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All Students Are Not Equal: A Case Study of Geometry Teachers’ Instructional Strategies When Trained in Multiple-Intelligence-Based Practices in Secondary Classrooms

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All Students Are Not Equal:
A Case Study of Geometry Teachers’ Instructional Strategies When Trained in Multiple-Intelligence-Based Practices in Secondary Classrooms

by
Cassandre Y. Davis

An Applied Dissertation Submitted to the Abraham S. Fischler College of Education in Partial Fulfillment of the Requirements for the Degree of Doctor of Education

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Approval Page

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Cassandre Y. Davis
Name

April 10, 2017
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I thank my parents, Evelyn and Yves Fontaine. Your plight coming to this country, hard work, and tears were not in vain. I thank you for the first book you read to me. I know this process did not begin when I entered this program but when you chose to begin my education outside of the classroom. I thank my siblings, Sabrina, Jennifer, Yves Jr., and Jean-Philippe for loving and supporting me and for the constant comic relief! I thank my in-laws, extended family, cousins, and friends for your love and patience. I thank my aunts and uncles who are here and those who have transitioned for supporting and loving my parents and me. I thank the generation of children behind me for encouraging me to set an example. Finally, I thank everyone who helped me directly, indirectly, intentionally, and accidentally. All efforts worked for my good.
Abstract

All Students Are Not Equal: A Case Study of Geometry Teachers’ Instructional Strategies When Trained in Multiple-Intelligence-Based Strategies in Secondary Classrooms. Cassandre Y. Davis, 2017: Applied Dissertation, Nova Southeastern University, Abraham S. Fischler College of Education. Keywords: Marzano, geometry, van Hiele, multiple intelligences, secondary school

Over 50% of secondary students failed the geometry end-of-course test in a Florida school district, indicating a need to improve academic performance. Secondary school students’ learning characteristics and the effectiveness of teachers’ instructional strategies are imperative to educational success. In this qualitative case study, geometry teachers’ instructional strategies, as defined by the Marzano Causal Teacher Evaluation Model, were explored once teachers were informed of students’ multiple intelligences and trained in multiple-intelligence-based lessons.

Participants were 2 geometry teachers and 15 secondary geometry students in a traditional public school. Using Howard Gardner’s multiple intelligences theory and the van Hiele model of learning geometry, the researcher analyzed interviews, observations, and teachers’ lesson plans to shed light on teachers’ use of multiple intelligence data and training.

Significant conclusions emerged from the findings of the case study. First, teachers’ dominant intelligences shape the use of instructional strategies. Second, multiple intelligences were used to personalize instruction, create a student-centered classroom environment, and nurture student engagement among secondary geometry learners. Lastly, when instructors taught based on students’ van Hiele levels, 5 of 8 intelligences are excluded. Teachers used strategies steeped in spatial, logical, and linguistic intelligences to teach students how to draw, think, and write. Strategies for students with interpersonal, intrapersonal, musical, naturalist, and kinesthetic intelligences were excluded.

Based on the conclusions of the study, educators have new information on ways to make geometry instruction more inclusive for their diverse learning population. Education stakeholders are also enlightened with what may be missing in geometry classrooms and impeding student success.
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Chapter 1: Introduction

Statement of the Problem

   While illiterates are ashamed of their inability to read, innumerates often take a
kind of pride in their mathematical ignorance. People who would never admit to
not knowing anything about Shakespeare—even if that were the case—will
openly boast that they can’t balance their checkbooks. (Chu, 1989, para. 4)

Americans’ lack of knowledge in mathematics has resulted in a decline of capable and
talented math learners. Nationally, the proficiency rates of fourth-grade math students
have not changed from 2009 to 2011 (National Assessment of Educational Progress,
2011). The number of students entering college with math-intensive majors fell 25%
between 1982 and 2012 (Vigdor, 2012). According to Lawrence (2012), nearly 44% of
Florida students failed the mathematics portion of the Florida College System’s entrance
exam, compared to less than a third failing the writing and reading parts of the test.

   Educators have made efforts to increase literacy (Pittman & Honchell, 2014). However,
there is a need for academic improvement in mathematics (Connor, 2011).

   Many students in Florida have never mastered basic math skills, resulting in a
need for remediation upon entrance to college (Sladky, 2010). The proportion of students
requiring remedial classes upon admission to a local Florida community college was 74%
in 2009 (Sladky, 2010). Algebra and geometry are among the remedial courses taken by
college students (Doherty, 2016). Geometry assessments measure students’
understanding of shapes, relationships between shapes, and properties of plane figures
(National Center for Education Statistics, 2013). In high school, more students passed the
annual end-of-course (EOC) test in algebra than the annual EOC test in geometry in 2013
(Yi & Travis, 2013). In Broward County, Florida, 47% of 10th graders, 69% of 11th graders, and 70% of 12th graders failed the geometry EOC test in the spring of 2012 (Florida Department of Education, n.d.).

A growing number of education experts believe the country must revamp the way students are taught mathematics in order to correct current math failure (Conner, 2011). One area of potential change is teachers’ use of students’ affective characteristics (Boylan, 2011). According to Nolting and Nolting (2008), teachers must consider learning characteristics of all students when teaching mathematics. Learning characteristics, such as learning styles or intelligences, involve the ways students learn information. By knowing how a learner approaches the solution to a problem and understands content, educators can help the learner succeed (Strother & Alford, as cited in Koslo, 2010). Both learning style and intelligence are related to a student’s potential for learning. Whereas learning preference is described as a fixed method in which students understand information (Wilson, 2012), intelligence is an aptitude among several types of processes used to solve a problem (Chen & Gardner, 2012). Learning preferences and intelligences can be used by teachers to help direct a student’s learning.

A teacher’s ability to meet the needs of all students is highly dependent on the teacher’s awareness of each student’s academic strengths and weaknesses (Strother & Alford, as cited in Koslo, 2010). Teachers’ knowledge of students’ intelligences can inform teachers’ planning and instruction. Providing teachers with such information can better prepare teachers who will subsequently better prepare students for success in all classes, especially those shown to be more difficult, such as geometry.

**Topic.** The topic of this dissertation study is the investigation of geometry
teachers’ instructional strategies when informed of students’ multiple intelligences and trained in multiple-intelligence-based strategies in a Florida public high school. Geometry instructors are charged with teaching a highly abstract course infused with analytical thinking to diverse students. Teaching practices based on students’ characteristics may improve instruction. In this qualitative study, the classroom practices of secondary geometry teachers trained in multiple-intelligence-based strategies were explored.

**Research problem.** Teacher knowledge, teaching style, and student characteristics are important factors in teaching mathematics (Boylan, 2011; De Corte, Verschaffel, & Eynde, 2000; Di Fatta, Garcia, & Gorman, 2009; Polly, 2006). According to Polly (2006), a teacher must be well versed in mathematics and flexible in teaching styles to effectively teach. At the dissertation research site, a high school in Florida, all mathematics teachers hold a professional teaching certificate confirming their competence in the area of mathematics. Teaching styles are not formally addressed but are part of the evaluation process (Marzano, 2012). Teachers are expected to use varying strategies and techniques to reach a population of students with diverse learning characteristics such as learning style and intelligences. However, teachers are not informed of their students’ learning characteristics. The multiple intelligences of the various students present in a randomly assigned class are not formally assessed or reported to the teacher who is charged with and responsible for students’ academic achievement. Within a challenging course such as geometry, students are faced with high-stakes deadlines and requirements affecting graduation and future educational endeavors. Information must be presented through effective strategies that meet the
specific needs and attributes of each student in order to maximize academic achievement in mathematics (Nolting & Nolting, 2008). There is a need to investigate teachers’ instructional methods and strategies when informed and trained in multiple-intelligence-based teaching strategies. Knowledge of students’ learning characteristics will allow teachers to provide more personalized instruction from the beginning of the school year.

**Background and Justification**

High school mathematics teachers in Florida currently have a maximum of 25 students per class as dictated by the Class Size Reduction Amendment (Florida Department of Education, n.d.). Lawmakers created a statute in support of smaller class settings to produce opportunities for more personalized instruction to meet the demands of diverse learning populations. Diverse learning populations consist of students with varied abilities and learning characteristics such as multiple intelligences or learning styles. Part of meeting the demands of a diverse learning population is the effective use of teaching methods such as differentiated instruction. Promoted by Tomlinson (2004), differentiated instruction is the practice of “ensuring how and what a student learns is a match for the student’s readiness level, interest, and personal mode of learning” (p. 188). In the mainstream classroom, differentiated instruction means presenting information in a variety of ways to match student needs. For instance, a teacher may present information through a chart explaining each step for the student who best learns through visual representation. Also, a teacher may create a song with the necessary steps for students who are best with auditory representations.

In a study of differentiated instruction used by elementary teachers, results included increased academic achievement in mathematics when instruction was given in
a more personalized manner through differentiated instruction than delivering instruction in one manner such as lecture or note taking (Kelly, 2013). Although differentiated instruction has shown to be successful and is required of secondary teachers, adequate information has not been provided to teachers concerning students’ interest and mode of learning. Differentiated instruction may be more beneficial if teachers are equipped with information regarding the learning characteristics of each child. Although teachers are expected to reach every child, teachers are not given a full picture of the students in their classrooms. Basic information is disseminated such as demographics, socioeconomic levels, and test scores; however, affective characteristics are not collected or distributed. Knowledge of student intelligences can aid a teacher in creating personalized lessons to meet the needs of individual students (Matthews, 2006; Shuhan, 2006). The teacher’s ability to recognize students’ strengths and weaknesses is imperative in all subjects, especially more difficult subjects such as geometry. Geometry is one of the weakest areas in mathematics for U.S. students (Fuson, Clements, & Beckmann, 2006).

Many students, due to their inadequate training and exposure to geometric principles from early childhood, are ill equipped by the time they reach secondary school (Corley, 1990; Schwartz, 2010). Subsequently, geometry is a difficult subject for many students (Fuson et al., 2006). As reported by the Florida Department of Education (2013), in the spring of 2013, 47% of 10th graders and 66% of 11th graders failed the Florida Geometry EOC test. Students in Broward County fared similarly with a failure rate of 39% for Grade 10 and 69% for Grade 11. One of the lowest scoring schools in Broward County reported 55% of test takers failing the Florida geometry EOC test (Florida Department of Education, 2013).
As a math teacher with 9 years of experience teaching geometry and other courses, the researcher has seen students express frustration with teaching methods and practices and wondered if a personality difference was an issue. As a former lead teacher in Algebra I and Geometry, the researcher has taken part in several teacher development programs. Multiple intelligences or any data concerning students’ learning characteristics were not addressed during the teacher development programs in which she participated. The researcher understands the dynamics in the relationships between teacher and student and the challenges faced when trying to manage 25 different personalities and expectations. If teachers are given a means or a tool to identify student learning characteristics such as intelligence, teachers may have a better idea of how to tailor lesson plans, activities, and assessments. Based on the researcher’s experience, differentiated instruction is a beneficial practice. However, differentiation may be better if teachers know which students to differentiate instruction for and which specific methods to use. Teachers may have more insight into the dynamics of their classrooms if they are aware of the type of learners present.

**Deficiencies in the Evidence**

In a study by Davis (2012), multiple-intelligence-based lesson plans were used in a sixth-grade class of 15 students. After assessing the dominant intelligence of each student in the experimental group, students were taught with multiple-intelligence-based strategies (Davis, 2012). The same teacher then instructed another group of 15 students using a traditional mode of teaching. After administering pre- and posttests to both groups, Davis concluded students in the experimental group showed no significant academic gains in mathematics when compared to students who had not been taught
using multiple-intelligence-based teaching strategies. Davis suggested future research should investigate the implementation of multiple-intelligence-based strategies with students of varied demographics such as age or gender.

In addition, Hardy (2005) investigated secondary students’ perspectives of learning in an atmosphere of conflicting methods. Hardy espoused a critical theory and multiple-intelligence-based framework and noted students were not given a fair opportunity to learn because the dominant teacher-centered method of lecture and note taking was in direct opposition to the learning modes of the African American students studied. Hardy suggested education reform begin with empowering students with their learning strengths based on multiple intelligences theory to ensure all students are adequately educated and supported in all subjects. Hardy also emphasized future studies should explore teachers’ understanding and use of multiple-intelligence-based practices.

The current research has extended Hardy’s (2005) study by informing and training teachers in the application of teaching strategies based on the understanding of multiple intelligences in secondary geometry classrooms. Multiple intelligences have been explored as a tool to identify elementary students’ weaknesses and strengths (Davis, 2012; Sohn, 2003). However, the researcher’s efforts to review published research on the role of teachers’ awareness and implementation of multiple-intelligence-based strategies among secondary mathematics students school revealed a gap in the published research. The current study was designed to fill this gap through an investigation of the use of multiple-intelligence-based strategies within a diverse high school population.

**Audience**

Findings from this study could assist administrators in supporting teachers in
creating lessons and providing instruction for all learners. Teachers may have greater insight, as a result of multiple intelligences training, into how students learn based on students’ intelligences. Teachers also will have increased knowledge of effective instructional methods. Finally, researchers can benefit from the study, as it was designed to fill a gap in the existing research.

**Definition of Terms**

*Differentiated instruction* involves a teacher making adjustments in pace, materials, assessments, and mode of delivery to customize instruction for each student (Tomlinson, 2004).

The *Marzano Teacher Evaluation Model*, also called the *Marzano Causal Teacher Evaluation Model*, is a proprietary method of restructuring teacher evaluations in an effort to develop effective instructors (Learning Sciences, 2014). The four domains of Marzano’s model are designed to delineate methods and practices proven to result in raising student achievement and developing instructor expertise: (a) classroom strategies and behaviors, (b) planning and preparing, (c) reflecting on teaching, and (d) collegiality and professionalism (Learning Sciences, 2014).

*Multiple intelligences* is a term created by Howard Gardner describing the different intelligences possessed by all individuals (Chen & Gardner, 2012). Among eight varying types of intelligence, each person has a dominant intelligence and a unique combination of strengths and weaknesses among the remaining intelligences (Chen & Gardner, 2012; Davis, 2012).

The *van Hiele model* is a description of students’ levels of understanding of geometric principles. The successful progression through the five van Hiele levels
includes (a) visualization, the ability to identify shapes; (b) analysis, classifying shapes based on their properties; (c) informal deduction, recognizing the relationship between shapes; (d) deduction, understanding the relationship between definitions, theorems, and postulates; and (e) rigor, or understanding abstract axiomatic systems (Erdogan, Akkaya, & Celebi Akkaya, 2009; van Hiele, 1999).

**Purpose of the Study**

The purpose of this dissertation study was to investigate geometry teachers’ instructional strategies when informed of students’ multiple intelligences and trained in multiple-intelligence-based teaching strategies in a high school in Florida. Currently, students in several high schools in the district are not performing satisfactorily on the state EOC exam in geometry. Part of student failure may be due to ineffective instruction. In an effort to explore methods that may improve the personalization and instruction for each student, the researcher investigated teaching strategies and students’ multiple intelligences in geometry classrooms.
Chapter 2: Literature Review

This chapter describes literature on topics surrounding student outcomes in geometry, teaching methods, multiple intelligences in classroom instruction, and the implication of multiple intelligences in learning and teaching geometry. Beginning with data outlining student failure in geometry and student characteristics, teaching techniques such as differentiated instruction and differentiation through multiple intelligences are described. Next, the theory of multiple intelligences and the use of multiple intelligences in instructional strategies within classrooms of varied subjects (including geometry) are discussed. Finally, additional literature is included to support the use of a research-based teacher evaluation model to describe teachers’ instructional strategies.

History of the Challenges of Mathematics

Education is the root of success. As a result, the consequences of a failed education are paramount. Global academic practitioners agree certain subjects must be mastered and understood by members of society for the progression and self-sufficiency of civilization. Mathematics, specifically, is an extremely important discipline inclusive of topics ranging from geographical principles to global economics. In fact, the subject predates formal education (Glinert, 2009). The primary purpose of mathematics is to meet societal needs. Historically, various civilizations kept track of land, crops, and animals through basic computation and the use of symbols (Glinert, 2009). In addition, rudimentary geometry was used in building pyramids in Egypt before formulas were documented for public use (Glinert, 2009).

As global society has become more technologically advanced, the need to understand mathematics is a growing requirement. Subsequently, math education is part
of the formal curriculum in public schooling in many countries. Students are trained in algebra, geometry, and trigonometry for practical uses (Glinert, 2009). One of the most difficult subjects to master is geometry (Fuson et al., 2006; Yi & Travis, 2013). Geometry connects mathematics to real-world topics such as shapes, measurement, and space (Fuson et al., 2006; National Assessment of Educational Progress, 2011). The study of geometry aids students in abstract thinking and problem-solving skills necessary in America’s highly competitive, technologically advanced culture (Fuson et al., 2006; Obama, 2013). Geometry is among the most important mathematical disciplines taught and used both informally and formally throughout time (Fuson et al., 2006; Glinert, 2009).

In the United States, students are taught geometrical principles from ages 5–18 (Fuson et al., 2006). Despite the years of training, a substantial number of students are failing mathematics assessments, such as the international mathematics test, Programme for International Student Assessment, and EOC exams. According to the National Center for Education Statistics (2013), only 9% of American students are among the world’s top performers on the international mathematics test, the Programme for International Student Assessment. In 2012, the U.S. scoring percentage was higher than 29 education systems, lower than 26 education systems, and not significantly different from nine education systems (National Center for Education Statistics, 2013). Domestic mathematic scores are also poor. On the Florida geometry EOC test, 47% of 10th graders and 66% of 11th graders statewide received a failing score (Florida Department of Education, 2013). Within the study school district, 39% of 10th graders and 69% of 11th graders also received a failing score on the spring geometry EOC assessment.
Education researchers have explored multiple methods to increase student achievement in geometry. Use of technology (Myers, 2010), adjustments in school logistics (Freeman, 2008; Sugg, 2013; Trinkle, 2011), and investigations of teacher characteristics (Klein, 2014) have resulted in mixed findings in student achievement. Additionally, classroom populations have diversified. A new focus on teacher practices has been implemented within recent years in an effort to increase student achievement in all subjects, including mathematics. The benefits and setbacks of these reforms are evident in present-day classrooms.

**Mixed and Inclusive Classrooms**

Current challenges in the general classroom range from language barriers to the special requirements of students with disabilities. Teachers became increasingly aware of these challenges in the mid-1990s. Prior to 1996, an average secondary mathematics classroom consisted of one teacher with approximately 25 mainstream, general education students (Fix & McHugh, 2009). Because of migration to the United States, a large number of foreign students became part of the American student body. Teachers became responsible for educating students with limited English proficiency skills, known as English language learner (ELL) students (Dekutoski, 2011). An ELL is a student who does not speak English with enough proficiency to participate fully in mainstream classroom teaching (Dekutoski, 2011).

The population of individuals with limited English proficiency skills doubled between 1996 and 2006 in the United States (Fix & McHugh, 2009). With an increase of students requiring additional support, teachers had to be equipped with new techniques and strategies to address the unique cultural differences and academic needs of their
students. Understanding the needs of ELL students has been challenging for teachers. Upon surveying 100 teachers in regards to teacher attitudes toward ELL students, Dekutoski (2011) found while teachers were accepting of ELL students, teachers faced challenges such as a lack of time, resources, support, and guidelines to address the needs of all students.

Moreover, because of the Individuals With Disabilities Education Improvement Act (2004), students with disabilities are also now included in the mainstream classroom in an effort to give students with disabilities an opportunity to expand their learning opportunities (Steffes, 2010). Steffes (2010) indicated students with learning disabilities have difficulty in reading (dyslexia), writing (dysgraphia), or mathematics (dyscalculia). Teachers are now required to teach students with learning disabilities alongside students in a general classroom, commonly referred to as an inclusive classroom setting (Steffes, 2010). Prior to the implementation of the Individuals With Disabilities Education Improvement Act of 2004, a special education teacher taught students with learning disabilities in a segregated setting.

To facilitate the change from special education classrooms to general classrooms, general teachers use a student’s Individualized Education Program (IEP) to guide classroom instruction and assessment. An IEP describes specific interventions for special-needs students to address academic objectives (Steffes, 2010). The IEP also describes the required adjustments to classroom instruction and assessment necessary for the student’s academic success, known as the student’s accommodations. Accommodations are defined as changes in test administration or coursework that do not substantially alter what the test or assignment measures; accommodations are designed
only to level the playing field in the identified area of skill deficit area (Wright & Wright, as cited in Steffes, 2010). Examples of accommodations include providing notes to the student, providing additional time on timed assessments, or reteaching students in small-group settings (Steffes, 2010).

The required accommodations have been difficult to implement for general classroom teachers. In a phenomenological study by Steffes (2010), eight secondary teachers described their perceptions of accommodations for students with learning disabilities in inclusive classrooms. Teachers cited “lack of self-advocacy by students with LD [learning disabilities], lack of communication and involvement by case managers,” lack of resources, and increased class sizes as barriers to success (Steffes, 2010, p. 123). To help bridge the instructional gap between learning groups and students, teachers practice differentiated instruction.

**Differentiated Instruction**

In classrooms with several personalities, abilities, and needs, a teacher must be able to present information in a manner that meets the academic requirements of each student. Differentiated instruction is a teacher’s adjustments in pace, materials, assessments, and mode of delivery to customize instruction for each student (Tomlinson, 2004). A teacher may assess a student’s understanding of a topic via an oral presentation instead of a written test to accommodate the students most comfortable with presentations. Student preferences and strengths fuel differentiated instruction practices. As a result, student characteristics, also referred to as a student’s learning profile, help inform classroom instruction. A learning profile may consist of students’ learning styles, multiple intelligences, and readiness levels.
Differentiated instruction was widely recommended during the late 1990s during a surge of educational reorganization. The global landscape began to change requiring more students to have higher levels of academic achievement beyond a high school diploma (George & McEwin, 1999). Increasing scientific occupations required training in subjects that were more technical. The national push towards the pursuit of college led secondary educators to find new methods, such as differentiated instruction, to increase student achievement levels (George & McEwin, 1999). Differentiated instruction became a method suggested by researchers to meet the needs of all students (Levine, 2012; Williams, 2012). More specifically, the need for differentiation was evident in mixed and inclusive classrooms, which are more prevalent and consistent with today’s educational landscape. The use of differentiated instruction has proven beneficial for all members of the mainstream classroom, such as ELL students and students with special needs.

In a quantitative study, Levine (2012) examined the pre- and posttest scores of students in a remedial math class. Teachers used differentiated instruction as a requirement in the remedial class to help increase academic achievement of the participants. The students were part of various subgroups including limited English language proficiency, lower socioeconomic status, and varied ethnicities. Participants in the 3-year study were 335 math students in Grade 10, of whom 25% were ELL students. Part of the teacher requirements in the remediation class was use of differentiated practices to account for the diverse student population. After the analysis of quantitative data in a comparison between pre- and posttest scores, Levine stated scores improved significantly because of differentiated instruction in the remedial math course.

Teachers in Levine’s (2012) study used strategies such as small-group work and
individual work for math remediation. Similar research has found techniques for ELL students include small adjustments to teachers’ lessons plans, flexible grouping among students, and presentation of information in ways that are manageable to ELL students (Baecher, Artigliere, Patterson, & Spatzer, 2012; Williams, 2012).

Furthermore, within classrooms with special education students, differentiated instruction is a means to bridge the gap between general education and students with special needs in an inclusive classroom environment. A study by Ivory (2007) explored the academic achievement of exceptional learners on state standardized tests after receiving differentiated and peer-mediated instruction interventions. Exceptional learners include a broad range of classifications, such as other health impairment, mild intellectually disabled, emotional and behavioral disorder, and students with a learning disability. Through a mixed methods approach, Ivory compared the mathematics standardized pre- and posttest scores of 21 exceptional middle school learners. Of the 21 exceptional learners, nine students received intervention via differentiated instruction. The passage rate of students receiving differentiated instruction doubled from pretest to posttest with an overall pass rate of 22%. Students receiving peer-mediation intervention passed at a rate of 41%. Based on quantitative data, Ivory (2007) concluded interventions in the exceptional learning math classroom were beneficial depending on the exceptionality of the student and the intervention. Differentiated instruction was a beneficial technique for the exceptional learner.

Beyond classrooms with special populations, schools also use differentiated instruction in mainstream math classes comprised of all learning groups. The use of differentiated instruction has resulted in mixed findings for math students. In a
quantitative study by Kelly (2013), teachers used differentiated instruction and lecturing, also known as whole-group instruction, to understand the level of effectiveness of a differentiated classroom. Instructors gave fifth-grade mathematics students in two separate groups a pretest and posttest on the topics of fractions and percentiles in both the differentiated classroom and whole-group instruction classroom. Students enrolled in the classes where different learning styles were accounted for through differentiated instruction had higher posttest scores than students given one teaching style of whole-group instruction (Kelly, 2013).

Similarly, in a mixed methods study of high school algebra students, Millikan (2012) explored how standardized EOC assessment test scores were affected by teachers’ use of differentiated instruction techniques. The researcher used an experimental group of 87 students and a control group of 85 students. Instructors used differentiated instruction techniques such as collaborative group work and projects involving critical thinking. Teachers used direct instruction for students in the control group. Direct instruction is teacher-centered instruction that focuses on the teacher and not the student. Data collected through test results, interviews, and classroom observations revealed neither method was more beneficial than the other. Although student test scores did not increase in the experimental group, teachers reported that students’ understanding benefited with the implementation and support of both techniques (Millikan, 2012).

Although differentiated instruction has been shown to be successful in some areas and inconclusive in others, educators continue to seek additional ways to differentiate instruction. As a result, consideration of a student’s learning characteristics such as learning styles and multiple intelligences became a method to differentiate instruction.
The current study adds to the research on methods to differentiate instruction in a mixed and inclusive classroom through the incorporation of student’s multiple intelligences into teachers’ instructional strategies.

**Theoretical Framework of Multiple Intelligences**

Intelligence is the potential to process information and solve problems deemed valuable by a society or culture (Chen & Gardner, 2012). Howard Gardner, developer of the theory of multiple intelligences, purported individuals may possess several different intelligences (Chen & Gardner, 2012). These varied intelligences are classified as follows: “verbal-linguistic (word smart), logical-mathematical (number sense/reasoning smart), visual-spatial (picture smart), bodily-kinesthetic (body smart), musical (music smart), interpersonal (people smart), and intrapersonal (self), and naturalist (earth smart)” (Shuhan, 2006, pp. 5–6). Each different intelligence is explained below.

**Linguistic-verbal.** Persons with linguistic intelligence have the ability to use words effectively. The capability to use words to inform others, remember information, and convince others to complete specific tasks is indicative of verbal-linguistic intelligence (Armstrong, 2009). Poetry, playwriting, editing, and journalism exemplify oral and written expressions of linguistic intelligence (Armstrong, 2000).

**Logical-mathematical.** Valued in the area of scientific discoveries and mathematical theories, persons with logical-mathematical intelligence tend to discern logical or numerical patterns (Armstrong, 2009). These persons use numbers effectively and have increased reasoning abilities. Processes such as categorization, inference, and generalization are used in the application of logical-mathematical intelligence (Armstrong, 2000).
**Visual-spatial.** Shared by members of the hunting or scouting profession, individuals with visual-spatial intelligence perceive the visual-spatial world with precision and accuracy. Persons with this intelligence are also able to transform their visual accuracy into tangible products as exemplified by interior decorators or architects. Visual technologies such as video games and graphic design create an avenue of expression for individuals with visual-spatial intelligence.

**Bodily-kinesthetic.** Highly important during the agrarian period of history, persons with bodily-kinesthetic intelligence are able to control body movements and are skillful with coordination, strength, and balance (Armstrong, 2009). Persons with this intelligence are also able to use their physical movements to convey and express ideas. Common professions of persons with bodily-kinesthetic intelligence are athletics, dancing, and sculpting (Armstrong, 2009).

**Musical.** Persons with musical intelligence have “sensitivity to the rhythm, pitch or melody, and timbre or tone color of a musical piece” (Armstrong, 2000, p. 2). The capacity to perceive, discriminate, transform, and express musical forms is present with individuals with musical intelligence. Seen in professions like composing or producing, this intelligence involves the appreciation of music from an intuitive aspect, a technical aspect, or both (Armstrong, 2000).

**Interpersonal.** Most applicable in areas involving service and hospitality, interpersonal intelligence involves one’s ability to discern the emotions, moods, motivations, and desires of others (Armstrong, 2009). Persons with this intelligence are sensitive to social cues like gestures, voice inflections, and facial expressions of other people. Highly interpersonally intelligent people also can react appropriately to external
cues via rational and sensible responses (Armstrong, 2000).

**Intrapersonal.** Persons with intrapersonal intelligence have a deep understanding of one’s own emotions, strengths, and weaknesses. Armstrong (2000) defined this intelligence as one’s personal understanding of one’s limitations, inner moods, and temperaments with the ability to “act adaptively on the basis of that knowledge” (p. 2). Fields such as theology and psychology value interpersonal intelligence.

**Naturalist.** The ability to, formally or informally, distinguish the relation between species is indicative of one who has naturalist intelligence. An animal activist or biologist shares in the ability to recognize the existence of neighboring species. One with naturalist intelligence is also sensitive to natural phenomena (Armstrong, 2000).

**Multiple Intelligences and Student Outcomes**

**Use in inclusive classrooms.** In mixed classrooms, researchers have extended the use of differentiated instruction to include multiple intelligences theory with mixed results. Accommodations for students’ intelligences may assist in developing instructional strategies (Berbaum, 2009). As reported by Nolting and Nolting (2008), a teacher’s awareness of a student’s learning preference, coupled with the correct presentation of information, yields successful results.

Berbaum (2009) explored the attitudes of five general education teachers in the area of differentiated instruction in five inclusive eighth-grade classrooms. Each teacher worked with 23 special education students in the mixed-ability, inclusive classroom. Through a multiple case study perspective, Berbaum discovered the challenges and successes of differentiated instruction practices with the incorporation of multiple intelligences theory with students with specific learning disabilities. Berbaum found,
through observations and interviews, that teachers with limited interpersonal skills had a difficult time executing differentiated instruction practices with special education students. Although teachers were trained in multiple intelligences theory and application during a school-sponsored training event, teachers felt inadequate. Only one of the participants used the student’s learning profile to differentiate assessment for special-needs students. Overall, teachers were unable to successfully differentiate instruction. The main challenge of implementation was “lack of differentiated instruction training, lack of collaborative planning time, and a perceived lack of motivation in students” (Berbaum, 2009, Abstract).

A similar study resulted in a lack of increase in mathematics scores of students taught through differentiated instruction by means of multiple intelligences theory. Roberts (2008) explored through quantitative methods how well 45 middle school students with learning disabilities performed on the reading and math test after being part of an after-school program as compared to students with learning disabilities who were not in the program. The after-school program provided remediation through multiple intelligences research methods, direct instruction, and differentiated instruction. The students with learning disabilities all received education services under the IEP. Roberts found students improved in the area of reading but there was no difference in the mean math scores of students with learning disabilities in the program versus those outside of the program.

Conversely, researchers conducted another study with special-needs students resulting in different findings. In a qualitative study, Etienne (2011) explored which differentiated instructional strategies used by teachers of students with learning
disabilities in a math inclusion class promoted math success. The researcher surveyed and interviewed seven math teachers over a 9-week period to explore the strategies used in a classroom of students with and without learning disabilities. Etienne learned teachers responded favorably towards the use of various strategies in their classrooms. Among the most successful approaches to promoting math success was the incorporation of learning styles and multiple intelligences. Teachers utilized students’ intelligences and learning styles to create student-centered lessons, resulting in an increase in student math success as determined by the inclusion teachers.

Differentiated instruction with an incorporation of multiple intelligences theory with students with special needs has proven to be successful in certain areas of academic achievement. As a result, researchers have sought success using multiple-intelligence-based practices with students in general classrooms across grade levels and subjects. The current study adds to the research on methods of differentiating instruction. Previous conflicting results of research on multiple intelligences in inclusive classrooms warrant further investigation through the lens of the multiple intelligences theory.

**Multiple intelligences and mathematics instruction.** Exploring and encouraging the use of children’s strengths and unique combination of intelligences can create students who are more comfortable with learning and engagement in mathematics (Willis & Johnson, 2001). The presentation of information aligned with a child’s intelligence affects a child’s ability to easily and more efficiently grasp new information (Sohn, 2003). Several researchers have explored the application of multiple intelligences in classroom settings.

Multiple intelligences practices have been explored as a tool to identify students’
weaknesses and strengths among elementary and middle school children in mathematics (Davis, 2012; Nance, 2011; Sohn, 2003). Sohn (2003) studied the incorporation of multiple intelligences into the classrooms of 66 students in sixth grade. The purpose of Sohn’s study was to explore elementary students’ ability to gauge their own intelligences and whether the ability to identify one’s own intelligence resulted in an increased ability to solve mathematics problems. After researcher-created multiple-intelligence-based lesson plans and the assessment of the multiple intelligences of all students, Sohn concluded the use of multiple intelligences tools and teacher-implemented multiple intelligences strategies can aid elementary students in selecting suitable approaches to solve mathematical problems.

Similarly, in a mixed methods study of 200 African American middle school students, Nance (2011) explored mathematics achievement scores of students who received multiple intelligences instruction versus those students who did not receive instruction based on multiple intelligences theory. Participants used multiple intelligences techniques for students whose dominant intelligences included linguistic and bodily-kinesthetic. Nance created two groups, each with 100 African American sixth-grade students. The teacher taught the experimental group using Gardner’s principles. Teachers were taught techniques, were given support during the implementation of techniques, and kept track of the use of each technique. The control group did not receive multiple intelligences instruction. The experimental group had a statistically significant difference in posttest scores from the control group (Nance, 2011). Nance concluded students who received multiple intelligences techniques had a greater increase in mathematics achievement as compared to students who did not receive multiple-intelligence-based
Another study of students yielded a different result than previous works. In a mixed methods study, Davis (2012) identified the dominant intelligences of 15 students in an elementary math class. The students were then taught with multiple-intelligence-based activities. Another group of 15 students were taught mathematics using a traditional mode of teaching by the same teacher. After administering pre- and posttests to both groups, Davis concluded students in the experimental group showed no significant academic gains in mathematics when compared to students who had not been given the multiple-intelligence-based instruction. Davis suggested future research should investigate the implementation of multiple-intelligence-based strategies with students of a different population such as secondary students. The researcher investigated the implementation of multiple-intelligence-based strategies with secondary students as suggested by Davis.

**Multiple intelligences and metacognition in geometry.** Multiple intelligences research has shown mixed results across grade levels and student learning groups, yet a link exists between multiple intelligences and metacognition, which may prove satisfactory in the implementation of multiple intelligences in a geometry classroom. Learning geometric principles requires students’ movement through the van Hiele levels of geometric thought (Corley, 1990; Wang, 2012). The van Hiele model consists of five levels: visualization, analysis, informal deduction, deduction, and rigor (Erdogan et al., 2009; van Hiele, 1999). Different practices are needed to teach students at each level (Mason, 2002). The van Hiele levels are not age dependent but are related to students’ experiences with geometry (Mason, 2002).
At the visualization level, students are able to understand the names of shapes and can sort shapes based on appearance (Erdogan et al., 2009). To facilitate learning at this level, an instructor can practice identifying shapes through exploration and hands-on activities (Groth, 2005). At the analysis level, students begin to understand the properties and characteristics of shapes. Instructors develop understanding by encouraging students to express their understanding of properties through drawings and discussions. At the informal deduction level of the van Hiele model, students begin to draw comparisons and relationships between shapes. In the classroom, an instructor begins to show examples of properties that are common within shapes and test hypotheses. For example, an instructor may ask students to participate in informal deductive arguments such as “whether or not a square can be considered a rectangle” (Groth, 2005, p. 28).

Most students begin high school geometry courses at the analysis or informal deduction level (Mason, 2002). The next level, deduction, however, is the level in which most high school geometry classes are taught and proofs are constructed (Mason, 2002). Teachers use postulates, theorems, and definitions to facilitate learning. Lastly, students move to the rigor level of van Hiele’s (1999) model, whereby students understand and think in terms of abstract mathematical systems. Instructors at the collegiate level are charged with continuing instruction by analyzing and comparing axiomatic systems.

Coupled with an instructor’s strategies, a student’s ability to reflect on personal methods and practices such as multiple intelligences may facilitate movement through the van Hiele levels. As declared by Pandiscio and Orton (1998), using metacognition can help students evolve in the understanding of geometric principles. Metacognition is understanding one’s thought process through reflection and other self-regulating practices.
(Borkowski, 1992; Buckheit, 2010). Buckheit (2010) suggested the process of arming students with metacognitive strategies could aid students in learning classroom material. Moreover, teachers should use metacognition in subjects like geometry to gain an understanding of how their students are learning in order to make instructional adjustments when needed (Borkowski, 1992; Heikkila, Lonka, Nieminen, & Niemivirta, 2012). The use of metacognitive strategies has proven to be imperative to academic success (Corley, 1990; Pandiscio & Morton, 1998). The application of learning styles and intelligences is one method to foster metacognition and student learning (Borkowski, 1992; Matthews, 2006). Strategies that promote student-led processes and strengths, such as the use of multiple intelligences, can increase learning in geometry (Shuhan, 2006). Tailoring instruction in geometry to target varying intelligences has led to increased student engagement within the classroom and better preparation for learning beyond the classroom (Di Fatta et al., 2009; Shuhan, 2006).

Education practitioners have explored the use of multiple-intelligence-based practices as a means of increasing student motivation and positive attitudes towards geometry in secondary classrooms. Hardy (2005) investigated secondary students’ perspectives of learning various content, including mathematics, in an atmosphere of conflicting instructional methods. Hardy espoused a critical theory and multiple-intelligence-based framework, noting that students were not given a fair opportunity to learn because the dominant teacher-centered methods of lecture and note taking were in direct opposition with the dominant intelligences and learning modes of the African American students studied. Hardy suggested education reform begin with empowering students with their learning strengths based on multiple intelligences theory to ensure all
students are adequately educated and supported in all subjects. To empower students with their learning strengths, teachers must be aware of multiple-intelligence-based practices.

In a similar mixed methods study, Miller (2013) explored the attitudes and achievement of ninth-grade geometry students. Among 198 participants, students in the experimental group were given homework strategies based on their learning preferences and intelligences. Students in the control group were given traditional study tips. Miller found students in the experimental group performed better on a geometry assessment and had a more positive attitude than students in the control group.

In addition, a study of geometry students in Grades 9 and 10 resulted in an increase in positive attitudes towards geometry with an insignificant increase in student achievement. Di Fatta et al. (2009) conducted three different interventions to increase student achievement in geometry. Teachers used multiple-intelligence-based lessons, offered positive reinforcement for homework, and increased student participation in collaborative group work. Students completed a multiple intelligences survey used to inform teachers of the most prominent intelligences present in their classes. After administering pre- and posttests and conducting interviews, the findings included student perceptions of increased learning without quantitative data to support any increase in student achievement. Although teachers stated using the multiple-intelligence-based lesson helped their students improve, and students said multiple-intelligence-based lessons helped with comprehension of geometry concepts, students test scores decreased after the intervention (Di Fatta et al., 2009).

Conversely, in a grounded theory study, Bloom (2010) interviewed and observed teachers to explore teachers’ perceptions of adjusting mathematics instruction based on
students’ needs and learning preferences. Teachers in Bloom’s study described an overload of information resulting in a need to streamline differentiated instruction activities. As a result, Bloom suggested, “Teachers may benefit from further exploration on what these activities look like in practice, how to explicitly identify students’ predominant intelligences, and how to integrate these regularly into math instruction” (p. 151).

Lastly, Johnson’s (2010) quasi-experimental mixed methods study of eighth-grade math students explored the effect of utilizing students learning preferences in instructional practices on student achievement. Instructors taught an experimental group of 30 middle school students based on their learning styles and multiple intelligences. The students took a mathematics pre- and posttest. Thirty students in a control group were taught in a traditional method and took a pre- and posttest. To understand teacher strategies, weekly lesson plans were collected in which teachers reported strategies such as modeling, evaluating readiness, adjusting questions, compacting curriculum, using tiered assignments, flexible grouping, and peer teaching (Johnson, 2010). Students in the traditional class were taught through class lecture, class discussion, and independent study. Johnson found no significant difference in test scores between the experimental and control groups.

**Summary of reviewed studies.** The studies conducted by Hardy (2005) and Miller (2013) resulted in increased student motivation and achievement. Yet, both studies explored the use of multiple-intelligence-based strategies from student perspectives without teacher involvement. In the studies by Di Fatta et al. (2009), Bloom (2010), and Johnson (2010), teachers used different classroom strategies than the traditional methods
of lecture and note taking. The results of studies exploring student achievement in mathematics have been mixed. Upon further exploration of why differences may have resulted in student achievement during the use of multiple-intelligence-based lessons, teacher practices should be considered (Bloom, 2010). Very few studies reviewed investigated the instructional strategies used by teachers. There is a gap in the literature regarding secondary teachers’ instructional strategies and use of multiple-intelligence-based strategies in geometry classrooms. The current study explored, through a variety of techniques such as observation and interviews, the practices teachers used in a real-life setting while implementing multiple-intelligence-based instruction.

**Professional Instructional Practices**

Researchers largely have agreed the relationship between teachers and students is vital to a productive classroom (Koslo, 2010; Morgan, Kingston, & Sproule, 2005; Mosston & Ashworth, 1985; Rodrigues, 2012; Zohar & Aharon-Kravetsky, 2005).

Several options of instruction exist in the realm of teaching geometry. Understanding appropriate teaching styles and methods to meet students’ needs is an integral part of the shift in today’s educational landscape (Bloom, 2010; Di Fatta et al., 2009). In classrooms with several backgrounds and abilities, a teacher must be able to present information in a manner that meets the academic needs of each student. The presentation of information is carried out through different teaching styles. The role of the teacher may change from provider of all information to facilitator depending on the student’s needs. Classrooms can have teacher-centered, student-centered, or differentiated instruction.

Teacher style, also categorized as instructional strategies or methods, can be described on a continuum and categorized into two general areas: teacher centered and
student centered. Described as a spectrum of teaching styles by Mosston and Ashworth (1985), styles range from a continuum of approaches, beginning with the teacher making maximum decisions and ending in students making all decisions. In the center of the spectrum, a line can be drawn separating teacher-centered styles from student-centered styles. In a teacher-centered classroom, teacher instructions and knowledge drive activities and the pace of the classroom. Memory and recall, practice drills, and repetition are commonly seen in a teacher-centered classroom. In a student-centered classroom, the pace and activities are driven by the students, and teachers often differentiate instruction to accommodate students’ preferences and strengths. Teachers present the topic or problem, and students lead discussions, hypothesize, and use methodologies to solve the problem. Whereas both categories of styles have value and merit in the classroom (Mosston & Ashworth, 1985), each method has resulted in a variety of academic consequences in past studies (Heltzel-Ward, 2013; Kelly, 2013; Parker, 2011; Pham, 2012).

In a quantitative study of two geometry classes, Heltzel-Ward (2013) explored how varying types of instruction affected student academic outcomes. One group of geometry students were taught using a lecture style and note-taking method, referred to as teacher-centered instruction (Heltzel-Ward, 2013). A second group of students was taught using different activities such as group work, cooperative learning, and discovery learning, referred to as student-centered instruction. Heltzel-Ward’s findings indicated both methods of teaching resulted in academic progress with no significant academic differences between methods.

Moreover, a quantitative study by Kelly (2013) on the teaching methods of
differentiation and the use of a single method of teacher-centered instruction (such as lecturing, also known as whole-group instruction) was used to understand the level of effectiveness of a differentiated classroom. Fifth-grade mathematics students in two separate groups were given a pretest and posttest on the topics of fractions and percentiles in both the differentiated classroom and whole-group instruction classroom. Students enrolled in the classes where differentiated instruction was used based on different student backgrounds had higher posttest scores than students given one teaching style of whole-group instruction. In a similar quantitative study, Parker (2011) investigated the impact of teaching styles of elementary school teachers on student math achievement scores. Findings included little impact on student achievement for students taught in either teacher-centered methods or student-centered methods.

Lange (2010) also conducted a quantitative study with teachers across 29 school districts to examine mathematic achievement and teacher perceptions related to inquiry-based and traditional classrooms in an elementary setting. Student achievement scores were analyzed and compared to teachers’ self-reported teaching styles, student demographic information, and teachers’ perception of self-efficacy through survey instrumentation. Lange compared the results of teacher-centered strategies such as memorization and computation to the use of student-centered strategies seen in inquiry-based instruction on student achievement in elementary mathematics. Results showed neither the teacher-centered nor student-centered teaching had an effect on mathematics performance with students in mainstream classrooms. Inquiry-based instruction did yield better performance for students with disabilities, however. Overall, Lange found a positive relationship between instructional strategies and teacher self-efficacy. Research
has shown mixed results in regards to student academic achievement with the use of teacher-centered and student-centered styles. Differences also exist in regards to teacher and student perceptions of the most appropriate teaching styles.

Davis-Langston (2012) examined the relationship between teaching styles, teacher perceptions of self-efficacy, and student achievement in an elementary mathematics class. Ninety-five mathematics elementary teachers and their students were the focus of the study. The researcher collected quantitative data in a correlational design in the form of student test scores and the results of instruments used to assess teachers’ teaching styles and teachers’ perceived levels of self-efficacy. The assessment gauged teaching styles including teacher-centered and student-centered styles. Davis-Langston found mathematics achievement in geometry was predicted by formal authority style (a teacher-centered style) and the facilitator teaching style (a student-centered teaching style). However, a “strong, significant relationship” was not found between the teaching style and the students’ mathematics achievement (Davis-Langston, 2012, p. 65). Davis-Langston suggested teaching and learning rely mainly on the capabilities and differences of each individual, not the teaching style. Little relationship existed between student achievement and teacher self-efficacy.

Furthermore, in a qualitative, grounded theory study, Toles (2010) explored the perceptions of 30 high school geometry students regarding motivational instructional strategies. The researcher collected journal entries, analyzed questionnaire responses, and conducted focus group interviews to explore the teaching strategies students felt had a positive or negative effect on their motivation to learn and subsequent academic achievement. Students preferred teachers use a mix of instructional strategies inclusive of
activities seen in a teacher-centered classroom, such as direct instruction, and activities exemplary of a student-centered classroom, such as personalized, interactive games and independent practice. Toles reported, “No single set of strategies is best for all students” (p. 130).

Teachers and students have varied opinions regarding which teaching style results in increased academic achievement for students. As a result, certain school districts have presented the acceptable option of both types of teaching styles for classroom use. Cothran and Kulinna (2006) declared, “Only teachers who utilize a variety of instructional models, and who understand their students view and react to those models, will be successful in maximizing the achievement of all students” (p. 179).

The goal of this study was to describe teacher strategies in the classroom setting based on predetermined, inclusive instructional strategies. One of the frameworks including both teacher-centered and student-centered activities is Robert Marzano’s teacher evaluation framework. The study used this framework to categorize teaching strategies in a classroom environment. The use of the Marzano Teacher Evaluation Model protocol allowed the researcher to produce a practical interpretation of teachers’ practices in a real-life setting.

The Marzano Causal Teacher Evaluation Model

An evaluation model such as the Marzano Causal Teacher Evaluation Model is being used or is under consideration in 17 states, including the site of this study (Learning Sciences, 2014). In 2011, Florida lawmakers mandated the use of the Marzano Teacher Evaluation Model as the Florida state model for teacher evaluation (Learning Sciences, 2014). Created by Robert Marzano, the Marzano Teacher Evaluation Model is aimed at
Restructuring teacher evaluations in an effort to develop effective instructors. The four domains of Marzano’s model are designed to delineate methods and practices proven to result in raising student achievement and developing instructor expertise (Learning Sciences, 2014). The domains are classroom strategies and behaviors, planning and preparing, reflecting on teaching, and collegiality and professionalism.

Specifically, the domain of classroom strategies and behaviors describes the mandated teaching strategies to be used during instruction. Among 18 strategies, three approaches are teacher centered. The remaining 15 student-centered approaches include practicing skills, strategies, and processes; organizing students to interact with new knowledge; elaborating on new information; and engaging students in cognitively complex tasks (Learning Sciences International, 2014). According to Marzano and Toth (2014), student-centered activities result in a greater understanding of instruction for increased cognitive complexity. Instructors should focus on the use of student-centered strategies to develop higher order thinking in students while incorporating applicable and effective teacher-centered strategies.

The use of a required protocol such as the Marzano Teacher Evaluation Model in this study was intended to support the successful implementation of multiple-intelligence-based practices in the classroom environment. Based on the evaluation’s inclusion of student-centered strategies and specifically those that require the acknowledgement of student preferences, Marzano’s model is a viable tool to gauge teachers’ strategies when using multiple-intelligence-based instruction.

In addition to the use of a school-mandated, research-based evaluation tool to inform the data collection process, the aim of the study was to fill gaps present in the
literature. The research of Davis (2012) and Sohn (2003) suggested multiple intelligences implementation should be viewed in a secondary setting. The study used multiple-intelligence-based instruction in a high school setting. Moreover, researchers such as Hardy (2005), Kelly (2013), Levine (2012), Bloom (2010), and Ivory (2007) suggested further investigation of the use of multiple-intelligence-based strategies in a mixed and inclusive classroom. The gap in literature relating to how teachers implement differentiated practices such as multiple intelligences in a math classroom warranted a more current, focused, examination. The study explored teachers’ use of students’ multiple intelligences when implementing multiple-intelligence-based instruction in an inclusive classroom.

**Research Questions**

This research study was guided by two research questions:

1. How and in what ways do geometry teachers use multiple intelligences in their instructional strategies, as defined by the Marzano Causal Teacher Evaluation Model, when informed of students’ multiple intelligences in a high school in southeastern Florida?

2. How and in what ways do geometry teachers use multiple intelligences in their instructional strategies as defined by the Marzano Causal Teacher Evaluation Model, when trained in multiple-intelligence-based practices in a high school in southeastern Florida?
Chapter 3: Methodology

This chapter describes the methods used to explore how and in what ways teachers utilized instructional strategies once informed by students’ multiple intelligences and trained in multiple-intelligence-based teaching strategies. The chapter begins with the researcher’s rationale of the design approach and the selection process for the study’s participants. Next, the researcher includes a description of the data collections tools, required procedures, and essential steps of data analysis. Then, topics concerning the study’s trustworthiness, ethical considerations, and potential researcher bias are presented.

Design

The design for the dissertation was a case study. As defined by Yin (2014), the case study design approach “investigates a contemporary phenomenon (the ‘case’) in depth and within its real world context, especially when the boundaries between phenomenon and context may not be clearly evident” (p. 16). Researchers use case studies to investigate an unknown, contemporary issue or to find a better understanding of a process in which several variables are pertinent to the case (Glesne, 2010). Typically, case studies pose questions using words like “how” or “why” indicating the need for extensive research on a given topic. Case studies rely “on multiple sources of evidence, with data needing to converge in a triangulating fashion” (Yin, 2003, p. 17). Multiple sources of evidence include, but are not limited to, observations, records, and interviews. Both qualitative and mixed methods studies use the case study design approach. As seen in the mixed method work of Johnson (2010), the case study approach is used to understand instructional strategies in a classroom setting.
In a mixed methods study, Johnson (2010) explored the effect on student achievement of utilizing students’ learning preferences. In an experimental classroom of 30 middle school students, teachers utilized students’ learning styles and multiple intelligences to guide instructional practices. In another classroom of 30 middle school students, instruction was traditional and without the inclusion of students’ learning preferences. Using quantitative methods, Johnson analyzed the achievement rates of all student participants in both classrooms.

Using a qualitative case study approach, Johnson (2010) used multiple sources of information to understand actual classroom practices of the teacher participants. Johnson asked teachers to submit weekly written lesson plans and conducted walk-through observations to identify instructional strategies in both the experimental and control classrooms. The researcher’s goal was to determine teacher actions, understand the application of teacher lessons in a classroom setting, and investigate student responses to the experimental intervention. The instructional strategies reported in the lesson plans included modeling, evaluating readiness, adjusting questions, compacting curriculum, using tiered assignments, flexible grouping, and peer teaching (Johnson, 2010). Teachers in the traditional class used class lecture, class discussion, and independent study. Johnson’s contemporary, qualitative approach and use of multiple sources of information such as lesson plans and classroom observations were modeled for the dissertation study.

This study investigated how and in what ways secondary geometry teachers in a southeastern public high school utilize instructional practices when trained in multiple-intelligence-based teaching strategies and informed of students’ multiple intelligences. The “desire to understand a complex social phenomena” in its “real life context” is
characteristic of a case study and the current study (Yin, 2014, p. 4). Subsequently, a case study design approach best suited the current study. The case study design was determined to be the best approach for this social sciences study because the topic of interest was a contemporary phenomenon. The researcher observed teachers’ contemporary classroom practices in a real-life setting. Furthermore, the case study design method allows the use of different forms of data collection tools such as observations, records, and interviews to obtain a full picture of the case. In the study, various forms of data were used to explore the research questions. The case study design was also the best approach for the study because other research approaches did not fit the investigation as adequately as the case study method.

**Participants**

The researcher used purposeful sampling for the dissertation. Purposeful sampling is a method in which “researchers intentionally select individuals and sites to learn or understand the central phenomenon” (Creswell, 2012, p. 206). The participants were two geometry teachers and 15 of their geometry students. Nine students from one teacher’s class participated, and six students from the other teacher’s class participated.

The teachers were employed at a high school district in Florida and taught Geometry Honors. Geometry Honors classes are at a more advanced pace than geometry regular classes, which are taught at a standard pace. The inclusion criteria for the study was any teacher who taught at least one section of Geometry Honors daily and any student enrolled in the teacher’s Geometry Honors class. The student participants were between the ages of 13 and 15 and enrolled in one of the teacher participants’ Geometry Honors classes.
Data Collection Tools

The researcher used many tools to elicit data for the case study. The researcher administered a multiple intelligences questionnaire to the student and teacher participants, observed classroom practices, conducted face-to-face interviews, and collected and reviewed teachers’ lesson plans throughout the duration of the study.

The Revised Multiple Intelligences Developmental Assessment Scales (MIDAS). To identify the dominant intelligence of each student participant, the researcher used the MIDAS questionnaire created by Shearer in 1987 and since revised (Shearer, 2011). According to reviewers, the primary purpose of the MIDAS questionnaire is to “provide an objective measure of the multiple intelligences using a process approach” (Hiltonsmith & Schneider, 2007, para. 5). The researcher sought permission to administer the MIDAS questionnaire before data collection from the author. The researcher sent a letter to Shearer, the author of the MIDAS questionnaire, expressing a desire to use the tool to identify the dominant intelligence of each student participant. After gaining permission to use the MIDAS questionnaire, the researcher purchased the research kits for students ages 13–16. The researcher also purchased two questionnaires for adult participants for use with teacher informants.

The researcher chose the MIDAS questionnaire for several reasons. First, the researcher required a paper questionnaire due to limited technical support at the study site. The MIDAS questionnaire could be administered via a paper questionnaire. Second, the researcher aimed to gain a fair understanding of students’ dominant intelligence without consuming an extensive amount of classroom time. The MIDAS questionnaire was administered for 25–35 minutes. Lastly, in an effort to create a
valid, sound study, the researcher preferred the use of a previously piloted questionnaire with a history of reliability. The MIDAS questionnaire has been used in over 300 dissertations and articles, and reviewers of the MIDAS questionnaire have regarded the scores as reasonably reliable (Hiltonsmith & Schneider, 2007). In a study of special education students, Alhajri (2011) used the MIDAS questionnaire to categorize the multiple intelligences of elementary and middle school students. Alhajri used the MIDAS questionnaire to develop individual education plans based on multiple intelligences versus former plans based on traditional IQ tests.

Observation protocol. The researcher also used an observation protocol, after receiving permission, to gain a better understanding of the central phenomenon of the case study. The researcher created a classroom observation protocol (Appendix A) based on the Marzano Causal Teacher Evaluation Model and Armstrong’s (2009) description of multiple-intelligence-based teaching activities.

The Marzano Teacher Evaluation Model contains a detailed list of methods, approaches, and strategies for teacher use inside and outside of the classroom (Learning Sciences, 2014). Specifically, Domains 1 and 2 of the teacher evaluation model describe required aspects of a teacher’s classroom instruction and planning. For example, in Domain 1, teachers can help students practice and deepen new knowledge by using homework and reviewing content (Learning Sciences, 2014). The researcher did not adjust Marzano’s protocol but used the research-based protocol to identify teacher practices in Domains 1 and 2.

An additional work of influence on the observation protocol was Armstrong’s (2000, 2009) teacher activities based on a student’s dominant intelligence. Armstrong
(2000) declared students of different intelligences can be taught successfully with the implementation of applicable teacher strategies. For example, students of logical-mathematical intelligence can be taught through math games, whereas students with an intrapersonal dominant intelligence can participate in independent study (Armstrong, 2000). The researcher used Armstrong’s (2000) teaching activities to identify instructional strategies in Domains 1 and 2 of the Marzano Teacher Evaluation Model after obtaining permission. The researcher used Armstrong’s work as a bridge to identify which instructional strategies from the Marzano Teacher Evaluation Model were applicable to the use of multiple-intelligence-based lessons in the classroom. For example, Element 9, chunking information into digestible bites, from the Marzano Teacher Evaluation Model can be used to teach for any of the intelligences. Playing games, Element 25, can be used in logical, intrapersonal, and bodily-kinesthetic intelligences. The selected instructional strategies (labeled by element number) could be used to teach one or all of a student’s dominant intelligences (see Table 1).

Table 1

| Chart of Multiple Intelligences and Marzano Teacher Evaluation Model Domains and Elements |
|----------------------------------|----------------------------------|----------------------------------|
| Intelligence | Domain 1: Classroom strategies & behaviors | Domain 2: Planning and preparing |
| Verbal | Element 13 |  |
| Logical | Elements 13, 18, 19, 25 |  |
| Visual | Element 13 |  |
| Bodily | Elements 25, 27 |  |
| Musical |  |  |
| Interpersonal | Elements 5, 25, 30 |  |
| Intrapersonal | Elements 13, 31 |  |
| Naturalist |  |  |
| All | Elements 6–9, 11, 14–17, 20, 36 | Elements 45–49 |
The researcher identified which strategies can be used for each intelligence. The researcher used the researcher-created observation protocol to identify the domain, element, instructional strategy, affected students, and the way the strategy was applied during classroom observations (Appendix A). The researcher also took field notes using the researcher-created observation protocol to identify additional actions by students and teachers. As the observation protocol was an original work by the researcher, the protocol was reviewed by an expert in the field of social sciences before use in data collection. The protocol also was piloted by an expert panel independent of the study before data collection began.

Interview protocol. The next data collection tool the researcher used in the qualitative study was a researcher-created interview protocol for use in one-on-one interviews (Appendix B). Qualitative researchers ask participants questions and record answers with one participant at a time in one-on-one interviews (Creswell, 2012). The one-on-one interview process allowed the researcher to ask open-ended questions with the option to probe with additional questions to capture the thoughts of the participants. The Marzano Teacher Evaluation Model and Armstrong’s (2000, 2009) application of multiple intelligences in the classroom influenced the researcher-created interview protocol. Marzano’s model was part of the basis of the interview questions, as the researcher sought to identify which classroom strategies and planning approaches, according to Marzano’s model, teachers used before and after being informed of students’ multiple intelligences and multiple-intelligence-based teaching strategies. Moreover, Armstrong’s (2000) classroom application of Gardner’s theory of multiple intelligences also influenced the researcher-created interview protocol.
According to Armstrong (2000), the teacher in a multiple intelligences classroom “continually shifts her [or his] method of presentation from linguistic to spatial to musical and so on, often combining intelligences in creative ways” (p. 56). The multiple intelligences classroom includes several forms of classroom instruction. As a result, interview questions included inquiry concerning activities used to support multiple intelligences, such as the provision of hands-on activities or the opportunity to exercise interpersonal intelligence through working in pairs or small groups.

To capture the participants’ responses, the researcher made notes on the protocol and recorded the interviews. The use of a recording device helped the researcher more accurately report findings. Before the use of the protocol, the researcher asked for informed consent from all participants. The researcher asked an expert panel to review the interview protocol before use. The protocol was also piloted with persons independent of the study before data collection began. The interview questionnaire was also used to ask participants how they planned activities and steps used for accommodating students with disabilities, IEPs, and lack of support from home, as described in Domain 2 of the Marzano Teacher Evaluation Model.

**Lesson plan review.** The use of document analysis is an integral part in the triangulation method of qualitative research. Document review can aid qualitative researchers in creating a more full view of the central phenomenon (Creswell, 2012). Teachers at the site were required to create and report daily lesson plans in an electronic format for each class. To understand how teachers plan lessons and the strategies teachers use during each lesson, the researcher requested and obtained a copy of each teacher’s lesson plans throughout the study. The researcher used the Marzano Causal Teacher
Evaluation Model to identify which strategies teachers used in the classroom. Using the researcher-created protocol (Appendix A), the researcher examined lesson plans to identify the domain, element, instructional strategy, affected students, and the way the strategy was applied in the classroom. The researcher also asked an expert in the education field to review the protocol before use. The protocol was also piloted with persons independent of the study before data collection began.

**Procedures**

The researcher first obtained approval from the Institutional Review Board (IRB). Next, the researcher sent all required documentation, as listed on the school board’s website (IRB documentation, the researcher’s proposal, letter of agreement from chair, etc.), to the Student Assessment and Research Department of the school district to gain permission to conduct the study at the site. Once the researcher was granted permission from the school district, the researcher then sought permission from the principal of the site to conduct the study. The researcher explained the desired participants, purpose, scope, risks, and intentions of the study. The researcher explained the need for two geometry teachers and at least five of each teacher’s geometry students for a total of at least 10 student participants. Once the principal agreed to the study and provided names of teachers and students who met the requirements, the researcher recruited participants.

The principal provided the names and e-mail addresses of potential teacher participants. The researcher then sent an e-mail to all potential teacher participants explaining the study and asking for their voluntary participation. The researcher explained all information shared during the case study would be strictly voluntary, and
any information the participant was uncomfortable with would be removed from the
documentation. The e-mail sent to potential teacher participants explained the time
commitment of the study, the purpose of the study, the voluntary nature of the study, and
the researcher’s intentions. To recruit students, the researcher sought permission from the
school principal to speak to the parents whose students were eligible for the study. The
researcher requested to speak to parents of all geometry students in the participating
geometry teachers’ classes at an informational session during the annual open house
night.

Two Geometry Honors teachers agreed to participate in the study. The researcher
spoke to the parents and students of the teacher participants during the informational
session about the purpose and voluntary status of the study. Parents were asked to
provide written consent to use their children’s multiple intelligences test results in the
study. Parents were shown the MIDAS questionnaire and were told all test results would
only be shared with the researcher, the teacher, and the student. The researcher also asked
for express consent to observe the children in the geometry classroom setting. Parents
were told the researcher would cause minimal disruption to the classroom environment
and the study would have no negative impact on the students’ academic achievement.
Parents were made aware of the voluntary nature of the study and the time commitment.
The researcher explained the time commitment for student participants was 20–30
minutes to complete the multiple intelligences test. Each geometry teacher taught
multiple class periods of Geometry Honors daily, so the researcher sought the
participation of the class period with the most number of voluntary participants.

Nine students from one teacher’s first-period class and six students from the
second teacher’s eighth-period class agreed to be a part of the study. Students agreed to take the MIDAS test and be observed in the classroom setting. Students were given a copy of their MIDAS scores once all data were collected by the researcher. No additional time was needed for student participation beyond classroom observations. Students were observed solely during their designated classroom time. The time commitment for teachers was roughly 6 hours throughout a 6-week period. Table 2 presents the timetable of all observations, lesson plan collections, and interviews executed during the study.

Table 2

*Schedule of Activities*

<table>
<thead>
<tr>
<th>Week</th>
<th>Participant</th>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Students</td>
<td>Administer Revised Multiple Intelligences Developmental Assessment Scales questionnaire</td>
<td>20 minutes</td>
</tr>
<tr>
<td>Week 2</td>
<td>Teachers</td>
<td>Collect lesson plans for the week</td>
<td>1 minute</td>
</tr>
<tr>
<td></td>
<td>Teachers &amp; students</td>
<td>Observe classroom instruction time</td>
<td>35 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collect lesson plans</td>
<td></td>
</tr>
<tr>
<td>Week 3</td>
<td>Teachers &amp; students</td>
<td>Observe classroom instruction time</td>
<td>35 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collect lesson plans</td>
<td></td>
</tr>
<tr>
<td>Week 4</td>
<td>Teachers &amp; students</td>
<td>Observe classroom instruction time</td>
<td>35 minutes</td>
</tr>
<tr>
<td></td>
<td>Teachers</td>
<td>Preinterview</td>
<td>45 minutes</td>
</tr>
<tr>
<td></td>
<td>Teachers &amp; students</td>
<td>Multiple intelligence training</td>
<td>35 minutes</td>
</tr>
<tr>
<td>Week 5</td>
<td>Teachers</td>
<td>Observe classroom instruction time</td>
<td>60 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collect lesson plans</td>
<td></td>
</tr>
<tr>
<td>Week 6</td>
<td>Teachers &amp; students</td>
<td>Observe classroom instruction time</td>
<td>35 minutes</td>
</tr>
<tr>
<td></td>
<td>Teachers</td>
<td>Postinterview</td>
<td>45 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collect lesson plans</td>
<td></td>
</tr>
</tbody>
</table>

Students and teachers were able to end participation at any point. Activities such as classroom observation of teachers and students, lesson plan reviews, teacher interviews, administration of multiple intelligences tests to students, and teacher training
occurred over the 6-week period to support the study.

Once the researcher obtained two geometry teachers and a total of 15 student participants, the researcher began the data collection process. The first step in data collection was the administration of the MIDAS questionnaire during Week 1 of the 6-week study by the researcher. Based on the number of students who obtained permission, the researcher determine the class periods in which to conduct the study. Ms. Ginger’s eighth-period class and Mr. Ale’s first-period class had the most participants.

Initially, teachers were not given the results of the students’ MIDAS questionnaires. The researcher first wanted to understand each teacher’s current, authentic teaching strategies without the influence of the students’ multiple intelligences data. The next step was to collect weekly lesson plans from the teacher during the administration of the MIDAS questionnaire to the students during Week 1. The researcher used the teacher lesson plans during the analysis.

During Weeks 2 and 3, the researcher conducted two 35-minute classroom observations and an individual 45-minute preinterview with the teacher informants one at a time. The researcher observed instructional practices and student interactions with the teachers and classmates. Field notes were taken on the observation protocol detailing classroom activities and the interaction between participating students and teachers. The preinterview was used to understand each teacher’s instructional strategies and planning methods.

After the interview, the researcher conducted an intervention through a training session with the teacher during Week 5. The training session lasted 60 minutes and occurred after school. The multiple intelligences training was used to inform teachers of
the basic principles of multiple intelligences and application in the classroom. The researcher-created intervention was based on the work of qualitative researchers Davis (2012) and Armstrong (2000). Davis created various multiple-intelligence-based activities for each type of intelligence. The activities were used in a study of multiple intelligences intervention among elementary school students. Armstrong’s (2000) description of ways of teaching and learning based on multiple intelligences provided a practical example of how teachers could introduce teaching activities in relation to specific intelligences.

Within the training session, the teachers learned the theory behind multiple intelligences, the application of multiple intelligences, and how multiple intelligences can be used in the classroom. The training presentations were delivered live with the use of PowerPoint slides. The topics presented during the workshop included (a) understanding the multiple intelligences theory, (b) how students learn, and (c) instructional activities based on multiple intelligences. The researcher also provided written documents containing research, literature, and instructional activities during the training session. Each teacher also received instructions to take MIDAS, the multiple intelligences assessment. Lastly, the dominant intelligences of participating students were given to participating teachers. Teachers were asked to utilize the multiple-intelligence-based strategies in their classrooms when appropriate and feasible.

The researcher then observed classroom strategies. At each observation, the researcher collected the teacher’s lesson plans describing the day’s agenda and activities. The researcher observed the classroom for two 35-minute sessions and conducted a 45-minute postinterview with the teacher informants during Weeks 5 and 6. The researcher
observed instructional practices and student interactions with the teachers and classmates. During the observations, the researcher took field notes detailing interactions and teaching strategies based on an awareness of students’ multiple intelligences. The postinterview was used to explore the teacher’s instructional strategies and planning methods after the multiple intelligences intervention.

**Data Analysis**

Data analysis is the process of accurately recording and organizing what one has heard, read, and seen in order to make sense of the knowledge acquired through the investigation (Glesne, 2010). In accordance with the case study approach, the researcher created and organized files for data, read notes and text, created initial categories, and used the categories to establish themes and patterns in an effort to produce findings (Yin, 2014). The researcher focused the case on results from the MIDAS questionnaire, the participant’s responses to interviews, data from observations, and information learned through a review of the lesson plans obtained by the researcher.

To analyze the results of the MIDAS questionnaire, the researcher identified the dominant intelligences computed by the calculations of Shearer (2011), the author of the MIDAS questionnaire. To analyze the results of the interview process and data captured through the observation protocol, the researcher transcribed all interview responses and observation notes. After reading all transcripts repeatedly, the researcher then performed an audit trail by searching for line-by-line codes, patterns of codes, and themes from the patterns. The researcher then created a matrix identifying individual themes and themes across the informants’ transcripts (Creswell, 2012). The researcher supported themes by direct quotes from the interview transcripts and notes from the observations.
researcher reviewed the data collected from the teachers’ lesson plans. The researcher identified patterns to create themes regarding the teacher’s planning activities. After each transcript, observation protocol with field notes, and lesson plan was analyzed and themes were determined, the researcher wrote a narrative from themes presented.

**Ethical Considerations**

Ethics are an integral part in the successful completion of a social sciences study. First, to ensure compliance, the researcher followed all IRB guidelines designed to protect human subjects during research. Second, the researcher focused on confidentiality, data protection, and open communication throughout all phases of the study such as recruitment, data collection, analysis, and beyond. To ensure confidentiality of participants, the researcher created pseudonyms for each participant. Actual names of the informants, the site, or any other connecting identifiers were not used. Each informant was given a unique pseudonym to ensure anonymity.

In an effort to remain ethical and keep all participants aware of the risks, benefits, purpose, and intentions of the study, the researcher maintained open communication between the participants and all affected persons. For example, parents of student participants had access to the multiple intelligences test of their student participants before the study began. Parents and students received a copy of the results of the MIDAS test at the end of the data collection process. Moreover, teachers and students were made aware of their rights to end participation at any time during the study. Each teacher received an Informed Consent form, and students’ parents received the parent permission form. The students filled out assent forms once parental approval was obtained prior to the interview outlining the voluntary basis, purpose, intentions, risks, and benefits of the
study.

The researcher used a personal, password-protected computer during and after data collection to protect the data. The researcher will keep all data securely and privately stored for 3 years after the study is submitted. After that point, all data will be shredded, deleted, and discarded securely.

**Trustworthiness**

To create a more robust examination and analysis of the case study, the researcher utilized the strategy of triangulation (Creswell, 2012). Triangulation uses three forms of data collection tools to create a full picture of the findings of a study. The researcher collected data through observations with field notes, interviews, and the document analysis of teachers’ lesson plans. The researcher piloted the researcher-created protocols, the interview questionnaire and observation protocol, with individuals independent of the study to ensure trustworthiness. The researcher also used an expert in the field to review the analysis and findings of the study. The expert is well-versed in social sciences with a doctorate in education. Furthermore, teacher participants had an opportunity to review and discuss all interview transcripts and lesson plans before submission into the final study through member checking. Teachers had the right to omit or amend any material the participant was uncomfortable sharing.

**Potential Research Bias**

The researcher’s potential bias was the researcher’s favorable disposition towards the application of multiple intelligences theory in a classroom setting through multiple-intelligence-based lesson plans and instruction. The researcher believes when instructors know more about their students’ dominant intelligences, the instructor’s classroom
strategies will improve and increasingly benefit students.

The researcher has been a mathematics instructor for over 10 years and has encountered the different personalities, abilities, strengths, and weaknesses of hundreds of students. Through experience and trial and error, the researcher has learned how to obtain the best results from students using a myriad of classroom techniques. Based on experience, one method of instruction does not work for every student. Subsequently, the researcher believes in the necessity of identifying the strengths and talents of each student. The application of multiple-intelligence-based teaching strategies is in alignment with the researcher’s perception of how students should be taught. A teacher must find the best method to teach each student by utilizing each student’s strengths.

Furthermore, the researcher is biased towards the positive introduction of multiple-intelligence-based lessons into public school. As observed by the researcher, private school children currently have access to multiple-intelligence-based instruction. The researcher believes public school children should be afforded the same benefit.

The researcher managed bias by remaining objective during all phases of the case study. The researcher used consistent language in regards to the use of multiple-intelligence-based lesson plans when working and communicating with all participants. The researcher also managed bias by keeping a reflective journal to ensure an impartial outcome of the study. The reflective journal ensured the researcher was aware of all biases throughout the study. Lastly, to manage bias, the researcher asked the expert to review the analysis and findings of the case study.
Chapter 4: Results

This chapter summarizes the findings of the qualitative case study after teachers were informed of students’ multiple intelligences and trained in multiple-intelligence-based teaching strategies. The researcher analyzed data from face-to-face interviews, the MIDAS questionnaire, field notes from observations, and information from lesson plan reviews. The use of multiple resources allowed the researcher to create a comprehensive narrative with vivid examples and rich dialogue. As the researcher’s focus is to present an authentic account of the teachers’ instructional processes, thoughts, and perceptions, the chapter opens with a description of the teacher participants in their classroom settings. Next, the MIDAS questionnaire results of teachers and their respective students are presented. Lastly, the researcher identifies the themes that emerged from the analysis process with extensive details and supporting evidence. Five general themes emerged from the data: (a) teachers’ limited use of multiple intelligences in accordance with the van Hiele (1999) model, (b) teachers’ dominant intelligences shaping the use of instructional strategies, (c) instructional strategies as a means of personalization, (d) multiple intelligences as a stimulus for student-led learning, and (e) teachers’ strategy of affection as a means for student engagement.

Teachers in the Classroom Setting

The participants in this case study were two experienced geometry teachers in a southeastern public school district. The participants were given pseudonyms to ensure confidentiality. The first teacher, Ms. Ginger, has been a mathematics teacher for 15 years, 11 at the study high school. She has taught Algebra I, Algebra II, Geometry, Analysis of Functions, and Pre-Calculus.
Upon entrance into Ms. Ginger’s classroom, the researcher’s attention was immediately captured by the organized chaos about her desk, cabinets, floor, and classroom equipment. Tools such as protractors, pencils, and papers were amid the large stacks of books and student assignments on her desk. However, Ms. Ginger knew where all necessary teaching tools were located. She laughed often about her workspace but affectionately referred to it as her “special hot mess.” Her eccentric personality was shown through her often solo conversations, which she often ended with a laugh. “My students think I’m crazy, but they gonna get this work done!” she exclaimed. Herein lies the essence of Ms. Ginger. While unorthodox on the outside, she is passionate about her students and has proclaimed their success and hard work before they enter her classroom. Ms. Ginger is familiar with, and has created, academic success for her students.

The second teacher participant is Mr. Ale. New to the staff of the study high school, Mr. Ale has taught several mathematics subjects within the school district including Algebra I, Algebra II, Geometry, and Calculus, with 11 years of teaching experience. Mr. Ale is a fun-loving character with boundless passion and spontaneous joy. Within minutes of observing Mr. Ale at the school’s open house, he expressed his concern for the profession of education and the future of students. He warned parents, “Education is under attack!” He spoke of how students are no longer interested in learning the information on their own. “They want to be spoon-fed!” He further explained his classroom would not be a breeding ground for laziness. Walking in without a pencil or knowledge of the subject matter qualified a student as already steps behind and would not be tolerated. His strict expectations of student preparedness and a willingness to learn were established within the first few weeks of school. Mr. Ale also presented his plan of
success for the students assigned to his classroom: “I will do it! I will fix it! Send any child to me who is willing to work, and I will not fail him or her!” Parents seemed relieved and expressed appreciation on their way out of the open house, while undoubtedly sending words of warning to their children.

As seen in the descriptions of both Ms. Ginger and Mr. Ale, the classroom is an available platform for the outward expression of teachers. However, to gain a greater understanding of the teachers’ and students’ multiple intelligences, the researcher administered the MIDAS questionnaire, a multiple intelligences questionnaire, to student and teacher participants.

**Ms. Ginger’s multiple intelligences classroom profile.** Six of the 18 students in Ms. Ginger’s eighth-period class agreed to participate in the case study. The four male and two female participants were between the ages of 13 and 15 and enrolled in Ms. Ginger’s Geometry Honors class. During Week 1, participants provided answers to the MIDAS questionnaire to capture their multiple intelligences profiles. The MIDAS questionnaire was administered through pencil and paper and completed in approximately 20 minutes. Each student’s resulting profile included the two most dominant intelligences based on the student’s self-reporting. The number of times each intelligence was categorized as dominant is shown in Table 3.

Among the student participants’ profiles, the two most prevalent intelligences were intrapersonal and interpersonal. The least prevalent intelligences among the sampled students were naturalist and spatial. Ms. Ginger was informed of her students’ multiple intelligences profiles during Week 4 of the study.

During Week 5, Ms. Ginger completed the MIDAS questionnaire. The adult
version of the MIDAS questionnaire also took approximately 20 minutes to complete.

Table 3

*Ms. Ginger’s Class Profile (N = 6)*

<table>
<thead>
<tr>
<th>Dominant intelligence</th>
<th>Student n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrapersonal</td>
<td>4</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>3</td>
</tr>
<tr>
<td>Logical</td>
<td>2</td>
</tr>
<tr>
<td>Bodily-kinesthetic</td>
<td>1</td>
</tr>
<tr>
<td>Linguistic</td>
<td>1</td>
</tr>
<tr>
<td>Musical</td>
<td>1</td>
</tr>
<tr>
<td>Naturalist</td>
<td>0</td>
</tr>
<tr>
<td>Spatial</td>
<td>0</td>
</tr>
</tbody>
</table>

Ms. Ginger’s self-reported questionnaire revealed interpersonal, logical, and kinesthetic intelligences were among her most dominant intelligences. The least dominant intelligences of Ms. Ginger were naturalist and musical. Ms. Ginger’s most dominant specific skills include everyday problem solving (ability to use logical reasoning to solve everyday problems) and calculations (the ability to think about thinking involving numerical operations). Ms. Ginger’s least dominant specific skills were vocal ability (a good voice for singing in tune and in harmony) and animals (skill for understanding animal behavior, needs, and characteristics).

Ms. Ginger’s multiple intelligences were in contrast with a majority of her student participants. Among the students sampled, two students had a dominant intelligence of logical, and only one had a kinesthetic dominant intelligence. Ms. Ginger shared the dominant interpersonal intelligence with four students, however. Understanding the profiles of Ms. Ginger and her students shed light on the academic blueprint each carried and how similarities and differences played a role in the classroom environment.
Mr. Ale’s multiple intelligences classroom profile. Mr. Ale’s classroom was a
diverse mix of learners from different ethnic backgrounds and varied experiences. Nine
students, ages 13–15, chose to participate in the study from Mr. Ale’s first-period class of
23 Geometry Honors students. The role of the six males and three female students in the
study was to take the MIDAS questionnaire, resulting in a profile of each students’
multiple intelligences. Participants provided answers to the MIDAS questionnaire during
Week 1 through pencil-and-paper administration. On average, the participants completed
the assessment in approximately 25 minutes. After self-reporting, each student’s
subsequent profile included the two most dominant intelligences. Mr. Ale’s class multiple
intelligences profiles are shown in Table 4.

Table 4

<table>
<thead>
<tr>
<th>Intelligence</th>
<th>Student n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical</td>
<td>5</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>3</td>
</tr>
<tr>
<td>Bodily-kinesthetic</td>
<td>2</td>
</tr>
<tr>
<td>Naturalist</td>
<td>2</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>1</td>
</tr>
<tr>
<td>Musical</td>
<td>1</td>
</tr>
<tr>
<td>Linguistic</td>
<td>0</td>
</tr>
<tr>
<td>Spatial</td>
<td>0</td>
</tr>
</tbody>
</table>

The numerical values in Table 4 represent the number of instances in which each
intelligence was categorized as dominant among the students. Logical and interpersonal
intelligences were the two most dominant intelligences among the sample of students.
The least dominant intelligences among the student participants were linguistic and
spatial. The students’ multiple intelligences profiles were captured during Week 1 and
were shared with Mr. Ale during Week 4 of the study.

The multiple intelligences profile of Mr. Ale was captured during Week 5. Mr. Ale’s multiple intelligences profile consisted of dominance in the interpersonal, intrapersonal, and logical main scales. The profile also consisted of subscale levels offering additional insight into Mr. Ale’s intelligences. According to the results of the MIDAS questionnaire, Mr. Ale’s most dominant subscales were everyday math (ability to use math effectively in everyday life) and spatial problem solving (self-awareness to problem solve while moving objects through space).

In comparison to his students, Mr. Ale shared similar dominant intelligences of logical and interpersonal. However, the musical and naturalist intelligences were Mr. Ale’s weakest intelligences but were the most dominant for several students. An analysis of the differences and similarities between dominant intelligences of teachers and students provided insight into the dynamics of classroom instruction and supported the development of the themes of this qualitative study. The emergent themes are described.

Themes

Five general themes emerged from the data: (a) teachers’ limited use of multiple intelligences through the lens of the van Hiele framework, (b) teachers’ dominant intelligences shaping the use of instructional strategies, (c) instructional strategies as a means of personalization, (d) multiple intelligences as a stimulus for student-led learning, and (d) teachers’ strategy of affection as a means for student engagement. The researcher sought to explore, through teacher interviews, lesson plans, and observations with field notes, the thoughts, perceptions, and instructional processes of teacher participants. The subsequent sections include the researcher’s supporting evidence in the development of
each emergent theme.

**Theme 1: Teachers’ Limited Use of Multiple Intelligences Through the Lens of the van Hiele Framework**

The van Hiele model is a description of students’ levels of understanding of geometric principles. The successful progression through the five van Hiele levels includes (a) Level 0, visualization, the ability to identify shapes; (b) Level 1, analysis, classifying shapes based on their properties; (c) Level 2, informal deduction, recognizing the relationship between shapes; (d) Level 3, deduction, understanding the relationship between definitions, theorems, and postulates; and (e) Level 4, rigor, or understanding abstract axiomatic systems (Erdogan et al., 2009; van Hiele, 1999). Although progression through the levels is not age dependent, the levels are sequential (Mason, 2002). For example, one must understand visualization before informal deduction.

In a secondary geometry classroom, a key example of students’ successful progression through the visualization, analysis, informal deduction, and deduction phases is the ability to support mathematical arguments using postulates, theorems, and definitions, also known as a proof. In order for students to advance successfully, teachers must have strategies to support learners’ understanding through these levels. In this qualitative case study, both teachers provided instruction at the analysis, informal deduction, and deduction levels. In addition, at each level, both teachers taught solely from the perspective of one of three types of intelligences: spatial, linguistic, or logical. Each teacher participant targeted levels of the van Hiele model through a shared but limited lens of intelligences.

**Ms. Ginger’s limited use of multiple intelligences through the lens of the van Hiele framework.** Ms. Ginger’s instructional strategies were in alignment with the
sequence of the van Hiele model throughout the study. First, in a unit about triangles, Ms. Ginger noted in her lesson plans the class learning goal to “classify triangles by using their angle measures (acute, right, obtuse, or equiangular) and side lengths (equilateral, isosceles, or scalene).” The second learning goal was to “find measures and side lengths using triangle classifications.” Ms. Ginger provided the class with a worksheet of shapes, definitions, and pictures, ideal for the spatial and linguistic learner at the analysis level of van Hiele’s model.

Second, to facilitate movement through the informal deduction level, Ms. Ginger highlighted the differences and similarities between shapes during a demonstration in the classroom. As stated by Ms. Ginger, “I point out the similarities, like this is what you’re looking for, this is what you should expect to see.” The emphasis on what one should expect to see is aligned with spatial intelligence.

During the following week of observations on the triangle unit, as evidenced by lesson plans, the students’ learning goal was to “prove triangles are congruent” using side-side-side, side-angle-side, angle-angle-side, angle-side-angle, and hypotenuse length measurements. Ms. Ginger began her lesson by having students draw triangles on the board. She then discussed different properties such as the reflexive property. “When you see one shared line, think reflexive,” said Ms. Ginger. The drawing and definition were suitable for the spatial and linguistic learner. Finally, Ms. Ginger constructed a proof, step by step, for the logical learner.

Ms. Ginger addressed the analysis, informal deduction, and deduction levels of the van Hiele model with activities rooted in spatial, logical, and linguistic intelligences. Ms. Ginger did not focus on other types of intelligences such as naturalist, musical,
kinesthetic, interpersonal, or intrapersonal. The same occurrence was seen in Mr. Ale’s classroom.

Mr. Ale’s limited use of multiple intelligences through the lens of the van Hiele framework. Mr. Ale, like Ms. Ginger, also focused instruction based on the van Hiele levels when teaching students about triangles. Using the Marzano instructional strategy of placing attention on established benchmarks, student goals written in the lesson plans were to “classify triangles by side and angles; classify triangles in a coordinate plane.” Classification is indicative of the van Hiele level, analysis. To teach classification of triangles, Mr. Ale used a linguistic practice of making word associations to the different classifications. As observed during a lecture, Mr. Ale associated the word *scalene* to the name of his “crazy” friend and asked the students to make their own comparisons.

Then, when targeting instruction for the informal deduction level of the van Hiele model, Mr. Ale was observed asking students to examine if an equilateral triangle is also equilateral through the use of the software program Geogebra. The use of technology such as Geogebra was an integral part of Mr. Ale’s classroom tools. As stated by Mr. Ale, “There’s no way a teacher can teach math without using Geogebra. Literally there’s no way.” The use of technology allowed Mr. Ale to examine the differences and similarities of triangles from spatial and logical intelligence perspectives. During another day of instruction, Mr. Ale listed the van Hiele Level 3 student goal to “prove that triangles are congruent” in his lesson plan. Mr. Ale began the lesson by drawing a picture on the board of a triangle to explain a theorem and reading the theorem to the class. The use of a drawing and lecture illustrated Mr. Ale’s focus on spatial, linguistic, and logical
intelligences. Like Ms. Ginger, while instructing students through the van Hiele model, Mr. Ale did not focus on musical, kinesthetic, interpersonal, naturalist, or intrapersonal intelligences. Mr. Ale and Ms. Ginger taught with an emphasis on drawing, words, and logic. Although these intelligences are conducive to teaching based on the van Hiele framework, both teachers’ instruction was also influenced by other criteria, such as the teachers’ dominant intelligences.

**Theme 2: Teachers’ Dominant Intelligences Shaping Instructional Strategies**

Before the first day of school, teachers and students are typically strangers to one another. Hence, the classic discussion of students’ summer activities is used as an icebreaker to begin understanding students’ interests and backgrounds. Students are then often given an overview of the teachers’ classroom procedures and expectations. Students are rarely informed, however, of teachers’ instructional strategies. More specifically, students are given little information in regards to why teachers choose various instructional strategies. Students may not be informed because teachers may be unaware of what factors shape their choice of instructional strategies. As evidenced in this qualitative case study, one factor that shapes teachers’ use of instructional strategies is teachers’ dominant intelligences.

**Dominant intelligences shaped instructional strategies in Ms. Ginger’s class.**

Ms. Ginger’s instructional strategies were a reflection of her dominant intelligences. As described in her lesson plans and documented in observations, Ms. Ginger’s teaching tools include videos, peer sharing, textbooks, and worksheets for classwork and homework. Problem solving was a requirement for most activities, with a condition of all calculations being done by hand. The instructional technique of mental math and lecture
was second nature for Ms. Ginger, as her dominant strengths included linguistic intelligence and calculations.

Also, students were required to create visual representations of information. Marks used to indicate congruency, parallel lines, and equality were part of the daily drawings on the classroom board. The requirement of creating visual representations of information through the use of marks and lines was in congruence with Ms. Ginger’s dominant strengths. Ms. Ginger’s dominant intelligence of kinesthetic has a subscale of dexterity, such as drawing marks and signs on geometric figures. Ms. Ginger chose to use strategies in alignment with her strengths.

Lastly, the interpersonal activity of group work, described as collaboration time by Ms. Ginger, was often used in Ms. Ginger’s class. While directed and formed by the instructor, students were allowed to work with others to gain a greater understanding of classroom material. Interpersonal intelligence, as seen in group work, was also dominant in Ms. Ginger’s profile.

The use of several techniques supported Ms. Ginger’s goal of providing instructional alternatives. However, the tools provided to students were in line with the teacher’s strengths, not the students’ strengths. As stated by Ms. Ginger,

If you don’t learn when I speak, you have a video. You know. Watch a video.
You have a textbook. You take notes. Yeah, ‘cause I have them do their own little notes and I have them, you know, watch videos, work with someone. So, if you don’t get it from me, they get it from someone else.

Ms. Ginger’s logical strength was highlighted in the use of instructional videos and the use of the textbook. The dominant intelligence of interpersonal was used as students were
instructed to seek help from others. Although Ms. Ginger was open to trying new methods and tools based on the class’s content knowledge, the strategies were based on her dominant intelligences, not those of the students, which would be most beneficial to the different intelligences present in the classroom.

Dominant intelligences shaped instructional strategies in Mr. Ale’s class. Mr. Ale’s dominant intelligences also shaped the types of instructional strategies used in his classroom. Described in Mr. Ale’s lesson plan, self-directed learning is a teaching strategy in which students are charged with gaining an understanding of the material before the lesson is taught by the teacher. The work students should complete while engaged in self-directed learning included watching videos, writing summaries of the videos presented, and taking notes from the textbook before the lesson was introduced. According to Mr. Ale,

So I use my own style that’s called SDL, it’s something that I’m researching right now. It’s called self-directed learning, where they get the work ahead of time. I post videos, and they do the write outs. The write out is they open the textbook and write out the examples from the section.

Self-directed learning is a highly intrapersonal method in its requirement that the student seek information and make personal meaning of the data. This method may be familiar and natural to Mr. Ale, as one of Mr. Ale’s dominant intelligences was intrapersonal intelligence. The ability to understand oneself was part of Mr. Ale’s profile and his teaching strategies.

Mr. Ale also used a strategy he described as “taking the brain out.” This strategy involves applying real-life perspective to classroom content. As stated by Mr. Ale,
Taking your brain out, every time we do that in class, where we take your brain out of the classroom. Make sure you see that real situations are happening, because some of the kids, they’re so young they don’t really know that there are actual things happening outside of the classroom pertaining to their knowledge. I give them real-world situations to see if they’re able to take the knowledge that they have learned out into the real world or into a simulation of the real world from the classroom.

Another example of the use of real-life context to create understanding was Mr. Ale’s process to help students generate and test hypotheses. As described by Mr. Ale,

I ask some simple questions like, how will this work, why did it work, can you show me evidence that it worked? How would you use it in the real-world situation? That’s how I help them to generate a hypothesis.

Mr. Ale incorporated real-life examples into his classroom consistently. The incorporation of real-life examples was aligned with Mr. Ale’s dominant specific skill of everyday math. According to Shearer (2011), the specific skill of everyday math means one’s ability to use math effectively in everyday life. Mr. Ale’s real-life examples echoed the usage of math in solving ordinary, practical math problems, which was one of Mr. Ale’s strengths.

In each classroom, the teacher was most dominant in logical-math and interpersonal intelligences and least dominant in the naturalist and musical intelligence categories. Neither teacher composed a song, referred to animals, or discussed strategies based on their least dominant intelligences. Both Ms. Ginger’s and Mr. Ale’s strategy usage was shaped by their strengths. However, after training, teachers evolved in their
usage of strategies to include personalization based on students’ intelligences.

**Theme 3: Instructional Strategies as a Means of Personalization**

Teachers at the study high school and all schools in the district site are familiar with the Marzano Teacher Evaluation Model. In fact, instructors’ annual evaluations are partially based on the usage of strategies in Marzano’s model. The manner in which each strategy is used, however, is at the sole discretion of the instructor. In the current case study, Ms. Ginger and Mr. Ale chose to use many of the same strategies before and after being trained and informed of students’ multiple intelligences; however, each teacher’s usage of the strategies became more personalized to the students.

**Instructional strategies as a means of personalization in Ms. Ginger’s class.**

Marzano’s strategy, organizing students to interact with new knowledge, was used before and after the intervention but was applied differently after the intervention. Before the intervention, organizing students to interact with new knowledge consisted of Ms. Ginger choosing groups. Students were randomly placed in groups with one another except in the case of ELLs. As seen during a review of Ms. Ginger’s lesson plans, ELLs were paired with students who spoke English more fluently. Students with disabilities were also given a person to work with of Ms. Ginger’s choosing.

After the intervention, the same strategy of organizing students to interact with new knowledge was delivered, but Ms. Ginger’s approach was different. During an exercise, students were able to choose their own groups. Per Ms. Ginger’s lesson plans, students were given the option to work with anyone in the class. The resulting groups looked starkly different but were cohesive. For example, one group included individuals with a dominant interpersonal intelligence who spent collaborative time working and
talking with one another. Another group was primarily quiet during the time they sat together. One member of the quiet group was also a participant of the study. His dominant intelligences were intrapersonal and logical. His group members likely shared his preference for working alone, as all students diligently worked without conversation. The teacher’s noninterference with the educational process and position seemed to suit them well. The use of the same strategy by Ms. Ginger allowed students with different intelligences, such as intrapersonal, a space to excel and thrive. Ms. Ginger provided a personalized learning environment with the use of the same strategy but with a different application.

**Instructional strategies as a means of personalization in Mr. Ale’s class.** Two doors down the hall in Mr. Ale’s classroom, a similar experience unfolded. Before the intervention, Mr. Ale used Marzano’s strategy, previewing new content, which refers to how a teacher introduces content to students, by giving an overview of the sections in the entire unit (Marzano, 2011). He drew pictures on the board to represent the changes between sections, described in his lesson plans as “frontloading or setting the stage for the next class.” The introduction was one sided and without student input. After the intervention, however, Mr. Ale’s usage of Marzano’s (2011) strategy of previewing new content changed. Mr. Ale personalized instruction by allowing students to interpret the information in ways in which they felt most comfortable. For example, Mr. Ale introduced a new section by asking students to describe their representations of a triangle. A student’s response of “a yield sign” prompted Mr. Ale to say, “She is visual,” showing his understanding of the students’ interests and background (an additional classroom strategy included in Marzano’s model). Mr. Ale chose to preview new content through
the perspective of the students.

Another strategy used by Mr. Ale was examining similarities and differences. Previously, this strategy was used by showing the differences between each section in the textbook. Mr. Ale verbally discussed the changes while drawing pictures on the board. However, after the intervention, Mr. Ale used the same strategy but presented the information from a more personal perspective. He was observed explaining the differences between triangles through storytelling, allowing students with linguistic intelligence an opportunity to see math from their dominant intelligence. The class mentioned ways they remembered the various classifications of triangles. One student remarked isosceles triangles had two congruent sides because the letters S-O-S reminded her of two of the same thing. Mr. Ale encouraged her interpretation with the words, “See, that’s how your mind works.” He then added to the conversation with his own method of remembering the differences between triangles and the classification: “I once knew a woman named Kalene who was crazy. Nothing matched. She makes me remember the scalene triangle because no sides are equal.” He then encouraged the students to associate the information to something personal in order to remember the differences and subsequent classifications. Mr. Ale’s adaptation of teaching strategies allowed students to interact with the material, through their own intelligences, and become more involved participants.

Even though both Ms. Ginger and Mr. Ale used the same teaching strategies before and after the intervention, each teacher was able to adjust to make the same strategies more applicable to all students. The personalization of strategies resulted in students taking a greater role in their learning as seen in a student-led classroom. As a
result, the third theme in the current case study is multiple intelligences as a stimulus for student-led learning.

**Theme 4: Multiple Intelligences as a Stimulus for Student-Led Learning**

Before the introduction of multiple-intelligence-based lesson plans and multiple intelligences student data, the classrooms of Ms. Ginger and Mr. Ale could be classified as either teacher centered or student centered. In Ms. Ginger’s teacher-centered classroom, most of the information was provided by the teacher. The instructor’s role in a teacher-centered classroom is the primary contributor of information versus students discovering and developing their own understanding. In a primarily student-centered classroom, such as that of Mr. Ale, the teacher acts as a facilitator of information (Mosston & Ashworth, 1985). The instructor works as a guide to helping students receive and understand content. As described by Mosston and Ashworth (1985), teachers can shift between teacher-centered and student-centered teaching styles. A teaching style shift took place in both classrooms after the multiple intelligences intervention of this qualitative case study. The classrooms of Ms. Ginger and Mr. Ale became more student led after teachers were informed of students’ multiple intelligences.

**Ms. Ginger’s teacher-centered classroom.** As described previously, Ms. Ginger had fixed classroom procedures and set standards. Her lesson plans outlined the days’ lesson and goals with verbiage such as “students will show the relationship between parallel and perpendicular lines” or “demonstrate how to find angle measurements given parallel lines cut by a transversal.” She was methodical and structured in her plans and lesson delivery. The preidentification of the required benchmarks in Ms. Ginger’s lesson plans further exemplified an adherence to established content standards. Ms. Ginger’s
structure also translated to her instructional strategies. At the start of each new lesson, students received a packet and were to use the textbook to complete the missing parts.

Ms. Ginger was often observed lecturing, providing notes, providing worksheets, and assigning videos for students to watch. She was the primary disseminator of information. While flexible in adopting new methods of teaching, the methods were teacher centered. Ms. Ginger made repeated reference to how she was the main source and means of information. As described by Ms. Ginger,

So I use a lot of the strategies that’s given for the special learner. You just never know what you’re going to get each day. I’ll come with one lesson, and I’m like ok, it’s not working, let’s see, and I’ll just pull something out, and I’ll just do different things just to get them moving. And so each day, I change, you know.

However, the dissemination of packets, task of watching videos, and lectures each require the teacher, both actual and virtual, to be the primary source of information.

With the introduction of multiple intelligences profiles of her students, Ms. Ginger’s classroom became more student centered. Students were given an opportunity to develop their own knowledge. Before the intervention, students were not allowed to work in groups of their choice. “I’ll put them together, and I’ll have them work with each other,” stated Ms. Ginger. With exposure to students’ multiple intelligences, Ms. Ginger allowed students a chance to create their own understanding of the concepts.

During a class observation, students were witnessed participating in Geometry Stations, an activity similar to small think tanks in which students can work together and share ideas to solve problems. On this day of observation, students chose their own groups and worked to complete an assignment through collaboration. The development of
knowledge was left to the student. Ms. Ginger acted as more of a facilitator by walking around the room and answering questions instead of solely providing information. As stated by Ms. Ginger, “It’s more so on them. I’m trying to put it on them to learn, not me. I know it. I have my degree, they don’t.” The unique labeling of students in terms of their strengths led to an increase of a student-led, student-centered atmosphere.

**Mr. Ale’s student-centered classroom.** Before the conversation of multiple intelligences began, Mr. Ale allowed students to lead classroom activities. As referenced by Mr. Ale,

> There is no set way. Like, for example, today I’m teaching and a student stopped me, went up to the board, put me aside, and started showing some other kids some problem that they were having. She said, “Stop, stop, stop for a minute. Hey guys, let me show you.”

Mr. Ale provided students an opportunity to develop their own understanding in ways unique and personal to the students. Mr. Ale also led the class in teacher-centered activities also such as lecture or teacher-led note taking labeled in his lessons as teacher’s opening statement and teacher’s lesson.

After the introduction of multiple intelligences, Mr. Ale’s classroom became more student centered. He viewed himself as more of a facilitator and allowed students to dictate the pace and direction of instruction. When asked about the practices used to engage students, Mr. Ale responded,

> It depends on the skills that the kids want to learn. For example, if a student should have known something and they don’t know it, then I have to go back to basics, ok, to practice the skill. If they need, if they already advanced in the
content, then we can deepen knowledge or go further, climb the ladder. But if they’re weak and we have different groups of kids in the classroom, then I have to do differentiated instruction.

The influence of students on instruction was also echoed in Mr. Ale’s lesson plans and in observation by a review of previous lessons, if requested by the students.

During another observation and specified in the lesson plans as the question of the day, Mr. Ale asked students, “Is an equilateral triangle also equiangular? Why or why not?” This line of questioning helped students examine and organize their thinking to reach a correct answer. The pace of instruction and information was dictated and supplied by the students. Mr. Ale acted as an impartial expert willing to help direct student thought and academic conversation.

Further, students led the path to discovery of new complex information when Mr. Ale asked students to reference prior knowledge to deepen new knowledge. “Can you use a coordinate plane to determine what a triangle is?” asked Mr. Ale. A student’s initial answer was “Yes, slope.” The mention of a previous skill, like finding slope, led to the discussion of how measurement can be used to categorize shape, such as triangles, thereby deepening knowledge. An organic and free classroom environment is the best descriptor of Mr. Ale’s classroom. By understanding the strengths of students, Mr. Ale empowered students to take control of their learning and begin academic dialogue to unfold understanding and comprehension of new topics.

Exposure to more information about students led Mr. Ale to shift towards a more student-centered environment and greater appreciation for student’s individuality. With an understanding of the information that contributes to the individuality of each student,
Mr. Ale developed a greater bond with students and began to exhibit more actions that indicated affection for his students. According to Marzano (2011), affection for students is an instructional strategy that supports teacher–student relationships and ultimately student academic success. A byproduct of more individualized data about students led to more care and regard for each student.

**Theme 5: Teachers’ Strategy of Affection as a Means for Student Engagement**

Once informed of students’ multiple intelligences, both Ms. Ginger and Mr. Ale used the highly effective strategy of using behaviors that indicate affection for students. Actions such as the teacher complimenting students regarding academic and personal accomplishments and the teacher engaging in informal conversations with students that are not related to academics are part of understanding students’ interests and background (Marzano, 2011). After the introduction of multiple intelligences, Ms. Ginger and Mr. Ale displayed additional acts of affection towards students beyond an appreciation for academia but as individuals.

**Ms. Ginger’s affection.** Part of Ms. Ginger’s preliminary research at the onset of the school year was reviewing student records from reports provided by administration, such as students’ IEPs. Student IEPs, created solely for students with disabilities, list the best instructional strategies for the student as well as the student’s current academic goals. To learn more general information about students without disabilities, or the general population of students, Ms. Ginger engaged in casual conversations while greeting students at the door or when walking around the classroom.

However, after being trained and informed of students’ multiple intelligences, Ms. Ginger understood more individual traits of each student and subsequently displayed...
more affection for her students. Ms. Ginger, when interacting with a study participant, was observed explaining a concept in a manner in which the student could relate. The student participant’s dominant intelligence was linguistic. The student asked a question in reference to the classification of triangles based on properties and relationships. In her response, Ms. Ginger asked the student to explain her own personal understanding of relationships. Ms. Ginger then built on the student’s response to further explain the similarities of triangles. She also provided intriguing linguistic information for the student to understand triangle classifications. Ms. Ginger was observed saying “Don’t use A-S-S to describe congruent triangles. Angle, side, side does not exist.” The linguistic learner smiled.

The exposure to multiple intelligences led to a different, more open, giving, and accepting classroom environment. As stated by Ms. Ginger,

It’s not about me. It’s about them. So, I’m always finding new ways, how can I reach them. They learn different than the way I learned. I do try and meet all of the learners’ needs, and I think I do.

**Mr. Ale’s affection.** Prior to the introduction of multiple intelligences, Mr. Ale acknowledged his familiarity with students’ backgrounds was limited to the reports supplied by the school counseling department. When asked about his methods to understand students’ interests and backgrounds, Mr. Ale stated,

Well, not every student wants to talk about their background, but background knowledge I can get their, from Pinnacle [online student information system], or from their, you know, paperwork. I can see what’s going on with their knowledge, you know, their math background or their English background, whatever, you
know. But not their personal background, you know, unless they have something from the administration that wants us to know something about their background that would help them.

Nonetheless, after being trained and informed of students’ multiple intelligences, Mr. Ale acknowledged the differences in his classrooms. When asked about how Mr. Ale understood students’ interests, he responded, “Everyone has a different background and interest.” He began to look at each student as an individual with specific characteristics. The introduction of additional student data also led to more expressions of affection for students. Mr. Ale explained,

I say, “You are awesome!” Just like that, and actually they are. They just need to hear it. I’ll just tell them that, “Listen, your parents need to stop. You need to stop saying my parents are good. Your parents need to say you’re a good son or a good daughter.”

Both Ms. Ginger and Mr. Ale took time to acknowledge directly and indirectly the needs and contributions of their students. A classroom of mutual respect for individuality and talent led to positive outcomes ranging from a student’s smile to a teacher’s praise.

**Conclusion**

A case study approach was utilized with the collection of data through observation, interviews, and document review. The data analysis provided insight into the perceptions, thoughts, and instructional processes of teacher participants. The analysis of all data yielded a story of authentic interactions, exchanges, growth, and development between teachers and students. Capturing and understanding the teacher participants’
multiple intelligences revealed teachers’ multiple intelligences contributed to their use of specific instructional strategies and was based on their dominant intelligences. Analysis also uncovered the following themes: (a) teachers’ limited use of multiple intelligences through the lens of the van Hiele framework, (b) teachers’ dominant intelligences shaping the use of instructional strategies, (c) instructional strategies as a means of personalization, (d) multiple intelligences as a stimulus for student-led learning, and (e) teachers’ affection as a strategy of engagement.
Chapter 5: Discussion

This concluding chapter discusses and describes the implications of the qualitative case study. The chapter opens with an overview of the problem. Then, the researcher discusses the implications drawn from each theme. Limitations of the study are presented. Next, the researcher provides recommendations to teachers and administrators. Lastly, the researcher makes suggestions for future investigation based on the limitations and findings of this study.

Overview of the Study

More than half of secondary students failed the geometry EOC test in a Florida school district in 2012 (Florida Department of Education, n.d.). As geometry is a course needed to graduate high school, student failures were alarming to parents and teachers. Whereas parents can primarily offer support to students, teachers have a substantial role in the success or failure of their students. A teacher’s instructional strategies are vital to student comprehension. Beyond standard information such as students’ test scores, socioeconomic status, disability classification, and last year’s school grade, teachers know very little about students’ affective characteristics such as learning style or multiple intelligences. To fill this gap, the case study was an examination of teachers’ instructional strategies when teachers were informed by students’ multiple intelligences and trained in multiple-intelligence-based lessons.

Participants in this case study were two experienced geometry teachers in a southeastern public high school and 15 of their students. The researcher analyzed data from face-to-face interviews, the MIDAS questionnaire, field notes from observations, and information from lesson plan reviews.
Discussion and Implications

After collecting and analyzing data, five themes emerged: (a) teachers’ limited use of multiple intelligences in accordance with the van Hiele model, (b) teachers’ dominant intelligences shaping the use of instructional strategies, (c) instructional strategies as a means of personalization, (d) multiple intelligences as a stimulus for student-led learning, and (e) teachers’ affection as a strategy of engagement. Each theme is discussed and related to the literature.

Multiple intelligences through the lens of the van Hiele framework. Geometry may be a complex and difficult subject for many students (Fuson et al., 2006). The introduction of new shapes and terms that are solely used in the context of geometry is difficult for students to understand. As a result, specific skills must be acquired to navigate the content. A student must learn how to draw shapes, classify shapes, and apply the correct theorems and definitions when solving problems. In high school, students also must know how to apply theorems, definitions, and postulates to prove concepts and ideas unique to geometry, such as the congruency of triangles, as seen in the case study. To promote comprehension among students, teachers should instruct students based on their level and their method of learning. However, as seen in the case study, teachers taught students from the perspective of three intelligences. The inclusion of the other intelligences was missing from instruction. Through the lens of the van Hiele (1999) framework, a geometry teacher is charged with developing specific skills for students as they progress through each level: visual skills, verbal skills, drawing skills, and logical skills (Erdogan et al., 2009). If one translates this information in terms of the types of intelligences that are needed to master these skills, one would note the vital need to target
spatial, linguistic, and logical intelligences.

As seen in the case study, these three intelligences were solely used when teachers focused teaching skills outlined in the van Hiele model. Teachers did not include musical or kinesthetic intelligences when teaching how to classify triangles. Teachers did not use a naturalist or kinesthetic approach when showing how to draw comparisons between shapes. Ultimately, teachers only used the intelligences steeped in drawing, words, and thinking. The student whose strength may not be spatial, logical, or linguistic was not taught in a manner conducive to that student’s intelligence, as evidenced in the case study. The musical or naturalist student was left without a bridge to the mathematically complex, abstract, vocabulary-laden world of geometry. Teachers’ focus on specific intelligences might be influenced not only by van Hiele’s framework, also by teachers’ dominant intelligences.

**Teachers’ dominant intelligences shaping their use of instructional strategies.** Very few professional development trainings investigate how teachers teach. District and administrative personnel ensure teachers have a clear understanding of the information that should be taught through a detailed discussion of the newest testing benchmarks or a review of the current textbook. However, there is no set standard on how teachers should teach. As a result, teachers have personal best practices and toolkits for instruction across disciplines, grade levels, content areas, and ability levels. Among teachers’ instructional options is the choice of instructional strategies. Although pedagogy has advanced and labeled certain strategies as high yielding and most effective as seen in the Marzano Teacher Causal Evaluation Model, teachers are inevitably able to decide which strategies to use in their classrooms.
Jett and Cross (2016) stated teachers’ characteristics and backgrounds are the basis for teachers’ choice of techniques. As evidenced in the case study, teachers’ use of instructional strategies was shaped by the teachers’ dominant intelligences. Each teacher participant possessed dominant logical-math and interpersonal intelligences. Both teachers were also least dominant in the naturalist and musical intelligence categories. Neither teacher used strategies linked to their least dominant intelligences before or after being trained in multiple-intelligence-based lessons. The repeated use of strategies shaped by teachers’ dominant intelligences led to teacher bias.

Instructors believed classroom teaching provided different options for student learning. However, the options were rooted in the dominant intelligences of the teachers. As stated by Ms. Ginger, “I change you know, I don’t stick with the same method all the time. I’m always evolving with time, yes, or with the day, or the moment.” Ms. Ginger offered options in terms of methods, but not intelligence. For example, Ms. Ginger used lectures, textbooks, and worksheets, which are different modes of presentation; however, all strategies are aligned with a linguistic intelligence. Ms. Ginger possessed a very high linguistic intelligence. This unconscious bias had negative consequences. For example, a student with a dominant kinesthetic intelligence was observed sleeping and disengaged on several occasions. The lack of engagement might have been a result of the presentation of information. As stated by Hardy (2005), the consequences of incongruence between teachers’ instructional strategies and students’ intelligences include feelings of hopelessness and sadness during a typical school day. The good-natured intention of flexibility in presentation by Ms. Ginger may satisfy students’ desire for versatility but did not provide the inclusion of different intelligences. However, while
continually vested in teachers’ strengths, instructors used strategies in different ways to provide a personalized experience for students. Teachers adjusted instructional strategies as a personalization tool.

**Teachers adjust strategies as a personalization tool.** Throughout the course of the study, the researcher observed teachers differentiate instruction to ensure students’ needs were met. Various methods were used while teachers informally gauged success. Ms. Ginger stated,

I do a lot of diagrams. So I use a lot of the strategies that’s given for the special learner and, because like my classroom, you just never know what you’re going to get each day. I’ll come with one lesson and I’m like, ok, it’s not working, let’s see, and I’ll just pull something out, and I’ll just do different things.

Although armed with “tons” of methods, such as “write-outs, backwards design, videos, flip classrooms, and self-directed learning” as described by Mr. Ale, educators were unsure of which strategies would be most beneficial to their students. In a subject with a considerable degree of difficult, as seen in geometry, presenting information to best fit the needs of students is imperative. As a result, teachers differentiated instruction with the entire class. As evidenced by lesson plans in both classrooms, each lesson’s target audience was “all” to indicate the same instruction for all students. Yet, as stated by King-Sears (2005), “Large-group instruction as the primary method of demonstrating new skills and strategies—whether in a special or general education setting—is not the most efficient way to differentiate” (pp. 401–402). Differentiation of instruction should occur in smaller group settings or individually. Fortunately, the identification of dominant intelligences provided teachers in the current case study with the information
needed to personalize and effectively differentiate instruction.

For example, a student whose dominant intelligences were interpersonal and spatial asked a question concerning the calculations written on the board. Mr. Ale repeated the steps used to solve the problem. The student had a puzzled expression. Mr. Ale proceeded to draw a picture and highlight important information with different colored markers. Upon repeating his original explanation while referencing the drawing, he asked the young lady if she understood. As she nodded her head in agreement, Mr. Ale stated to the class, “See, some kids have to see it. She had to see it.” Mr. Ale differentiated instruction through an adjustment of the mode of delivery. He transitioned from an explanation solely with numbers (a logical intelligence) to identifying critical information with different colors and an illustration (a spatial intelligence). He changed his presentation to more effectively differentiate instruction and meet the needs of his student. During an interview, Mr. Ale acknowledged the need to personalize instruction: “We have different groups of kids in the classroom. I have to do differentiated instruction.” Multiple intelligences provided a more effective way to differentiate instruction.

Ms. Ginger also expressed a new method to differentiate instruction. Instead of offering various presentations to the entire class as a group, Ms. Ginger used explicit methods for specific students, once informed of students’ multiple intelligences. “I use vocabulary chats, or they can move in pairs, it all depends on the student. I do try and meet all of the learners’ needs,” stated Ms. Ginger. She chose to look at students apart from the entire group. These findings are in alignment with other studies by Kelly (2013), Hardy, (2005), and Miller (2013) finding multiple intelligences is a powerful means of
differentiating instruction. Multiple intelligences also were an integral aspect of teaching styles in the current qualitative case study.

**Multiple intelligences as a stimulus for student-led learning.** Before the introduction of multiple intelligences in the current case study, Ms. Ginger demonstrated a teacher-centered teaching style. All content was provided by Ms. Ginger. Mr. Ale’s style ventured between teacher-centered and student-centered learning. He often allowed students to gain their own understanding but also disseminated information. After the introduction and training in multiple intelligences, both teachers adopted more student-centered teaching strategies. Teacher participants went from being providers of information to facilitating learning among their students. For example, Ms. Ginger changed from choosing groups for her students to allowing students to choose their own groups or work alone. This shift in strategy allowed students with either intrapersonal or interpersonal intelligences to work in a manner they found most comfortable.

Mr. Ale also shifted from presenting information from a linguistic practice of lecture to allowing students to explore their understanding of content through a linguistic practice of storytelling. A student whose dominant intelligence was linguistic explained her understanding of the properties of a triangle. Additional students joined the conversation, leading to more understanding of the day’s topic. By using more student-centered strategies, instructors permitted learners to develop their understanding and knowledge, both individually and collectively. In the current study, teachers allowed students to play a greater role in their learning, ultimately empowering students.

For instance, both Ms. Ginger and Mr. Ale allowed students to go to the board to explain problems. In one instance of observation, Ms. Ginger asked a student to solve a
problem. When the child expressed his confusion, Ms. Ginger asked the student to choose another student to assist him. Both learners worked diligently, exchanging ideas and questions before reaching the correct solution. “Good job, team!” Ms. Ginger exclaimed. The young men smiled and shared a glance of relief with one another. In another observation, Mr. Ale allowed students to express their understanding of the concept assigned the night before. Students began to share their ideas and correctly explained the theories in the text. As stated by Mr. Ale, “They told me to go on. We got this! Move on to the next section.” Students were self-assured once given the freedom and safe space provided in their geometry classroom. Student-led learning is helpful in an abstract subject such as geometry. Learning how to build upon ideas and thoughts aids and empowers students in navigating unique vocabulary and complicated concepts.

The empowerment experienced by students led to increased confidence and self-reliance. Empowerment is essential to academic success. As seen in the case study and supporting findings by Vatterott (1995), young people are inspired to learn and take responsibility of their learning if they feel they have a role in their learning. The influence of academic empowerment is experienced not only in the classroom in which it begins but also in lifelong educational experiences. If students are taught how to learn and develop their own thoughts, as seen in a multiple-intelligence-infused, student-centered classroom, student ability to self-teach in the future is inevitable. The awareness of students’ multiple intelligences by teacher participants resulted in a shift in not only teacher strategies but also teacher’s relationships with students. Teachers also used instructional strategies of care and affection as a means of student engagement.

**Teachers’ strategy of affection as a means for student engagement.** Teacher
educator programs cannot teach instructors to care. Administrators cannot fully gauge a teacher’s level of empathy towards children before assigning that person to teach 150 students on the first day of school. Principals and parents can only hope their child receives instruction from a caring and dedicated teacher. Despite no means to make someone care, teachers can take small actions to show they are interested in the well-being of their students. For instance, Mr. Ale was observed accepting the late work of a student because her “work is too beautiful to miss.” When asked how Mr. Ale communicates high expectations for his students, he replied,

I let them know that they are better than me, I only know more. There’s no difference. I only know more. As a matter of fact, some of the kids know more technology than I do. It’s a fact. Maybe I know more math because it’s just from experience, so we’re even. I’m not better than them, they’re not better than me. We’re even.

The growing affection was evident in the classrooms of Ms. Ginger and Mr. Ale through additional time spent working with students and obvious bonds between teacher and student. Ms. Ginger also took the time to support her students by placing motivational quotes on their desks. When asked why she placed these quotes on their desks, she stated, “It’s just my way of brightening their day.”

Little research has indicated knowledge of students’ multiple intelligences plays a role in teachers’ affection towards students. However, when secondary students were asked what helps them learn, remarks included teachers taking the time to know students and being mindful of the way students learn, making the classroom more enjoyable and productive (“What Helps Us Learn,” 2010). The study supports this claim and
exemplifies how the inclusion of a students’ attribute of multiple intelligences can serve as a means for students and teachers to have a better classroom experience. The events in the participants’ classrooms over the course of the study served as examples of the efforts and processes required when enlightening young minds daily in classrooms across America.

Limitations

According to Glesne (2010), the limitations of a study include the “documents, people, or places” unavailable to the researcher (p. 212). The case study had three limitations. First, the qualitative study had a small sample size of two teachers and 15 students. Second, the study occurred at one site. Since the researcher had access to the site as a former employee, the site was most feasible in the successful completion of the study. However, the participants were limited to those who attended and worked at the site. Finally, the study was limited in time, and the training was a single hour-long workshop.

Recommendations

As a result of the findings of the study, the researcher has several recommendations to assist in the improvement of student learning. First, the researcher recommends teachers be trained extensively (beyond the training offered in the study) on intelligences outside of those in direct alignment with geometric content. Creating instructional activities steeped in intelligences beyond the technical, spatial, and logical boundaries of geometry, as seen in the van Hiele framework, may provide a bridge for students with different intelligences such as naturalist, musical, and kinesthetic.

Second, the researcher recommends teachers be made aware of their multiple
intelligences profiles before instruction begins to reduce or avoid teacher bias. As seen in the current study, teachers’ dominant intelligences shape the use of specific strategies. To ensure teachers are made aware of a subconscious affinity towards certain intelligences, teachers should take a multiple intelligences assessment and study their multiple intelligences profile.

Third, students should also take a multiple intelligence assessment to inform teachers of their most and least dominant intelligences. Teachers should be given students’ multiple intelligences profiles in the beginning of the school year to ensure teachers have all of the information to properly differentiate instruction as early and effectively as possible.

Fourth, teachers should be well trained and given materials for the use of multiple-intelligence-based lessons. Understanding how to apply instruction to all intelligences will assist students in understanding instructional content. As evidenced by this study, teachers are able to implement various strategies once trained and informed of these activities.

The researcher recommends the education and training of administrators and teachers on multiple intelligences as a means to support student-centered instructional strategies. For example, when educators preview new content with students, one way to encourage student-centric learning is to ask students to express their idea of the topic through a physical activity, a drawing, a story, or a song. The incorporation of the different means of expression allows the inclusion of several different intelligences while students form their own understanding and knowledge. Consequently, students are engaged, empowered, and expressing a desire to learn.
Considerations for Future Research

First, future researchers can explore the outcomes of training teachers on how to incorporate intelligences such as naturalist, musical, and kinesthetic in a geometry classroom for an extended period of time. Researchers can observe how or if teachers can bridge the gap between spatially, linguistically, and logically rich content to those who think in terms of music, nature, and physical movement.

Second, future researchers should explore the perceptions of students and teachers in a classroom in which the teacher’s dominant intelligences and subscales differ from students’ dominant intelligences and subscales. For example, as seen in the study, Ms. Ginger was dominant in kinesthetic intelligence with a high subscale of dexterity. Ms. Ginger’s student was also dominant in kinesthetic intelligence, yet with a specific strength of physical movement, described as the ability to move the whole body for physical activities such as balancing, coordination, and sports. This strength is different from Ms. Ginger’s strength of using the hands with dexterity and skill for detailed activities. The difference in subscales may yield a different experience for the student and teacher.

Future considerations should include the students’ and teachers’ perceptions of classroom instruction and teachers’ use of strategies. Whereas teachers were made aware of their students’ learning profile, the researcher did not reveal teachers’ multiple intelligences profiles until the end of the study. Future researchers may inquire how teachers, before and after they are informed of their own intelligences, perceive their instructional practices.

Due to this study’s small sample size and time limitations, the same study could
be conducted with more participants, a different content area, and a longer research period. The current case study occurred over a 6-week period with Geometry Honors teachers. A longer study with more extensive multiple intelligences training may yield different results.

Lastly, researchers could analyze teachers’ evaluations using the Marzano Causal Teacher Evaluation Model before and after teachers are trained in multiple intelligences. Future researchers could investigate if the infusion of multiple intelligences results in higher or lower performance scores on evaluations for classroom teachers.

**Conclusion**

Overall, as researchers seek to find ways to improve the classroom setting for both teachers and students, teachers must keep in mind that no classroom is uniform. Each classroom has a unique set of differences among student learners. Educators are charged with infusing, educating, and introducing valuable information to young minds on an hourly basis for most days of the week. The charge is as great as the reward. Teachers have the honor of cultivating the talent of the world, but not without effort and struggle. The use of multiple intelligences is a small part of the techniques teachers can use to cultivate the minds of their students. With the help of future researchers, more techniques and strategies will be introduced to empower the next generation of students and last well beyond their high school geometry class into their futures.
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Appendix A

Researcher-Created Protocol for Classroom Observation and Lesson Plan Review
### Research-Created Protocol for Classroom Observation and Lesson Plan Review

<table>
<thead>
<tr>
<th>List the domain and element information</th>
<th>Instructional strategy</th>
<th>Used with which student</th>
<th>How was strategy used?</th>
<th>Additional observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Observation example: 1/9</em></td>
<td>Chunking content into “digestible bites”</td>
<td>All</td>
<td>Gave a mini-lecture of upcoming lesson</td>
<td>Most students seemed disengaged—did not take notes, did not ask questions</td>
</tr>
<tr>
<td><em>Lesson Plan example: 2/2</em></td>
<td>Use of available resource</td>
<td>All</td>
<td>Gave all students laptops</td>
<td>Most students seemed engaged</td>
</tr>
</tbody>
</table>
Appendix B

One-on-One Teacher Interview Questionnaire
One-on-One Teacher Interview Questionnaire

Directions: Please answer the following questions to provide a better understanding of your teaching practices.

1. What factors influenced the physical organization of your classroom?
2. How do you help students interact with new knowledge?
3. How do you help students practice and deepen new knowledge? Do you review, use homework, or help students examine similarities and differences in the new knowledge?
4. How do you help students generate and test hypotheses?
5. What practices do you use to engage students?
6. What practices do you use to establish and maintain effective relationships with students?
7. What practices do you use to understand students’ interests and backgrounds?
8. How do you communicate high expectations for all students?
9. How do you prepare for lessons and units?
10. How do you utilize technology in and outside of the classroom for the purpose of classroom instruction?
11. How do you plan and prepare for English language learners, special education students, and students who lack support for schooling?
12. How often are students able to work in pairs or small groups?
13. What opportunities do students have to create tangible items to reveal their understanding of material?
14. How often do students move around the room when learning a lesson?
15. Name the different mediums or resources used to teach a lesson. For example, do you use video clips, pictures, music, artifacts, or a whiteboard to illustrate a lesson?