, NY: Teachers College Press, Columbia University

Bruner, J. S. (1965). *The process of education*. Cambridge, MA: Harvard University Press.

Buddy, J. W. (2007). Using personality traits and effective communication to improve collaboration. *School Library Media Activities Monthly*, *23*(9), 26-29. Retrieved from http://finartiles.com/p/articles/mi_7729/is_200705/ai_n32216995.

Carless, D. R. (2006). Good practices in team teaching in Japan, South Korea and Hong Kong. *System*, *34*, 341-351.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. Thousand Oaks, CA: SAGE Publications

Chiou, W., & Yang, C. (2006). Teachers' modeling advantage and their modeling effects on college students' learning styles and occupational stereotypes: A case of collaborative teaching in technical courses. *Adolescence*, *41*(164), 723-737. Retrieved from http://finartiles.com/p/articles/mi_m2248/is_164_41/ai_n17094454/

Clark, B. (2002). *Growing up gifted* (5th ed.). Columbus, OH: Charles E. Merrill.

Cohen, D. K., & Hill, H. C. (2000). Instructional policy and the classroom: The mathematics in California. *Teachers College Record*, *102*(2), 294-343. doi: 10.1111/0161-4681.00057.

Cohen, M. B., & DeLois, K. (2001). Training in tandem: Co-facilitation and role modeling in a group work course. *Social Work with Groups, 24*(1), 21-36. doi: 10.1300/J009v24n01_03.

Colangelo, N., Assouline, S. G., & Gross, M. U. (2004*). A nation deceived: How schools hold back America's brightest students*. Iowa City: The Connie Belin Jacqueline N. Blank International Center for Gifted Education and Talent Development.

Cook, L. & Friend, M. (2001). A Meta-analysis of co-teaching research: Where are the data? *Remedial and Special Education*, *22*(5), 258 -268. Retrieved from http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=10d58373-47cd-4f9a-8b05-c0d49474875c%40sessionmgr4&vid=10&hid=19

Cranton, P. (1994). *Understanding and promoting transformative learning: A guide for educators of adults*. San Francisco, CA: Jossey-Bass.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed method approaches*. Thousand Oaks, CA: Sage Publications.

Cuseo, J. (2006). The case for learner-centered instruction. *On Course Newsletter*, *Jan 2006*. Retrieved from http://oncourseworkshop.com/Miscellaneous018.htm

Cunningham, L. G., & Rinn, A. N. (2007). The role of gender and previous participation in a summer program on gifted adolescents' self-concepts over time. *Journal for the Education of the Gifted*, *30*(3), 326-352. Retrieved from http://www.eric.ed.gov/PDFS/EJ75655.pdf

Davis, G. A. & Rimm, S. B. (1998). *Education of the gifted and talented*. Needham Heights, MA: Allyn & Bacon.

Dettmer, P. A., Landrum, M. S., & Miller, T. N. (2006). Professional development for the education of gifted students. In F. A. Dixon & S. M. Moon (Eds.), *The handbook of secondary gifted education* (pp. 611-648). Waco, TX: Prufrock Press.

Dieker, L. (2001). What are the characteristics of 'effective' middle and high school

co-taught teams for students with disabilities? *Preventing School Failure*, *46*(1), 14-24. doi: 10.1080/10459880109603339.

Dieker, L. A. & Ousley, D. M. (2006). Speaking the same language: Bringing together highly-qualified secondary English and special education teachers, *Teaching Exceptional Children Plus*, *2*(4), Article 3. Retrieved from http://journals.cec.sped.org/tecplus/vol2/iss4/art3.

Duhardt, B., Marlow, L., Inman, D., Christensen, P., & Reeves, M. (1999). Collaboration and co-teaching: General and special education faculty. *Clearing House*, *72*(3), 186-190. doi: 10.1080/00098659909599625

Duke, D., Showers, B., & Imber, M. (1980). Teachers and shared decision-making: The costs and benefits of involvement. *Educational Administration Quarterly*, *16*, 93-106. doi 10.1177/0013161X8001600108.

Ebmeier, H. (2003). How supervision influences teacher efficacy and commitment: An investigation of a path model. *Journal of Curriculum and Supervision*, *18*(2), 110-141. Retrieved from http://www.web.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=11&hid=19

Enersen, D. L. (1993). Summer residential programs: Academics and beyond. *Gifted Child Quarterly*, *37*(4), 169-176. doi: 10.1177/001698629303700406.

Erikson, E. (1997).*Lifecycle completed*. New York, NY: W. W. Norton.

Feldhusen, J. F. (1986). A conception of giftedness. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (pp. 112-127). Cambridge: Cambridge University Press.

Feldhusen, J. (1991). Saturday and summer programs. In N. Colangelo & G. Davis

(Eds.), *Handbook of gifted education* (pp. 197-208). Boston, MA: Ally and Bacon.

Flick, U., Von Kardorff, E., & Strinke, I. (2004). *A companion to qualitative research*. Thousand Oaks, CA: Sage.

Franke, R. H., & Kaul, J. D. (1978). The Hawthorne experiments: First statistical interpretation. *American Sociological Review*, *43*(5), 623-643. doi: 10.2307/2094540.

Friend. M.. & Cook. L. (2003). *Interactions: Collaboration skills for school professional* (4th ed.). White Plains, NY: Longman.

Gagné, F. (1995). From giftedness to talent: A developmental model and its impact on the language of the field. *Roeper Review*, *18*, 103-111. doi: 10.1080/02783199509553709.

Gagné, F. (2003). Transforming gifts into talents: The DMGT as a developmental theory. In N. Colangelo and Davis. G. A. (Eds.), *Handbook of gifted education* (3rd ed), (pp. 60-74). Boston, MA: Allyn & Bacon.

Gagné, F. (2004). Transforming gifts into talents: The DMGT as a developmental theory. *High Ability Studies*, *15*, 119-147. Retrieved from http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=13&hid=19&sid=10d58373-47cd-4f9a-8b05-c0d49474875c%40sessionmgr4

Gallagher, J. J. (1985). *Teaching the gifted child*. Boston, MA: Allyn and Bacon.

Glazer, E.M., & Hannafin, M. J. (2006). The collaborative apprenticeship model: situated professional development within school settings. *Teaching and Teacher Education*, *22*, 179-193. doi: 10.1016/j.tate.2005.09.004.

Glesne, C. (1999). *Becoming qualitative researchers: An introduction*. New York: Longman.

Goodhew, G. (2009). *Meeting the needs of the gifted and talented students*. New York, NY: Continuum International.

Gray, T. & Harrison, P. (2003) Team teach with a student: A pilot study in criminal justice. *Journal of Criminal Justice Education*, *14*, 163-180. doi: 10.1080/10511250300085721

Gubbins, E. J., Westberg, K. L., Reis, S. M., Dinnocenti, S., Tieso, C. L., Muller, L. M., Park, S., Emerick, L. J., Maxfield, L. R., & Burns, D. E. (2002). *Implementing a professional development model using gifted education strategies with all students* (RM02172). Storrs, CT: The National Research Center on the Gifted and Talented, University of Connecticut.

Guskey, T. R. (1991). Enhancing the effectiveness of professional development programs. *Journal of Educational and Psychological Consultation*, *2*(3), 239-247. doi: 10.1207s1532768xjepc0203_3

Guskey, T. R. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press.

Guskey, T. R. (2002). Professional development and teacher change. *Teachers and Teaching: Theory and Practice*, *8*(3/4), 381-391. doi: 10.2080/135406002100000512

Hancock, D. R., & Algozzine, R. (2006). *Doing case study research: A practical guide for beginning researchers*. New York: Teachers College Press.

Harris, C., & Harvey, A. (2000). Team teaching in higher education classrooms: Toward

collaborative knowledge and construction. *New Directions for Adult and Continuing Education*, *87*, 25-32. doi: 10.1002/ace.8703

Hawley, W., & Valli, L. (1999). The essentials of effective professional development. In L. Darling-Hammond & G. Skyes (Eds.), *Teaching as the learning profession: Handbook of policy and practice*. San Francisco: Jossey-Bass Publishers.

Hollingsworth, L.S. (1942). *Children above 180 I. Q. Standford-Binet: Origin and development*. New York: World Book.

Hourcade, J. & Bauwens, J. (2002). *Cooperative teaching: Rebuilding and sharing the schoolhouse*. Austin, TX: PRO-ED, Inc.

Hrepic, Z., Zollamn, D. A., & Rebello, N. S. (2007). Comparing students' and experts' understanding of content of a lecture. *Journal of Science Education and Technology. 16*(3), 213-224, doi: 10.1007/s10956-007-9048-4

Improving American Schools Act of 1994, Pub. L No. P. L., 103-382, Title XIV, p. 388, (1994).

Jang, S. (2006). Research on the effects of team teaching upon secondary teachers. *Educational Research* 48 (2), 177-194. doi: 10.1080/00131880600732272

Johnsen, S., Witte, M., & Robins, J. (2006). Through their eyes: Students' perspectives of a university-based enrichment program. *Gifted Child Today*, *29*, 56-61. Retrieved from http://www.eric.ed.gov/PDSF/EJ46305.pdf.

Johnson, D. W., & Johnson, R. T. (1994). *Leading the cooperative school* (2nd ed.). Edina, MN: Interaction Book Company.

Johnson, D. W., & Johnson, F. F. (1997). *Joining together: Group theory and skills*. Needham Heights, MA: Allyn & Bacon.

Killen, D., & Murphy, D. (2003). *Introduction to type and conflict*. Palo Alto, CA: CPP, Inc.

Knowles, M. S. (1990). *The adult learner: A neglected species* (4th ed.) Houston, TX: Gulf Publishing.

Krebs, D., Richards, S., Tomlinson, C., Kasak, D., & Robinson, L. (2005, January). Meeting the needs of high-ability and high-potential learners in the middle grades. *A Joint Position Statement of the National Middle School Association & the National Association for Gifted Children*, Retrieved from http://www.nagc.org/index.asp?id=400

Kuipers, B., Higgs, M., Tolkacheva, N., Witte, D., & Marco, C. (2009). The influence of Myers-Briggs type indicator profiles on team development processes: An empirical study in the manufacturing industry. *Small Group Research*, *40*, 436-464. doi: 10.1177/1046496409333938

Lawrenz, F., Huffman, D., & Appeldoorn, K. (2002). *Classroom observation handbook*. St. Paul, MN: The College of Education & Human Development, University of Minnesota.

Maguire, P. (1994, January). Developing successful collaborative relationships. *Journal of Physical Education, Recreation, and Dance*, *65*, 32-36. Retrieved from http://www.proquest.umi.com/pqdweb?index=12&sid=1&srchmode=3&vinst=PROD&fmt=6&sartpage=-1&clientid=87&vname=PQD&RQT=309&did=5026691&scaling=FULL&ts=1318700807&vtype=PQD&aid=1&rqt=309&TS=1318700911&clientld=87

Marland, S. P. (1972). *Education of the gifted and talented: Report to the Congress of*

the United States by the U. S. Commissioner of Education. Washington, D C: Department of Health, Education and Welfare.

Martin, L. (2008). Transforming ourselves: Developing the multiprofessional team. In M. Weaver (Ed.), *Transformative learning support models in higher education: Educating the whole student* (pp. 149-163). London: Facet.

McCombs, B. L., & Whisler, J. S. (1997). *The learner-centered classroom and school*. San Francisco, CA: Jossey-Bass.

McHugh, M. W. (2006). Governor's school: Fostering the social and well-being of gifted and talented students. *Journal of Secondary Gifted Education*, *17*, 178-186. Retrieved from http://www.eric.ed.gov/PSF/EJ746054.pdf

Mezirow, J. (1991).*Transformative dimensions of adult learning*. San Francisco, CA: Jossey-Bass.

Miles, M. B. & Huberman, A. (1994). *Qualitative data analysis* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Murawski, W. W., & Swanson, H. L. (2001). A meta-analysis of co-teaching research: Where are the data. *Remedial and Special Education*, *22*, 258-267. doi: 10.1177/074193250102200501

Myers, I., & McCaulley, M. (1985). *Manual: A guide to the development and use of the Myers-Briggs Type Indicator*. Palo Alto, CA: Consulting Psychologists Press.

National Center on Educational Restructuring and Inclusion Bulletin. (1995). *National survey on inclusive education: Overview and summary report*, 2, 1-10. Retrieved from http://www.eric.ed.gov/PDFS/ED375606.pdf

National Conference of Governor's Schools (NCOGS). (2010, July 27). *Comprehensive Programs*. Retrieved from http://www.ncogs.org/web/

National Defense Education Act of 2006, 21st Century, H.R. 4734--109th Congress (2006). Retrieved from http://www.govtrack.us/congress/bill.xpd?bill=h109-4734

Neel, A. (1997). *Theories of psychology: A handbook.* New York, NY: Schenkman.

No Child Left Behind Act (NCLB, 2001), 20 U.S.C. § 1074(G). (2004, March). Retrieved from http://www.ed.gov/nclb/methods/teachers/hqtflexibility.html

Olszewski-Kubilius, P., & Seon-Young, L. (2004). Parent perceptions of the effects of the Saturday enrichment program on gifted students' talent development. *Roeper Review*, *26*, 156-165. doi: 10.1080/02783190409554261

Ormrod, J. (1995). *Educational psychology: Principles and applications*. Englewood Cliffs, NJ: Prentice-Hall.

Pajares, F. (2002). *Overview of social cognitive theory and self-efficacy*. Retrieved from http://www.emory.edu/EDUCATION/eff/html

Perry, B., & Stewart, T. (2005). Insights into effective partnership in interdisciplinary team teaching. *System*, *33*(4), 563-573. doi: 10.1016/j.system.2005.01.006

Piaget, J. (1977). The growth of logical thinking from childhood to adolescence. In H. E. Gruber & J.J. Von`eche (Eds.), *The essential Piaget*, (pp. 405-444). New York, NY: Basic Books.

Powell, J. H., & McGowan, T. M. (1996). In search of autonomy: Teachers' aspirations and exceptions from a school-university collaborative. *Teaching and Teacher Education*, *12*, 249-260. doi: 10.10610742-051x(95)00039-M

Price, B. J., Mayfield, P. K., McFadden, A. C., & Marsh, G. E. (2000). Chapter 3:

Collaborative teaching. *Special Education for Inclusive Classrooms*, Retrieved from http://www.parrotpublishing.com/Inclusion_Chapter_3.htm

Ravid, R., & Handler, M. G. (2001). *The many faces of school-university collaboration: Characteristics of successful partnerships.* Englewood, CO: Teacher Ideas Press.

Reidy, R. F. (2007). *Texas Higher Education Coordinating Board: Texas Governor's School – University of North Texas Final Report FY07* (Report filed October 29, 2007 with the Texas Higher Education Coordinating Board).

Reidy, R. F. (2008). *Texas Higher Education Coordinating Board: Texas Governor's School – University of North Texas Final Report FY08* (Report filed October 30, 2008 with the Texas Higher Education Coordinating Board).

Reidy, R. F. (2009). *Texas Higher Education Coordinating Board: Texas Governor's School – University of North Texas Final Report FY09* (Report filed October 30, 2009 with the Texas Higher Education Coordinating Board).

Renzulli, J. S. (2005). The three-ring conception of giftedness: A developmental model for promoting creative productivity. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (pp. 246-279). New York: Cambridge University Press.

Rice, D., & Zigmond, N. (2000). Co-teaching in secondary school: Teacher reports of developments in Australian and American classrooms. *Learning Disabilities Research and Practice, 15*, 190-197. doi: 10.1207/SLDRP1504_3

Rideout, C. A., & Richardson, S. A. (1989). A teambuilding model: Appreciating differences using the Myers-Briggs Type Indicator with developmental theory.

Journal of Counseling and Development, *67*, 529-533. Retrieved from http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=22&hid=19&sid=10d58373-47cd-4f9a-8b05-c0d49474875c%40sessionmgr4

Robinson, B., & Schaible, R. M. (1995). Collaborative teaching. *College Teaching*, *43*, 57-59. doi: 10.1080/87567555.1995.99525515

Robinson, A., Shore, B., & Enersen, D. (2007). *Best practices in gifted education: An evidence-based guide*. Waco, TX: Prufrock.

Ross, J. A., & Bruce, C. (2007). Teacher self-assessment: A mechanism for facilitating professional growth. *Teaching and Teacher Education, 23*, 146-159. doi: 10.1016/j.tate.2006.04.035

Sawada, D., Piburn, M., Turlry, J., Falconer, K., Benford, R., & Bloom, I. (2000). *Reformed teaching protocol (RTOP) (ACEPT Technical Report No. IN00-1).* Tempe, AZ: Arizona Collaborative for Excellence in the Preparation of Teachers.

Scruggs, T. E., Mastropieri, M. A., & McDuffie, K. A. (2007). Co-teaching in inclusive classrooms: A meta-synthesis of qualitative research. *Exceptional Children*, *73*, 392-416. Retrieved from http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=23&hid=19&sid=10d58373-47cd-4f9a-8b05-c0d49474875c%40sessionmgr4

Shaplin, J. T. & Olds, H. F. (1964). *Team Teaching*. New York, NY: Harper and Row.

Skoog, G. D. (1993). Peer coaching among university professors: a personal analysis and commentary. In R. Anderson & K. Snyder (Eds.), *Clinical supervision: Coaching for higher performance* (pp. 295-310). Lancaster, PA: Tehnomic.

Sliverman, L. (1993). *Characteristics of Giftedness Scale*. Denver, CO: Gifted

Development Center: A Service of the Institute for the Study of Advanced Development.

Snyder, K. J., & Anderson, R. H. (1986) *Managing productive schools: Toward an Ecology*. Orlando, FL: Academic Press College Division.

Sternberg, R. J. (1986). A triarchic theory of intellectual giftedness. In R. J. Sternberg & J. E. Davidson, (Eds.). *Conceptions of giftedness* (pp. 223-243). Cambridge: Cambridge University Press.

Stuart, J., & Rutheford, R. (1978, September). Medical student concentration during lectures. *Lancet*, *23*, 514-516. doi:10.1016/S0140-6736(78)92233-X

Tannenbaum, A. J. (1986). Giftedness: A psychosocial approach. In R. J. Sternberg & J. E. Davidson, (Eds.). *Conceptions of Giftedness* (pp. 21-52). Cambridge: Cambridge University Press.

Teaching observation protocol center for science and mathematics education research. (2009). The Maine Center for Research in STEM Education, University of Maine, Orono, ME. Retrieved from http://www/umain.edu/center/files/2009//11/Maine-RiSE-Center-Teaching-Observation-Protoc.pdf

Terman, L. M. (1925). *Genetic studies of genius*. Stanford, CA: Stanford University Press.

Terman, L. M., & Oden, M. H. (1951). The Stanford studies of the gifted. In P. Witty (Ed.), *The gifted child* (pp. 20-46). Boston, MA: D. C. Heath.

Thousand, J., Nevin, A., & Fox, W. (1987). Inservice training to support education of learners with severe handicaps in their local schools. *Teacher Education and*

Special Education, *10*, 4-14. doi: 10.1177/088840648701000102

Thousand, J., Villa, R., Nevin, A., & Paolucci-Whitcomb, P. (1995). A rationale and vision for collaborative consultation. In W. Stainback & S. Stainbak (Eds.), *Controversial issues confronting special education: Divergent perspectives* (pp. 223-232). Baltimore, MD: Paul H. Brookes.

Tomlinson, C. A. (1999). *The differentiated classroom: Responding to the needs of all learners*. Alexandria, VA: Association for Supervision and Curriculum Development.

Tunniliffe, C. (2010). *Teaching able, gifted, and talented children*. Thousand Oaks, CA: SAGE Publications Ltd.

Vella, R. A., Berardinelli, P. & Burrow, J. (1998). *How do they know they know: Evaluating adult learning.* San Francisco, CA: Jossey-Bass.

Villa, R. A., Thousand, J. S., & Nevin, A. I. (2008). *A guide to co-teaching: Practical tips for facilitating student learning*. Thousand Oaks, CA: Corwin Press.

Vygotsky, L. S. (1987). *Mind and society: The development of higher mental processes*. Cambridge, MA: Harvard University Press.

Wallace, B., Leyden, S., Montgomery, D., Winstanley, C., Pmerantz, M., & Fitton, S. (2010). *Pupils within an inclusive setting: Partial strategies for developing best practices*. New York, NY: Routledge.

Wallace, T., Anderson, A., & Bartholomay, T. (2002). Collaboration: An element associated with the success of four inclusive high schools. *Journal of Educational & Psychological Consultation*, 13, 349-381. doi: 10.1207/S1532768XJEPC1304_05

Wendel, R., & Heiser, S. (1989). Effective instructional characteristics of teachers of junior high gifted students. *Roeper Review*, *11*, 151-153. doi: 10.1080/02783198909553192

Wenger, M. S., & Hornyak, M. J. (1999). Team teaching for higher level learning: A framework of professional collaboration. *Journal of Management Education*, *23*, 311-327. doi: 10.1177/105256299902300308

Wheeler, P., Hunton, J., & Bryant, S. (2004). Accounting information system research opportunities using personality type theory and the Myers-Briggs Type Indicator, *Journal of Information Systems*, *18*, 1-19. doi: 10.2308/jis.2004.18.1.1

Wild, M. D., Mayeaux, A. S., & Edmonds, K. P. (2008). *Team work: Setting the standard for collaborative teaching, grades 5-9.* Portland, ME: Stenhouse.

Wilhelm, R. (2004). *Texas center for education technology: The Anderson interview.* Retrieved from http://www.tect.unt.edu/weblibrary2/laureate/?id=1&uid=anderson

Wilson, S., & Berne, J. (1999). Teaching learning and acquisition of professional knowledge: An examination on contemporary professional development. *Review of Research in Education*, *24*, 173-209.doi: 10.3102/0091732X024001173

Wright, P. & Leroux, J. (1997). The self concept of gifted adolescents in a congregated program. *Gifted Child Quarterly*, *41*(3), 83-94. doi: 10.1177/001698629704100304