Grouping the Mathematically Gifted: A Mixed Methods Investigation of Homogeneous and Cluster Arrangements

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This dissertation titled
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Abstract

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Grouping the Mathematically Gifted: A Mixed Methods Investigation of Homogeneous and Cluster Arrangements

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American public schools are faced with the incredible problem of underachievement among gifted youth (Benbow & Stanley, 1996; Feldhusen & Moon, 1992). The problem of underachievement among gifted youth is a result of inadequate services, improper placement, and neglect of gifted programming from school leaders (Clark, 2008; Reis & McCoach, 2000). Gifted learners often become impatient with the slow pace of academics within the classroom and desire a more rigorous curriculum (Bloom, 2007). This mixed methods dual case study compared the academic achievement of mathematically gifted fifth grade students receiving mathematics instruction within two specific grouping configurations. One group received mathematics instruction in a homogeneous (i.e., ability) group and the other received mathematics instruction in a cluster-group arrangement.

Quantitative data for this study included pre- and post-test scores, used to explore the effects of grouping strategies. Analysis of the data was performed using t-test models of regression. Qualitative information was obtained by interviewing participating teachers and principals of two schools where the intervention occurred. The findings indicate students grouped homogeneously during instruction have better achievement when comparing pre- and post-test data. Results also suggest that teachers prefer to deliver
instruction within homogeneous arrangements and school administrators need more flexibility when assigning gifted students to classes.
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I would also like to recognize the participating school district, students, teachers and administrators for providing their time and allowing me to pursue this study. Their dedication and support is certainly appreciated.
Dedication

I dedicate this dissertation to the participating students, teachers and administrators for them this would have not been possible. I also dedicate this dissertation to my co-chairs Dr. Dwan Robinson and Dr. Dianne Gut. They have consistently been supportive and inspired me to pursue my passion.
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Chapter 1: The Problem and Context

American public schools are faced with the incredible problem of underachievement among gifted youth (Benbow & Stanley, 1996; Feldhusen & Moon, 1992). According to Seeley (2004) an underachiever “is a student who does not achieve in the academic areas at a level consistent with his or her capability” (p. 1). Although schools see underachievers whose ability levels vary, some educators (e.g., Feldhusen & Moon, 1992; Reis & McCoach, 2000; Siegle, Reis, & McCoach, 2006) have expressed particular concern about the underachievement of gifted children and youth. Giftedness according to Booth and Stanley (2004) is: “Evidence of advanced development across intellectual areas within a specific academic or arts related area, or unusual organizational power to bring about desired results” (p. 168). Typically schools monitor and label a student as gifted by using available instruments, including “inventories, checklists, and student performance” (Borland, 2005, p. 362). School districts often consider multiple instruments when setting eligibility requirements for formal gifted services. These can range from teacher evaluations to formal assessments (Booth & Stanley). Traditionally schools use a variety of scores, which include achievement, intelligence, and aptitude tests. They may also consider teacher recommendations and grades for classifying a student as gifted (Booth & Stanley).

As several educators (e.g., Clark, 2008; Morisano & Shore, 2010; Seeley, 2004) have argued, many gifted students underachieve because of inadequate services, improper placement, and neglect of certain gifted programming by school leaders. “All students, even those identified as gifted, deserve a personalized education. However, many
educators outside gifted education believe that *giftedness* is a fancy label and that gifted students do not need a special curriculum” (Besnoy, 2005, p. 33). There tend to be growing numbers of gifted learners becoming impatient (Bloom, 2007) with the structure and pace of academic content presented in the classroom and gifted students often reveal frustration when the pacing of the classroom curriculum is not appropriate for their learning needs (Booth & Stanley, 2004). When gifted students are held back from learning at their own pace, a greater degree of sensitivity and even hyperactivity can be observed. This central nervous system reaction causes an internal reaction in a student’s sympathetic nervous system otherwise known as a student’s *braking mechanism* to dysfunction; therefore impulsivity and hyperactivity are often observed (Booth & Stanley, 2004). Students with a compromised sympathetic nervous system often experience hyperactivity or impulsivity, which can affect their social and academic performance (University of Connecticut, 2013).

Students who do not have their social and emotional needs resolved by appropriate educational placements may need counseling or additional services to help them understand how their advanced abilities make them unique from their same-aged peers. Counseling services can help gifted students cope with the feeling of being different (Ishak & Bakar, 2010; Silverman, 1993). The social-emotional development of high achieving and gifted students can be impaired by a lack of exposure to other peers at their intellectual level (Booth & Stanley, 2004). When a gifted and high achieving student is placed in a traditional classroom away from gifted peers, the social-emotional development of the gifted child is diminished which has direct correlation to achievement

One potential result of this trend of underachievement and improper placement of gifted students is that American gifted and high achieving students are not performing at the same rate as the international competition. At the international level, research conducted by the Trends in International Mathematics and Science Study (TIMMS) shows that 40% of Singapore and other Asian students score at the highest level on the (TIMMS) mathematics achievement tests, while a mere 10% of American fourth graders and 6% of American eight graders achieved at an equivalent level on the 2007 assessment (Gavin, Casa, Adelson, Carroll, & Sheffield, 2009; Feldhusen & Moon, 1992). This report focuses on the performance of 36 different countries participating in the fourth grade assessment and 48 countries participating on the eighth grade assessment.

The 2007 Trends in International Mathematics and Science Study (TIMSS) is the fourth administration since 1995 of this international comparison. Developed and implemented at the international level by the International Association for the Evaluation of Educational Achievement (IEA)—an international organization of national research institutions and governmental research agencies—TIMSS is used to measure over time the mathematics and science knowledge and skills of fourth- and eighth-graders. (Williams, Jocelyn, Roey, Katsberg & Brenwald, 2009, p. iii)

Darling-Hammond (1990) contends that only 6% of 17-year-old Americans can solve mathematical problems that require multiple steps. These statistics are powerful and
suggest that high achieving students are not reaching their full potential in American public schools (Clark, 2008; Feldhusen & Moon, 1992; Hoover-Schultz, 2005; Morisano & Shore, 2010). Many educators (Clark, 2008; Davis, 2009; Galbraith, 1985; Hirsch, Vialle, Rogers, & McCormick, 2010) agree that gifted students should be permitted to learn at their own rate, however, in actuality highly able students may experience the invisible ceiling and are held back by their classmates (Colangelo, et al., 2005). The “invisible ceiling restricts the progress of academically gifted students” (p. 1), and can be considered a barrier that prevents gifted students from working at or above their potential.

The No Child Left Behind Act of 2001 (NCLB) [Pub. L. 107-110; 115 Stat. 1425; 20 U.S.C. 6301 et seq.] is a comprehensive educational reform act aimed at closing the achievement gap and promoting school accountability by increasing annual testing for students and funding allocations from the federal government (NCLB, 2001). NCLB pays limited attention to students who perform above proficient levels and “it is this group that is invisible on the national agenda…” (Colangelo et al., 2005, p. 2). School leaders have voiced concern about the lack of policy and the effects of NCLB for gifted students (Mendoza, 2006), however, little has been done to improve gifted policy. Additional policy language must be considered to help serve and protect gifted students (National Association for Gifted Children (NAGC), 2013).

Some theorists suggest there is decreased emphasis on advancement for gifted students. For instance, Thornton (1995) states, “our school systems are actually giving tacit approval to creating underachievement in one ability group so that the needs of the other ability group can be served” (p. 64). Glass (2004) argues that America’s brightest
and most talented students have quit learning and are underachieving. Curriculum has been *diluted or watered-down*, therefore many gifted and talented students often do not give their best effort in order to succeed (Glass). A diluted curriculum occurs when teachers or school districts diminish the intellectual level of the material. Gifted students are typically ready for more advanced content when compared to their peers so instead of a watered-down curriculum, school districts must find ways to help students traverse the curriculum at a faster rate. “This lack of challenge in the curriculum for higher-level students in American public schools is exacerbated… due to… budgetary shortfalls, increasing enrollment, demands for teacher time, and lack of teacher skill” (Glass, 1994, p. 27).

The current trend of cutting and slashing funding for gifted education from state budgets is a call to action for all educators of the gifted. This watershed moment must be addressed with a proactive grassroots vision because the greatest effects will be felt at the most basic level: the local schools. (Besnoy, 2005, p. 32) Local school districts should consider taking action to protect gifted services and find fiscally responsible ways to serve gifted youth. Stanley and Baines (2002) suggest that No Child Left Behind (NCLB) has put an emphasis on teaching to the average level learner, and progressing students through each grade level as rapidly as possible, and in response, many school districts have reduced and/or eliminated gifted programs. When gifted program are reduced or eliminated, gifted students are placed in a traditional classroom, where the learning activities are not sufficiently accelerated to meet their learning demands (Glass, 2004).
In the regular education classroom, teachers can differentiate instruction to reach the higher-level learners. Some school districts have “eliminated or cut back on more traditional gifted programs in favor of differentiation curriculum and instruction in the regular education classroom” (Hertberg-Davis, 2009, p. 251). A differentiated learning environment within a traditional educational setting, appears to be a solution for gifted students, however, many teachers perceive this approach as time consuming (Hertberg-Davis, 2009). Hertberg-Davis (2009) content when curriculum needs modified to address gifted learners, thoughtful differentiation takes time to develop. On the opposing side, “the amount of time it takes to plan differentiated curriculum decreases over time as teachers become more accustomed to the process, learn to plan efficiently, and develop a storehouse of differentiated lessons and units from which to work” (Hertberg-Davis, 2009, p. 252). A differentiated approach to instruction has demonstrated success in increasing student achievement (Kelly, 2013), “but, like any approach to educating gifted students, it functions best as a critical component within a spectrum of services provided for high-ability learners” (Hertberg-Davis, 2009, p. 253).

Davis (2009) argues that test mandated by federal policy such as No Child Left Behind and Race to the Top has made the traditional classroom less conducive for the gifted learner because the pressures of the test have caused teachers to resort to test-prep methods of instruction. Teachers are spending time teaching students how to take tests rather than using problem-based, inquiry lessons that allow students to develop and use higher order thinking skills (Kontovourki & Campis, 2010; Wilkins, 2012). “As the number of special programs for gifted students in schools has decreased there has been a
dramatic growth in educational opportunities for academically talented students offered outside of school…” (Booth & Stanley, 2004, p. 130). “When students with gifts and talents are left out of the [curricular modifications], gifted student needs are not addressed, and they often do not make the academic gains they are capable of accomplishing” (Coleman, & Johnsen, 2011, p. 2). When developing an education plan for gifted students, it is imperative that school districts and families work collaboratively to take advantage of opportunities inside and outside of the classroom (Booth & Stanley, 2004). In support of more rigorous academic standards, the Common Core State Standards have recently been adopted by many states.

In 2011, the Chief State School Officers developed the Common Core State Standards in Mathematics and English Language Arts. These standards are “aligned with college and work expectations and stress rigorous content and application of knowledge through higher order skills” (Johnsen, 2012, p. 229). In addition to the Common Core, many states have agreed to administer a different type of assessment developed by one of two consortiums: Partnership for Assessment of Readiness for College and Career (PARCC) or Smarter Balance. The questions on these newly revised assessments aligned to the Common Core require students to extend their higher order thinking skills. Coupled with the curriculum changes and more rigorous set of academic standards, grouping options can be considered to support the gifted learner.

Strong evidence (Bent, 1969; Brulles & Winebrenner, 2011, 2012; Gentry & Owen, 1999; Hansen & Toso, 2007; Kanevsky & Keighley, 2003; Rotigel & Fello, 2004) supports the effectiveness of grouping (i.e., homogeneous and/or cluster), which allows
gifted students to be grouped together and receive an appropriately challenging and rigorous curriculum (Minnesota Educators of the Gifted and Talented (MEGT), 2006). Grouping the mathematically gifted helps reduce the time spent on reviewing concepts and maximizes the instructional pace (Rotigel & Fello, 2004). Mathematically gifted and high achieving students have exceptional memory, ability to reason and problem solve, and preference for working abstractly (House, 1987). Furthermore strong students in math are “those who have the potential to become the leaders and problem solvers of the future” (Sheffield, 1999, p. 9). Gifted and high achieving math students can have their needs met with an enriched and modified curriculum and in some cases with specialized grouping (Rotigel & Fello, 2004). The National Council of Teachers of Mathematics (NCTM) notes that

all students need access each year to a coherent, challenging mathematics curriculum taught by competent and well-supported mathematics teachers… and students with special interest or exceptional talent in mathematics may need enrichment programs or additional resources to challenge and engage them. The talent and interest of these students must be nurtured and supported so they have the opportunity and guidance to excel. (2000, pp. 12-13)

When mathematically gifted students receive instruction with like-minded and like ability students the amount and pace of instruction can be accurately modified and delivered to benefit their academic needs (Rotigel & Fello, 2004).

Grouping options may include grouping students all day for instruction (homogeneous) or flexible grouping options throughout the day (cluster) based each
student’s academic readiness (MEGT, 2006). Many theorists suggest a cluster group approach, which is a highly used grouping strategy that meets the needs of gifted learners (Brulles & Winebrenner, 2011, 2012; Gentry & Owen, 1999). A cluster arrangement allows gifted learners to interact with like-minded peers and receive daily instruction within the regular education classroom. This service model has few financial implications for a school district (Brulles, Saunders, & Cohn, 2010). Programs for the gifted and talented have been a low priority for school districts and educational leaders, and development in this area has been described as “inconsistent, uneven, and weak” (Moltzen, 1996, p. 1).

**Statement of the Problem**

There are many underserved student groups in America (e.g., students living in poverty, minority students, and students with disabilities), however, Benbow and Stanley (1996) and Lewis, Cruzeiro, and Hall (2007) also declare gifted students as an underserved population in schools. Roeper (1986) state that gifted students have also “become the educationally disadvantaged children in America” (p. 6). Farmer (1993) and Finn (2014) agree by arguing that gifted learners have not been provided opportunities to reach their full potential. Furthermore Gavin, Casa, Adelson, Carroll, and Sheffiel (2009) suggest that the mathematically gifted student is the most neglected. “Outstanding mathematical ability is a precious societal resource” (Gavin et al., p. 188) that is needed for leadership roles in America.

Special programs specifically designed for the gifted and talented have been around since the 1900’s, as students were first identified as gifted in the 1920’s (Bines,
1991). Once students started becoming identified with gifted abilities, a nationwide push
to improve gifted education gained momentum during the Cold War around 1950 (Glass,
2004). The Cold War was an intense political and economic conflict between the United
States (US) and the Soviet Union, now known as Russia. During this time, the US and
Russia were known as super powers, both trying to demonstrate their strength through
technology and innovation. In 1958, the U.S. Congress approved The National Defense
and Education Act (NDEA) P.L. 85-864; 72 Stat. 1580, the first ever-federal aid provided
to education (Glass, 2004). In the 1960’s however, gifted education took a back seat
(Glass) and continues to be secondary today.

Hirsch, Vialle, Rogers, and McCormick (2010) state that a specialized educational
setting (e.g., resource room, cluster and homogeneous groups) benefits academically
advanced students. Studies cited in Hirsch et al. include Cross, Stewart, and Coleman
(2003) and Gross (2002) which indicate that gifted students should be removed from the
stresses of the regular classroom environment so they do not feel the need to modify their
demeanor or actions so that they can relate to their classmates. Hirsch et al. (2010) also
suggest gifted student infrequently have their cognitive needs addressed in a regular
education setting and experience a diluted curriculum that does not meet their intellectual
capacity. A diluted program can cause a gifted student to underachieve and can have
negative consequences to their self-worth (Hirsch et al.).

Davis (2009) suggests that when teachers are assigned to a mixed ability
classroom, they often do believe that gifted and high achieving students, in that setting,
need or deserve a differentiated curriculum (Davis). “Differentiated instruction refers to a
systematic approach to planning curriculum and instruction for academically diverse learners” (Tomlinson, 2003, p. 3). Addressing the content, process, product, and environment according to students’ readiness and learning profiles can differentiate instruction. Successful differentiation can occur in a classroom setting when a variety of key instructional fundamental are offered. According to Adam and Pierce (2006) essential elements include “classroom management techniques, planned use of anchoring activities, a variety of differentiated instructional strategies, and differentiated assessments” (p. 3). Instructional strategies that are used in a differentiated classroom include but are not limited to compaction, learning contracts, cubing, and tiered lesson planning (Adam & Pierce). Priority has been given to improving the performance of students who do not test at the proficient level, and interest in the gifted student is secondary (Clark, 2008). With the introduction of Value Added, the measure of growth a student shows in one school year, school leaders and educators will have to become more concerned with the gifted population. According to the Ohio Department of Education (2014) “Value-added analysis is a statistical method that helps educators measure the impact schools and teachers have on students’ academic progress rates from year to year” (para 3). In Ohio, Value Added is used to formulate a specified percentage of each teacher’s overall merit rating for some schools district during the 2013 – 2014 school year (Blevins, 2013).

This notion adds to the philosophy that gifted students must not be held back within the traditional classroom setting and must be provided with differentiated instruction in order to show academic growth. While some scholars (Daniel, 2008;
Cawthon, 2007) argue that No Child Left Behind (NCLB) has provided an increase focus on national educational standards by creating a high stakes environment that holds school districts accountable, others argue that No Child Left Behind ignores the top performing students (Glass, 2004; Grgich, 2009).

No Child Left Behind cannot, at its, core, be interpreted to mean that the brightest students must wait on the slowest. All students should have the right to exercise their talents to the fullest potential. Accepting the educational philosophy of excellence for all does not equate to identical education for all. There are no identical students. (Glass, 2004, p. 28)

Differentiated instructional strategies can help reach different types of learners. Differentiated approaches to learning takes into account the learning demands and needs of the varying abilities within one classroom (Kanevsky, 2011). Differentiated activities “begin with an awareness of what students want so their preferences can be integrated into their learning” (Kanevsky, 2011, p. 280). A differentiated approach to instruction provides students with an approach to learning they want (Kanevsky, 2011).

Gifted students hold themselves and their classmates to high standards, and some research suggests that when placed in heterogeneous classrooms, gifted students are held back in their intellectual growth by succumbing to a curriculum that is geared toward the average learner (Gowan & Burch, 1971; Hansen & Toso, 2007; Rakow, 2012). Benbow and Stanley (2006); French, Walker, and Shore (2011); Huss (2006); and VanTassel-Baska (1991) all agree that cooperative learning and certain forms of grouping may damage gifted education even more by eliminating the ability for gifted students to work
and think with like-minded individuals. These approaches and heterogeneous groupings have diverted general education teaching from concentrating on the demands of gifted and high achieving learners (Winebrenner & Devlin, 1998).

Gifted programs have generally utilized one of several general strategies, such as enrichment groups, acceleration, cluster and full-time ability groups (Goldring, 1990). Grouping the gifted is largely philosophical with many educators and school leaders holding contradictory opinions (Goldring, 1990; Holloway, 2003; Kettler, 2011; Kulik, 1992; Reed, 2004). Some educators agree that gifted students excel in homogeneous classrooms and argue gifted students become bored, underachieve, develop behavior issues and challenges, and are not provided opportunities to expand on their skills within the regular education classroom (Bent, 1969; Goldring, 1990; Hansen & Toso, 2007; Kanevsky & Keighley, 2003).

Research on grouping the gifted clearly states that gifted students should learn at a different rate and level of difficulty than typical peers. Gifted student should be provided the opportunity to work with like-minded students like themselves and if denied these opportunities, significant declines in academic advancement and outlook towards school may occur (Berlin, 2009; Rogers, 1993; & Devlin, 2001). Rogers (1993) proposed, “Gifted learners need some form of grouping by ability to effectively and efficiently accomplish several educational goals, including appropriately broadening, extending, and accelerating curricula” (p. 5). Students of high ability can benefit when they are in groups with like-minded students, so they can experience an accelerated and compacted curriculum that is expanded upon within the learning activities (Rotigel & Fello, 2004).
“The pacing of instruction, the depth of content, and advancements in knowledge fields, which gifted students must have, cannot be effectively facilitated without a variety of ability-grouped arrangements” (Rogers, 1993, p. 5).

Cluster grouping involves five to ten gifted identified students at a grade level (Winebrenner, & Devlin, 1998) “placed in a mixed ability classroom as a small group and provided proportionate differentiated curriculum and instruction by a teacher with gifted training” (NAGC, 2009, p. 1). Winn (1959) refers to homogeneous ability grouping as “the classification of pupils for the purpose of forming instructional groups having a relatively high degree of similarity in regards to certain factors that affect learning” (p. 269). Gamoran (1986) suggests ability grouping literature typically compares the learning of homogeneously grouped classes, but a general consensus regarding cluster grouping and homogeneous grouping has yet to be reached.

**Significance of the Study**

Throughout the past three decades, many scholars (Kulik, 1992; Slavin, 1987a; Slavin 1987b) have researched the various effects of grouping strategies, however, little has been accomplished to enhance the education services options for gifted students (Seely, 2004). An extensive amount of research on giftedness took place during the height of the space race, which dates back to the Cold War era (Kulik, 1992). During this time, America was trying to be first to outer space and attempting to demonstrate its power through innovation. The space race marked an increase in educational spending and encouraged studies of math and science (Toppo, 2007). Since the early 1970’s gifted studies grew infrequently with many years passing before subsequent studies occurred
(VanTassel-Baska, 2006). Studies conducted in the 1970’s and 1980’s (Alexander, Cook, & McDill 1978; Rosenbaum; 1976; Rowan & Miracle, 1983; Schafer & Olexa, 1971; Weinstein, 1976) support ability grouping and show that high ability students achieve more when placed with like-minded students. Many researchers agree that special programs should be in place for gifted and talented students, however, the best instructional arrangements and grouping options are still debatable (Swiatek & Lupkowski-Shoplik, 2003).

The current study helped school leaders critically analyze current procedures used for grouping students in the studied districts and allowed them to make informed decisions about instructional grouping practices currently in place. Generalizations made using the data benefited the target school districts and offered both qualitative and quantitative data that was used to inform programming decisions. Researching the effects of specific gifted programs has been limited, as it is difficult to assign control and experimental groups because gifted students are usually assigned to one classroom or teacher (Adelson, McCoach, & Gavin, 2012). “There is a paucity of empirical studies dealing with benefits of gifted programming in mathematics for elementary students. Most of the empirical research has been conducted with students who are at the middle school level and above” (Pierce, Cassady, Adams, Speirs-Neumeister, Dixon, & Cross, 2011, p. 570).

More research is needed to determine the effectiveness of… curriculum compacting, and ability grouping on the achievement of mathematically talented elementary students and to determine how these instructional approaches and
grouping options can best be combined to meet their needs. (Gavin & Adelson, 2008, p. 384)

Gifted students are underachieving because of inadequate services, improper placements, and neglect from school leaders (Clark, 2008; Morisano & Shore, 2010; & Seeley, 2004). Data from the current study can help inform school districts about gifted programming options and help guide district leaders in making instructional decisions regarding better ways to serve gifted students (Adelson, McCoach, & Gavin, 2012; Gavin & Adelson, 2008; Slavin, 1987a; Slavin 1987b).

“Educators may always disagree, and probably wisely so, on how to define giftedness and best serve gifted students” (Booth & Stanley, 2004, p. 139). Gifted advocates continually justify why children who are commonly known for taking care of themselves and being independent need special opportunities and curricular modifications (Booth & Stanley, 2004). Moreover, gifted advocates also fight the charge that giftedness measures are undemocratic and grouping is elitist (Booth & Stanley, 2004; Fiedler & Lange, 1993; Fiedler, Lange, & Winebrenner, 2002). Studies regarding gifted education have been limited in recent years due to consideration of the special education population, however, with Value Added and Common Core (CC) initiatives, new data must emerge.

**Common Core and Curriculum**

The CC math and English Language Arts standards are educational learning standards that have been adopted by 48 states in the US. One question raised by many educators is whether certain grouping options result in greater achievement gains for
gifted students (Goldring, 1990). Many studies have suggested that when gifted students are grouped with like-ability students (i.e. homogeneously) their learning needs are met more frequently (Goldring, 1990; Preckel, Götz, & Frenzel, 2010; Sheppard & Kanevsky, 1999). Other advocates of grouping options claim that homogeneous groups result in greater achievement, but limited research is available for middle school mathematics. Some teachers and school perceive that the Common Core standards adopted by 48 states in 2010 will not necessitate alternative delivery models for gifted students because the standard are set higher than previous standards (Johnsen, 2012). According to Common Core State Standards Initiative (2012):

The Common Core standards provides a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help them. The standards [Common Core] are designed to be robust and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers. (para. 1)

Opponents of the CC consider the United States as more racially, ethnically, and religiously diverse than smaller nations and that to think that every student in America should learn the same thing is illogical (Teinken, 2011). Mandating a single curriculum ignores the basic understanding of diversity and developmental psychology. A national curriculum assumes that all students’ start and finish in the same place and are guaranteed the same results. The CC standards “are not strong or sufficiently accelerated enough to address the needs of gifted learners” (Johnsen, 2012, p. 81). Coleman and Johnsen’s (2011) research “indicates that within a general education setting, little to no
differentiation for high achieving students occurs on a regular basis” (p. 15). The Council of State School Officers (CCSSO) “has acknowledged that some students will traverse the Common Core more rapidly and test out of them earlier” (Johnsen, 2012, p. 81). “In addition to acceleration, the Common Core needs to be differentiated and include open-ended opportunities for more complex thinking and real-world problem solving” (Johnsen, 2012, p. 81). Wang, Haertel, and Walberg (1993) argue that curriculum has the greatest influence on students’ academic performance and success when it is proximal in the education process.

**Gifted Learning Environment**

In the United States, the national focus is on providing quality-learning experiences for tens of thousands of students who perform below the average level even when attempting basic skills (Clark, 2008). The consequences of overlooking the demands and learning needs of gifted students will be shocking (Clark). We need the ideas of our nation’s brightest students to help solve world problems (Clark).

These minds do not come fully formed at birth; as giftedness must be nurtured. Restricting appropriate stimulation for children limits the very existence of their human abilities, the solutions, and the pursuit of global goals involved in the quality and viability of life on the planet. This critical need for appropriate stimulation and the knowledge of the dire consequences that would result from its limits makes the mission of and the rationale for gifted education acutely important. (Clark, 2008, p. 5)
Gifted students need and deserve an enriching curriculum and appropriate learning environment in order to have their academic and social needs met. The purpose of this mixed methods case study was to focus on the mathematics achievements of gifted fifth grade students when provided geometry instruction in homogeneous and/or clustered arrangements. According to Swiatek and Lupkowski-Shoplik (2003), most researchers agree that special programs should be in place for the gifted and talented students, however, the best type of programming and grouping options are still debatable. Research suggests that certain grouping arrangements with curricular acceleration are effective for gifted learners (Swiatek & Lupkowski-Shoplik, 2003), but little empirical evidence exists to address middle school mathematics.

“Educators have known for years that a child’s potential can be fluid and that the environment that is provided for learning will influence how this potential unfolds” (Coleman & Johnsen, 2011, p. 45). Gifted students differ greatly amongst themselves (Neihart, Reis, Robinson, & Moon, 2002) and “have greater diversity in achievements levels than among typical students. Thus an idea of a one-sized fit all gifted education program is not based upon the actual characteristics of gifted students” (Coleman & Johnsen, 2011, p. 6). Creating appropriate conditions for the gifted learner will result in a brain that is more efficient and faster in processing information. The brain is not gifted because it has more cells, but rather the increase in neural connections have become more integrated, more quickly made, and more complex (Clark, 2008). The potential of a gifted student depends on the optimal educational intervention and grouping strategies offered by a school (Coleman & Johnsen, 2011). It therefore becomes an obligation of the school
to identify gifted students and provide them with educational opportunities just like it is their duty to provide appropriate educational opportunities for other students (Glass, 1994).

**Nature of the Study**

This study used a case study mixed methods research design. The researcher investigated and compared the mathematics achievement of identified gifted fifth grade students within homogeneous and cluster arrangements. This study used inferential statistics as the quantitative analysis framework along with semi-structured qualitative interviews to gain further insight into the current decision making process currently in place at the target districts for grouping gifted students. As part of the research design, inferential statistics allowed the researcher to make inferences from data to more general conditions (Trochim, 2000). A mixed method approach allowed the researcher to combine quantitative and qualitative information to help identify strengths and concerns of current grouping procedures of gifted students. A mixed methods case study approach allowed the researcher to obtain quantitative information in the form of tests scores and qualitative information in the form of interviews to help answer the research questions.

This study involved grouping mathematically gifted students in homogeneous and cluster arrangements in which the homogeneous group received a compacted curriculum and the clustered group received differentiated instruction within a mixed ability classroom. The two groups received teacher-delivered instruction on the same mathematics academic content standard (See Appendix A) within two different grouping arrangements. The researcher performed statistical analysis using pre- and post-test data
to addresses the research questions specified below. The qualitative data collected included interviews with teachers and administrators regarding their opinions and decision-making process for current grouping practices for gifted students. Semi-structured interviews took place before and during the teacher-delivered instruction, which allowed respondents to discuss issues they believe played a role in their grouping decisions. Follow up interviews were conducted during the instructional period as necessary.

**Research Questions and Hypotheses**

This study compared the academic achievement of mathematically gifted fifth grade students when receiving mathematics instruction within two specific grouping configurations. One group received mathematics instruction in a homogeneous (i.e., ability) group and the other group received mathematics instruction in a cluster-group arrangement. The following questions guided this investigation:

**Question 1:** Is there a difference in the academic achievement of mathematically gifted fifth grade students who receive geometry instruction in cluster groups and those instructed in homogeneous groups?

**Null Hypothesis 1:** There will be no difference between gifted fifth grade students’ mathematics achievement when grouped in homogeneous or cluster arrangements.

**Alternative Hypothesis 1:** There will be a difference between gifted fifth grade students’ mathematics achievement when grouped in homogeneous or cluster arrangements.
Research Question 2: What processes do administrators and teachers currently use in making grouping decisions of gifted students in the target district?

Summary of Methodology

This study used a mixed methods/multiple methods approach with a multi-site case study design. After a review of current research (Baskas, 2011; Creswell, 2009; Denzin & Lincoln, 2005; Johnson & Christensen, 2012; NCTI, 2012; Shadish, Cook, & Campbell, 2002) it was determined that a mixed method approach for data collection would be used to combine both qualitative and quantitative methods. A mixed method/multiple methods research design allowed the researcher to collect both qualitative and quantitative information, which resulted in a better understanding of the variables (Johnson & Christensen, 2012). “[Multiple] methods research involves the mixing of quantitative and qualitative research methods, approaches, or other paradigm characteristics” (Johnson & Christensen, 2012, p. 33). The research design positions the researcher in the empirical world and connects them to a specific body of relevant material (Denzin & Lincoln, 2005). According to Johnson and Christensen, (2012) quantitative methods rely on the gathering of quantitative data.

Quantitative research approach primarily follows the confirmatory scientific method because its focus is on hypothesis testing and theory testing. Quantitative researchers consider it to be of primary importance to state one’s hypotheses and then test those hypotheses with empirical data to see if they are supported. (Johnson & Christensen, 2012, p. 33)
The researcher investigated and compared the achievement of identified mathematically gifted fifth grade students within homogeneous and cluster arrangements. "When comparing relationships among variables, where objective theories are tested, the most logical method would be quantitative design" (Baskas, 2011, p. 3). The researcher also collected qualitative information in the form of semi-structured interviews. Qualitative methods are used to appreciate the views of those interviewed (Johnson & Christensen, 2012; Glesne, 2006). Qualitative methods allow the researcher to contextualize issues and apply knowledge gained to transform or change social conditions (Glesne, 2006). “Qualitative research is used when little is known about a topic or phenomenon and when one wants to discover or learn more about it” (Johnson & Christensen, 2012, p. 33).

The population for the study consisted of 50 students, 25 of whom received instruction within a clustered arrangement and an additional 25 who received instruction within a homogeneous setting. The hypotheses were tested using an independent t-test, which helped determine and examine the impact of grouping strategies and student achievement.

The pre-test (See Appendix D) for all groups was administered at the beginning of a unit of study and focused on selected geometry standards (See Appendix A) according to the district’s pacing guide. The post-test (See Appendix D) was administered at the end of the selected unit within the instructional time-frame as indicated by the district’s pacing guide. The independent variable for this study was defined as the type of grouping: homogeneous or clustered. The dependent variable for this study was student achievement as determined by the pre-post test gains.
**Theoretical Framework**

This research study used a post-positive stance as the theoretical framework. Post-positive research emphasizes meaning and the creation of new knowledge. Post-positive research takes on the following characteristics:

(1) Research is broad rather than specialized; (2) theory and practice cannot be kept separate; (3) the researchers’ motivation for and commitment to research are central and crucial; (4) the idea that research is concerned only with correct techniques for collecting an categorizing information is inadequate. (Ryan, 2006, pp. 12 - 13)

A post-positive stance claims that “values, passion, and politics” (Ryan, 2006, p. 18) help guide research. “Research in this mode requires an ability to see the whole picture, to take a distanced view or an overview” (p. 18). This kind of objectivity requires passion for justice and the researcher must have the ability to subject one’s own assumptions to scrutiny (Ryan). This type of theoretical framework requires “patience, honesty, courage persistence, imagination, sympathy, and self discipline alongside dialogue and debate” (Ryan, p. 18). Post-positive researchers do not set out to solve problems, but rather investigate problems (Ryan).

Studies of giftedness and ability grouping have been conducted in the past with conflicting results being documented. This study compared two highly recommended strategies (i.e., cluster and homogeneous grouping arrangements) (Brulles, Saunders, & Cohn, 2010; Brulles & Winebrenner, 2011, 2012; Holloway, 2003; Kettler, 2010; Kulik & Kulik 1984a; Loveless 1998; NASSP, 2006; National Association for Gifted Children
(NAGC), 2009; Preckel, Gots, & Frenzel, 2010) for gifted learners. Educators may not always agree about how to properly serve gifted students, however, gifted advocates continue to justify the importance and need for an appropriate learning environment for high achieving learners (Booth & Stanley, 2004).

Students who are able to find intellectual peers, either by placement in a special program or by acceleration, generally feel less pressure to conform and more freedom to pursue academic goals. In the absence of peer support, however, the pressures on gifted students may be intense and stressful. (Neihart, Reis, Robinson, & Moon, 2002, p. xvi)

When gifted students are assigned to classrooms with other gifted students, the social difficulties associated with giftedness can be minimized (Booth & Stanley, 2004). “When we think of the needs of students who are gifted, we must reframe the standard protocol interventions so that they offer additional enrichment, challenge, and enhancement for learners with strengths in the targeted area” (Coleman & Johnsen, 2011, p. 4).

Definition of Terms

The following operational definitions are used in this study:

- **Acceleration**: “Progress through an educational program at rates faster or at ages younger than conventional” (Pressey, 1949, p. 2).

- **Achievement**: “Achievement is measured by students’ performance at a single point in time and how well those students perform against a standard” (Battelle for Kids, 2007, para 2).
• **Cluster group:** Cluster grouping includes five to ten identified gifted students at a grade level (Winebrenner, & Devlin, 1998) placed in a “mixed ability classroom as a small group and provided proportionate differentiated curriculum and instruction by a teacher with gifted training” (NAGC, 2009, p. 1).

• **Compacted curriculum:** “The student’s instruction entails reduced amounts of introductory activities, drill, and practice. Instructional experiences may also be based on relatively fewer instructional objectives compared to the general curriculum. The time gained may be used for advanced content instruction or to participate in enrichment activities. Instructional goals should be selected on the basis of careful analysis for their roles in the content and hierarchies of curricula. The parsing of activities and goals should be based on pre-instructional assessments” (Colangelo, Assouline, & Gross, 2005, p. 6).

• **Differentiation:** “Differentiated instruction is a flexible approach to teaching in which the teacher plans and carries out varied approaches to the content, the process, and/or the product in anticipation of and in response to student differences in readiness, interests, and learning need” (Tomlinson, 1995, p. 10).

• **Gifted learner:** “Children and youth with outstanding talent who perform or show the potential for performing at remarkably high levels of accomplishment when compared with other of their age, experience, or environment. The children and youth exhibit high performance capabilities in intellectual, creative, and/or artistic areas, possess an unusual leadership capacity, or excel in specific academic fields” (O’Connell-Ross, 1993, p. 26).
• **Homogeneous group**: Winn (1959) defines homogeneous ability grouping as “the classification of pupils for the purpose of forming instructional groups having a relatively high degree of similarity in regards to certain factors that affect learning” (p. 269).

• **Invisible ceiling**: The invisible barrier that prevents gifted students from working at or above their potential (Colangelo, Assouline, & Gross, 2005). Also known as the glass ceiling.

• **Least Restrictive Environment**: The Least Restrictive Environment is derived from the mandated law established by the Education of All Handicapped Children Act, Public Law 94-142 in 1974, now called the Individuals with Disabilities Education Improvement Act [IDEIA] that provides a free and appropriate public education in the least restrictive environment (LRE) for students identified with a learning disability.

• **Mathematically gifted student**: “Mathematically gifted students differ from the general group of students studying math in the following abilities: spontaneous formation of problems, flexibility in handling data, mental agility of fluency of ideas, data organization ability, originality of interpretation, ability to transfer ideas, and ability to generalize” (Johnson, 2000, p. 1)

• **Otis Lennon School Ability Test (OLSAT)**: The OLSAT is an ability instrument that measures a student’s abstract thinking and reasoning skills (Pearson, 2009).

• **Stanford Binet Intelligence Quotient Test**: An instrument that provides an indication of the student’s cognitive ability in five different domains: “fluid
reasoning, knowledge, quantitative reasoning, visual-spatial processing, and working memory” (Riverside Publishing, 2013, para 3).

- **Tracking**: “…schools use tracking to group students between classes, offering courses in academic subjects that reflect differences in students' prior learning” (Loveless, 1998, p. 5). Once assigned to an academic track, students typically cannot move to another grouping arrangement.

- **Twice-Exceptional**: “Children who are gifted [and] also have a disability that hinders their success unless proper interventions are provided” (Ohio Gifted Task Force, 2002, p. 6).

- **Watered-down**: The process of diminishing the intellectual level of the curriculum that encourages underachievement of gifted students (O’Boyle, 2008).

**Assumptions**

Assumptions in this study include the responsibilities of the teachers and the role of the students during the time of the investigation. The researcher assumed participating teachers and students provided honest and accurate answers when completing the pre and post-test. It was also assumed that the teachers delivered the instruction in the specified manner. The researcher also assumed that the students had a very similar academic history and came from supportive homes that encouraged good study habits and school attendance.

**Limitations**

Limitations are the conditions that the researcher cannot control. The primary limitation of this study is that it focused on two middle schools and centered on
mathematically gifted students only in grade five. The small sample size within the
cluster groups also posed a limitation for the quantitative analysis. The student population
in general was a limitation because the researcher had no control over which students
received a gifted label. The researcher also identified the academic content standards
taught during the unit of study as a limitation because the state’s department of education
defines the standards. The investigation timeline was also considered a limitation because
the researcher was required to follow and use the district’s pacing guide. This study did
not address the effect the individual teacher had on students’ achievement, but rather the
effect of grouping students in certain ways and the type of instructional process. This
study was limited to a suburban school district with limited diversity, and focused solely
on gifted students. Transferability of the findings of this study may not apply to schools
in other regions with a wider range of diversity or abilities.

**Delimitations**

Delimitations are those conditions that the researcher can control, however, limit
the boundaries of the study. This study only examined gifted students’ achievement,
which poses a delimitation. Additionally the pacing guide set forth by the school district
introduced a delimitation because the researcher had to conduct the study within the
defined time-frame. The student population for this study was defined for the researcher
and the study focused only on the mathematically and/or superior cognitively gifted
student. Often a student can carry multiple labels of giftedness or other exceptionalities,
however, this study did not necessarily acknowledge other exceptionalities that might
have inhibited a student’s ability in the math class. The researcher used the district’s
instructional information system (IIS) to design the pre- and post-test. This is considered a delimitation because the researcher did not choose the IIS but did have control over the types of questions appearing on the assessments. Teacher participation was also considered a delimitation because each teacher involved in this study had experience teaching gifted students.

Conclusion

Despite principles and standards declared by the National Council of Teachers of Mathematics (NCTM) and other organizations, mathematically gifted students are still underserved and unchallenged in regular classrooms (Koshy, Ernest, & Casey, 2009; McAllister & Plourde, 2008). Some educators and school leaders hold the view that mathematically gifted students are not an “educational issue or problem, for through their talents they could take care of themselves” (Koshy, Ernest, & Casey, 2009, p. 214). Excellence for all, if it is to mean the same standards and same curriculum, becomes inequitable for all because it fails to recognize individual differences (Clark, 2008). Van-Tassal-Baksa (1997) states, “equity is present when all students have equal access to potential opportunities based in reasonable standards of competence” (p. 11). Given the challenges associated with educating gifted students many questions still remain answered (Swiatek & Lupkowski-Shoplik, 2003). “How can high quality, challenging, and enriching learning opportunities that allow teachers to nurture, recognize, and respond to all children’s potential be created (Coleman & Johnsen, 2011, p. 44)? Studies are needed to understand why and under what conditions various grouping strategies produce achievement effects (Adelson, McCoach, & Gavin, 2012; Gavin & Adelson,
2008; Slavin, 1987b). “Educators have known for years that a child’s potential can be fluid and that the environment provided for learning will influence how this potential unfolds” (Coleman & Johnsen, 2011, p. 45).
Chapter 2: Literature Review

School districts face complicated decisions about appropriate placement and service options for mathematically gifted students. By the year 2000, The United States had a goal to lead the world in achievement in science and math (United States Department of Education, 1998). The evidence from many sources according to Reed (2004) indicates this goal has not yet been reached or even realized in some states. Federal and state legislation has tried to increase school accountability by mandating achievement test, but this has only put an emphasis on teaching to proficient levels (Brulles, Saunders, & Cohn, 2010). This type of legislation diverts attention away from the gifted and talented population and away from excellence, creativity, and exploration (Brulles, Saunders, & Cohn, 2010). “Models for gifted programs, such as content-replacement, enrichment, and self-contained classrooms, once prevalent in school districts around the country, have suffered without appropriate and adequate funding and/or administrative attention or support” (Brulles et al., p. 329). The result of eliminating gifted programs and services has resulted in “inclusionary practices, which is characterized as the heterogeneous classroom” (Brulles et al., p. 329). Under present circumstances, some leaders (Gentry, 1999; Rogers, 1991; Winebrenner & Brulles, 2008) “in the field of educating gifted learners have advocated the use of cluster grouping along with curricula that are differentiated according to the needs of the students in the classroom” (Brulles et al., 2010, p. 329). While others (Clark, 2008; Kulik, 1992; Kulik & Kulik, 1984b; Loveless, 1998; MEGT, 2006; Shield, 1995) have advocated for homogeneous classrooms for the gifted and talented. This chapter will present current
and previous empirical literature on gifted education, including grouping strategies and mathematics learning theories.

**Giftedness Defined**

“Gifted and talented students are those with abilities, identified at preschool, elementary, and secondary levels” (MEGT, 2006, para 1). Gifted student can achieve at high levels when compared to many peers (MEGT, 2006). Students who exhibit high abilities require specialized, differentiated curriculum (MEGT). Giftedness, according to Clark (2008) is a designated label used to identify students with advanced levels of intellect. Giftedness can be nurtured by allowing the child to participate in learning experiences that challenge the current level of intelligence, ability, and interest (Clark, 2008). The United States Department of Education defines giftedness as:

Children and youth with outstanding talent who perform or show the potential for performing at remarkably high levels of accomplishment when compared with others of their age, experience, or environment. These children and youth exhibit high performance capabilities in intellectual, creative, and/or artistic areas, possess an unusual leadership capacity, or excel in specific academic fields. They require services or activities not ordinarily provided by the schools. Outstanding talents are present in children and youth from all cultural groups, across all economic strata, and in all areas of human endeavor. (O'Connell-Ross, 1993, p. 26)
Furthermore, mathematically gifted students, according to Reed (2004) are students who “can do mathematics typically accomplished by older students or engage in qualitatively different mathematical thinking than their classmates or chronological peers” (p. 90).

Mathematically gifted students are not a homogeneous group. Mathematically gifted learners are very diverse and come in a variety of ages and academic levels (Reed, 2004). Mathematically promising students have been described as “those who have the potential to become the leaders and problem solvers of the future” (Sheffield, 1999, p. 9). Sowell, Zeogler, Bergwall, and Cartwright (1990) describe the precocious mathematically gifted learner as one who can perform mathematics computations and solve problems typically accomplished by older students. Not all high performing mathematically gifted students will exhibit the same traits, but in general, mathematically gifted students have “longer attention spans, better memories, and persistence in wanting” (Johnsen & Kendrick, 2005, p 21) to solve complex problems when compared to the typical student (Johnsen & Kendrick, 2005).

Continuous research from the field of neuroscience regarding the development of the brain has made it apparent that high levels of intelligence results from complex, effective, and efficient use of the brain (Clark, 2008). This occurs only when early and continuous stimulation from the environment interacts with specific genes. Hirsch, Vialle, Rogers, and McCormick (2010) suggest that gifted students cognitive requirements are not being met in the traditional classroom. Moreover, gifted students are infrequently challenged academically. When a gifted child is neglected from challenging coursework, research suggests this may not only influence their overall
academics, but also their social and emotional development (Hirsch, Vialle, Rogers, & McCormick, 2010). A gifted child’s self-worth can be negatively impacted due to a lack of challenge and rigor (Dweck, 1999; Hirsch, Vialle, Rogers, & McCormick, 2010).

The terms intelligence and intellectual ability have many different meanings, but can be used interchangeably. A child’s ability is a result of a variety of factors including the environments and brain development (Clark, 2008). Intelligence is the result of development of all the functions of the human brain (Clark, 2008). The development of intelligence is ongoing and genes are likely to have maximum effect in an environment that nurtures the development of the gift and/or talent (Clark). “Children are not born gifted, but they are born with unique and nearly unlimited potential. Clearly there is an early and continuous need for talent development” (Clark, 2008, p. 50). Clark (2008) describes the conditions to include the following:

- The provision of a variety of quality experiences from our early beginnings as the neural patterns and sequences are being formed,
- The development of the concepts of integration, choice, patterns, and sequences, starting with a child’s early experiences,
- The provision of feedback throughout the acquisition of knowledge and skills,
- The enrichment of the environment and the experiences that the environment provides so that the growth of intelligence is facilitated and expanded rather than limited and inhibited. (p. 50)

Creating these conditions will result in a brain that is more efficient and faster in processing information. The brain is not gifted because it has more cells, but rather the
increase in neural connections have become more integrated, more quickly made and more complex (Clark). The school has a moral duty to provide all students an educational opportunity that enhances their learning potential without restricting their mental capacity.

One essential factor of gifted development according to Glass (2004) is cognition. Cognition is described as the “curiosity, attention, and superior memory” (p. 25) that learners possess. Gifted learners are typically “highly motivated, extremely independent, and tend to be more introverted and introspective” (p. 25). Gifted students have the ability to learn new information quickly that are specific subject areas (Glass). In order to understand the conflicts faced by gifted proponents, it is necessary to appreciate and become aware of the historical and legislative aspects of gifted education.

**Characteristics of Gifted Students**

Characteristics of the gifted and talented have been observed and reported for many years. The gifted child is different from the typical child and it is necessary for school personnel and parents to recognize the following characteristics when developing an appropriate educational plan (Clark, 2008; MEGT, 2006; NAGC, 2011; Tzuriel, Efrat, & Kashy-Rosenbaum, 2011). Gifted and talented students begin talking at early ages and progress quickly through developmental stages. Many gifted students learn to read easily and enjoy different kinds of literature (NAGC, 2011). Exposure to many forms of literature helps gifted students develop an understanding for complex words. Gifted students learn rapidly and are able to make connections to topics being discussed in the classroom. They are also known for having excellent memories, which helps them
remember facts after minimal exposure (Clark, 2000; MEGT, 2006; NAGC, 2011). Gifted students have a natural curiosity and ask questions in an attempt to make connections with previously learned concepts. Additionally, gifted students are able to concentrate for extended time frames on topics that interest them (NAGC).

Mathematically gifted students have abilities with numbers beyond their age group and can easily grasp abstract mathematical ideas and many are good at solving puzzles and problems in general (NAGC). Gifted students have excellent cognitive skills, however, they also possess some unique social and emotional attributes.

Gifted and high achieving students show early evidence of maturity and often develop a sense of humor based on irony and sarcasm (Clark 2008; MEGT, 2006; NAGC, 2011). Gifted and talented students often are overly concerned with issues of justice and fairness. They understand the need for rules and typically follow them. Many gifted students are emotionally sensitive which can cause them to become angry and/or frustrated (Clark, 2008). Many question authority and feel they have the right to do so because they feel they may know better, which can come across as arrogance to authority figures (NAGC, 2011). Many gifted children prefer to find companions in older students or adults, as their thoughts and ideas are above typical same aged-children (Clark, 2008; MEGT, 2006; NAGC, 2011).

Gifted and talented students have many unique qualities that make them exceptional. In fact, giftedness may also co-exist with a specific learning disability. When a gifted learner also possesses a learning disability (e.g., gifted and dyslexia) or some other exceptionality, these students are often considered to be twice exceptional. “Twice-
exceptionality is gaining increasing recognition in the gifted education literature” (Foley-Nicpon, Assouline, & Colangelo, 2013, p. 1). These students would be best served under the Individuals with Disabilities Education Act (IDEA) Public Law 108-446 for their area of disability, in addition to being provided with gifted programming. “IDEA guarantees that a child with a disability will receive a free appropriate public education in the least restrictive environment (LRE) appropriate” (IDEA, 2004, Para. 4).

Gifted learners may not encompass all of the above characteristics, but it is important for educators, parents, and school administrators to be familiar with the social, emotional, and academic needs of gifted learners. The American education system has not always recognized the needs of the gifted learner (Colangelo, Assouline, & Gross, 2004; Cross, 2011; Hargrove, 2012). The gifted child has a set of unique learning needs and educational professionals must meet these needs.

Through formal interviews and survey methodologies, Galbraith (1985) identified eight concerns of gifted children. To identify the eight criticisms, Galbraith interviewed and surveyed over 400 students ranging in age from seven to 18 in six different states. Galbraith revealed that information about their giftedness is often withheld from gifted students. If gifted children do not understand what giftedness is, then teachers cannot effectively create an optimal learning environment (Hunt & Seney, 2009). In a related study, Kunkel and Chapa (1992) found the same complaint stating that students’ confusion about giftedness has serious implications later in life. Kunkel and Chapa contend:
Their [gifted students] ambivalence about giftedness manifested itself largely as an apparent eagerness to diminish their own uniqueness, enforce equality (e.g., "Everybody's gifted in their own way") and broaden the definition of giftedness to include all variation in human ability. For adolescents in which the most powerful social imperative is conformity, denial of giftedness may serve an important psychosocial function. (p. 10)

Gifted students must first understand their gifts and talents and then embrace and take ownership of the responsibility for those gifts (Hunt & Seney, 2009). “Teachers of the gifted can encourage the emergence of self through self-acceptance” (Hunt & Seney, p. 45). Educators can teach a unit on what it means to be gifted and help students embrace their gifts and talents (Hunt & Seney). Having an understanding of giftedness will help promote achievement and allow gifted learners to embrace their gifts.

**The Teacher of the Gifted Learner**

Public school teachers face many challenges in this era of standardization. Teachers feel overworked, overwhelmed, and often lack training to effectively reach all levels of students in one classroom. Gifted students have unique learning needs and many educators believe they are unprepared/untrained to address the exceptional needs of gifted students.

In order for gifted students to maximize their potential, gifted and general education teachers must meet their unique needs. Unfortunately, many general education teachers, administrators, and others outside the realm of gifted
education have not been exposed to the issues surrounding gifted education.

(Besnoy, 2005, p. 32)

Teacher must develop a nurturing and positive learning environment for gifted students to successfully meet their unique social and emotional needs. The teacher is key when developing a supportive environment so gifted students can grow academically and socially (Hunt & Seney, 2009). A supportive environment is “characterized by acceptance, confidence, mutual support, respect for other, and reduction of tension and anxiety in the learning interaction” (Hunt & Seney, p. 45). An effective teacher for the gifted becomes the facilitator and disseminator of knowledge. The teacher builds a nonthreatening environment that includes a “harmonious relationship among the students, where all feel accepted and are encouraged to work together, help one another and learn from each other” (Hunt & Seney, p. 46). The gifted classroom must be a safe place where students feel comfortable expressing themselves and can activate and nurture their gifts. “Programs for the gifted cannot achieve excellence without teachers who possess personal characteristics and competencies to meet those needs” (Hunt & Seney, 2009, p. 46). Galbraith (2009) notes that gifted students want a flexible teacher that makes learning fun and is willing to help. In addition, teachers of the gifted and talented must “understand the pluses and minuses of giftedness, are inspiring, and do not pretend to know everything” (Hunt & Seney, 2009, p. 47). Once in the classroom, the teacher of gifted and talented must provide a differentiated learning environment, which addresses the student’s cognitive and emotional learning demands. The teacher must act as a facilitator of learning, a model, mentor, and most importantly a life-long learner (Hunt &
Seney). Teachers must allow gifted learners to express their own unique talents and embrace their gifts.

**Emotional and Social Aspects of Giftedness**

There are social and emotional advantages and disadvantaged associated with being diagnosed as gifted. Labels can cause children to perceive themselves as being different (Berlin, 2009). Gifted students, like all students, benefit from social relationships, however, peer relationships can be hindered by differences between gifted and typical peers (Swiatek, 1998). “The emotional aspect of giftedness leads to concerns about meeting the gifted learners’ [sic] psychological and social-emotional needs” (Hunt & Seney, 2009, p. 47). Gifted learners think and feel differently than typical students. “Although the gifted child’s intellectual or academic achievement may be more like those of older children or adults, his or her physical, psychomotor, and emotional development may be age appropriate” (Hunt & Seney, p. 48). It may be possible for gifted students to achieve academic excellence and develop positive social relationships, but not both (Swiatek, 1998). The stigma associated with being gifted is real and Coleman and Cross (1988) note that “stigma is operating when its presence interferes with normal social interaction. It makes no difference whether or not the interference can be justified in an objective sense” (p. 42). “Thus, if gifted adolescents believe that they are treated differently because of their abilities and behave differently because of this belief, they can be considered to be dealing with a stigma” (Swiatek, 1998, para. 4).

Grouping strategies help facilitate a friendlier social and emotional learning environment. Ability grouping has demonstrated positive academic and social effects for
gifted learners. In homogeneous settings, the gifted learner faces mutual reinforcement of enthusiasm for academics and areas of interest (Hunt & Sweeny, 2009). Hunt’s (2004) study of 208 mathematically gifted 6th grade students showed that achievement scores improved when gifted students were assigned to classrooms with like-minded peers. Hunt’s study also noted no observed statistical change in achievement gains between average and low ability students based on the grouping arrangements. Educators and school leaders should consider grouping strategies to promote academic achievement among gifted youth. The mathematically gifted brain differs significantly from the typical learner’s brain (O’Boyle, 2008). In order to better understand the gifted learner’s unique mindset, the next section discusses the unique qualities of the brains of gifted students.

The Mathematically Gifted Brain

O’Boyle (2008) proposes a “neurobiological foundation to exceptional mathematical ability” (p. 181). This means that the structure and function of the mathematically gifted brain is much different than the typical brain. The mathematically gifted brain shows signs of greater growth of the right cerebral hemisphere (RH) coupled with “unusual reliance on its specialized visuospatial processing capacities” (p. 181). Visuospatial processing skills allow individuals to see and determine relationships among objects. These skills help mathematically gifted students understand the relationship among shapes (i.e., squares and rectangles). In O’Boyle and Benbow’s (1990) original study, the researchers used a test called the chimeric face task (CFT) (i.e., “half smile/half neutral face composites compared to their mirror image” (O’Boyle, 2008, p. 182). Participants were asked to explain which side of the image appeared to be happier. The
results revealed that the mathematically gifted chose the “left side smile/right side neutral composites” (p. 182) of the CFT significantly more than average participants. This suggests that the mathematically gifted student relies more on the right hemisphere (RH) of the brain when processing material. Another characteristic associated with the mathematically gifted brain is a distinctive form of brain bilateralism. Brain bilateralism includes “heightened connectivity and integrative exchange of information between the left and right cerebral hemispheres” (p. 181). Although the results of O’Boyle and Benbow’s study reveal that brains of the mathematically gifted rely on the RH of the brain when processing the CFT images, the results also suggest that the mathematically gifted show unusual connectivity between both hemispheres of the brain. This connection between the two hemispheres allows for additional and faster processing of information.

O’Boyle (2004) and Clark (2008) discuss how the gifted brain differs qualitatively and quantitatively from the typical-math-able student. O’Boyle (2004) conducted research on the “morphological and functional characteristics” (p. 182) of the adolescent gifted brain and concluded mathematically gifted students demonstrate heightened expansion of the right hemisphere and dependence upon it when managing information. O’Boyle (2004) also states “behavioral and neuroimaging findings… suggest three general characteristics that best describe the operating properties of the mathematically gifted brain” (p. 184), including

(a) enhanced development of the [right hemisphere] RH, resulting in a unique form of functional bilateralism, with specialized contributions from both sides of the brain combining to drive cognition and behavior; (b) enhanced
interhemispheric communication and cooperation (perhaps via the corpus callosum or increased grey/white matter ratio, or glia/neuron ratio), which assist in coordinating and integrating information between the cerebral hemispheres; and (c) heightened brain activation, approximating (or exceeding) that of an adult brain even though they are still adolescents, which is suggestive of enhanced processing power and may reflect highly developed attentional and executive functions that serve to fine-tune their unique form of cerebral organization. (p. 184)

The above characteristics help establish why the brain functioning of a mathematically gifted learner is so unique. The mathematically gifted brain is unique in the way it processes information and certain educational implications apply. The classroom teacher must utilize techniques that are designed for the mathematically gifted brain. The mathematically gifted brain has a tendency for bilateral engagement (O’Boyle, 2004), “it seems logical for teachers in the classroom to provide and rely upon multimodal learning methods when instructing math-gifted children” (O’Boyle, p. 184). An additional difficulty identified by O’Boyle is that mathematically gifted students reported being bored in their current classroom environment. When mathematically gifted students are bored in a classroom they may engage in behaviors that are disruptive to themselves and their classmates. One way to minimize this disruption is to engage the mathematically gifted child with rigorous and relevant curriculum. A second undesirable outcome according to O’Boyle “is the phenomenon of [watering] down” (p. 185). This occurs when mathematically gifted students intentionally score below their potential or
underachieve on exams because they want to fit in better with the typical, less-gifted students. Gifted students are aware and sensitive to their differences, and often deny they have special abilities and talents. This manifestation of not recognizing their talents can and does result in underachievement. “Obviously, the employment of a [watering] down strategy, while socially understandable, results in significant academic underachievement and, potentially, a tremendous waste of mathematical talent” (O’Boyle, p. 185).

American public schools must find better methods to instruct gifted youth. Throughout the history of American public education, gifted education has never been the central focus. The next section will review the significant qualities of gifted education and provide an overview of the historical content of gifted programming.

**History of Gifted Programs and Giftedness**

Curriculum development in this country has been faced with many challenges and the source of much debate. A battle over the form and functions of schools occupied center stage for many education and national leaders during the twentieth century (DeYoung & Theobald, 1991). The 1983 *A Nation at Risk* report synergized the curriculum movement. In 1990, President Bush and the U.S. governors adopted six national goals for education, entitled Goals 2000, in an attempt to provide a common direction for educational improvement (Goertz, 2001). “The history of curriculum development for the gifted has been fraught with problems, similar to the general history of curriculum development in the country” (VanTassel-Baska & Brown, 2009, p. 75). Many effective programs for gifted learners use acceleration as the approach to drive instruction. The accelerative approach to learning can be attributed to the efforts of
Terman and Oden (1947) and other well-known authors such as Pressey (1949) that suggest accelerated learning other models for bright learners. “…Current curriculum models are grounded in a history of research, development, and implementation of both acceleration and enriched approaches, typically used in self-contained classes because the level of content instruction could be modified based on the group” (VanTassel-Baska & Brown, 2009, p. 76).

Prior to the 20th century, giftedness was scrutinized and many gifted students were termed “freak” (Glass, 2004). Some educators viewed gifted students as abnormal whose exceptionalities were restricted to social and academic development rather than a talent (Glass). The perception of giftedness in the United States began to shift with the initial publication of Terman’s 1925 book called Genetic Studies of Genius. Terman’s suggested that gifted children are “superior to unselected children in physique, health, and social adjustment; [and] marked by superior moral attitudes” (Glass, p. 26).

Special programs designed to challenge and accommodate gifted learners started gaining credibility in the 1920’s. During the Cold War, the United States Congress approved financial support for gifted and talented education (Glass, 2004). In 1960, gifted education again lost focus because of concerns for poor quality of education in rural and urban school districts. The requirement for educating gifted students was at odds with the emphasis for educating all students. Renzuilli and Reis (1991) declare this a specific goal in an article titled The Reform Movement and the Quiet Crisis in Gifted Education:
To improve the education of at risk students [and especially those students in inner city schools and rural poor areas] who, if they don’t drop out, often graduate from high school without the ability to read, write, or do basic arithmetic. (p. 28)

The reform movement was a catalyst and served as motivation for the American public education system (Renzulli & Reis, 1991).

A concern for at-risk students led to the first major federal support for general education through the Head Start program, and since that time, literally billions of federal and state dollars have been appropriated to help overcome limited achievement on the part of children and youth from disadvantaged backgrounds.

It would be nothing short of immoral to question the value of this goal and even to hint that it has drawn support away from services to gifted and talented students would conjure up all of the social and political criticisms about elitism that our field has judiciously sought to avoid. (p. 28)

In 1974, The U.S. Congress appropriated aid to states in support of gifted programs (Glass, 2004). These funds were allocated for studies to gain additional data about how gifted students were achieving in public schools. This legislative action resulted in a report from 1971 that…”depicted gifted students as a neglected minority” (Glass, 2004, p. 26). The 1971 report authored by the Education Commissioner Sidney P. Marland, Jr. provided momentum for federal government assistance for gifted education and research, which came in the form of a newly formed department called the Gifted and Talented Education Office (Glass). The United States Congress approved the Jacob K.
Javits Gifted and Talented Student Education Act (H.R. 2036) in 1988, which was the only federal aid dedicated to gifted and talented research during that time period.

“The No Child Left Behind Act of 2001 was designed to ensure quality education for all students, particularly those at risk for academic problems or failure” (Gallagher, 2004, para. 1). However, “the No Child Left Behind Act created an oxymoronic conundrum…” (Gentry, 2006, para. 2). “NCLB is a politically charged, top-down, hostile take over of America’s school…” (para. 2). Gentry felt NCLB was a top-down, bureaucratic take over that overlooked the academic growth of gifted students to help close achievement gaps on state mandated achievement test. Further, he suggested that NCLB created an environment in which school leaders have little obligation to concentrate on gifted students because so much emphasis is put on reducing the achievement gap. Some believe that additional legislation might help raise awareness within the field of gifted education, while others argue that gifted students can take care of themselves and do not need any specialized programs (Clark, 2008).

“The standards movement has grown exponentially since 1983, when the National Commission on Excellence in Education published A Nation at Risk.” (Johnson, 2012, p. 1). Additionally, “since the 1980s, education has been influenced by the standards movement and the need for accountability” (p. 20). Gifted education could benefit from legislation and guidelines that help guide educational leaders, teachers, and parents develop and fund sufficient programs for gifted students (Johnsen, 2012). In recent years, there have been no further improvements and no additional mandates to help improve gifted education at the federal level (Glass, 2004). Most states require school districts to
identify giftedness, however, mandates for serving gifted students are limited. Gifted curriculum is not the only topic of debate. The methods schools use to identify student as gifted and talented have become scrutinized. The next section will summarize commonly used approaches used to identify students as gifted and talented.

**Identification of Gifted Students**

Historically, giftedness has been measured with the Stanford-Binet IQ assessment that designates students with an IQ of 136 or higher as gifted (Glass, 2004). Gifted testing typically occurs in elementary grades (i.e., grades 2-5). Individuals who believe testing alone should not be the only method for identifying students as being gifted have questioned the validity of the Stanford Binet IQ instrument. (Glass). Many programs for gifted students have deemphasized IQ and achievement testing as the only instruments to determine giftedness (Glass). The NAGC guiding document for the identification of gifted students contends, “[i]nstruments used for student assessment to determine eligibility for gifted education services must measure diverse abilities, talents, strengths, and needs” (Landrum, Callahan, & Shaklee, 2001, p. 44). Clark (2008) suggests using nomination forms, teacher reports, family history, student inventories, student work, and multidimensional testing to evaluate and identify a student as gifted. “The major purpose of identification is to obtain information that will help educators provide the program that is best suited for the development of the gifted student’s potential” (Clark, 2008, p. 208). Identification of students is best done by a committee of professionals representing a variety of areas of expertise. This committee might include teachers, principals, counselors, and psychologists (Clark, 2008).
Concerns about equity and lack of cultural diversity of identified gifted students have also fueled criticism regarding the manner in which students are identified gifted (Booth & Stanley, 2004). “The concerns over recruiting and retaining minority students in gifted education programs have persisted for several decades” (Ford, 1998, p. 1). Booth and Stanley suggest the most commonly noted reasons for the under representation of minority population in gifted programs are the use of culturally biased assessments. Booth and Stanley argues that “traditional conceptions of giftedness are narrow and skewed toward certain cultures” (p. 140). Some scholars have argued that many high poverty and minority students are underachieving because they need a gifted program to develop their un-manifested talents (Booth & Stanley). Ford (2012) argues that improving the number of minority students enrolled in gifted and Advanced Placement (AP) classes will reduce the achievement gap. Factors that contribute to the underrepresentation of minorities in gifted education include screening instruments, personnel issues (e.g., teacher training, teacher expectations) and retention issues (e.g., student-teacher relations, peer relations) (Ford, 1998). Some scholars argue that minority students do not receive letters of recommendation from teachers because of “prejudicial thinking about the capabilities of Black students” (Ford, Scott, Moore, & Amos, 2013, p. 1). Ford (2012) recommends school districts collect more data to help understand why AP and gifted classes have limited numbers of minority students. School districts need to identify programs that support the advancement of minority students and use data and research to improve and sustain high levels of success and performance among gifted minorities (Ford). Additionally, Ford argues, “educators must raise their expectations for
lower income students and implement effective strategies for maintaining and increasing advanced learning within this population” (p. 34).

“Democratizing the selection of gifted children has also predictably led to efforts to democratize the instruction of students so identified” (Booth & Stanley, 2004, p. 154). When schools enroll students with many different types of academic strengths in gifted programs, educators cannot effectively diversify the content of their lessons to suit the learning demands of all the different types of gifted learners. The multi-dimensionalist philosophy discusses instructing a wide variety of potentially gifted students within the same classroom and compares this to a coach attempting to develop, in the same training session, “the talents of the school’s top prospects in basketball, football, tennis, and swimming. When all types are served together, none is served well” (Booth & Stanley, p. 154).

Gifted students are a diverse group of individuals whose unique attributes need to be considered when designing an educational program to meet their needs. Thus, it is important to assess a variety of cognitive and affective characteristics, including a student’s strengths, weaknesses, interest, and personality traits. The information gleaned from this assessment will inform the nature of the program required. (Booth & Stanley, 2004, p. 130)

School districts must find ways to appropriately evaluate and assess potentially gifted students and use available resources to instruct and nurture each student’s unique gifts and talents. “Special attention should be given to the identification of gifted and talented students who may not be identified through traditional assessment methods…to help
them participate effectively in special grouping programs” (NAGC, 1991, para. 2). The American education system prides itself on providing education to all students. Many gifted advocates (i.e., Booth & Stanley, 2004; Clark, 2008) are concerned about the equality in opportunities for gifted students.

**Equity**

Equity refers to being fair and impartial and in education, equity applies to serving and providing all students a free and appropriate education. “No one questions the need for special educational services for students in the lowest percentiles of the IQ distribution. All students need appropriate development placement” (Booth & Stanley, 2004, pp. 154 - 155). Students who are equally atypical or on the other extreme of ability also need and deserve instruction that is suitable and appropriate for their cognitive capacity. School districts should continue to search for the “extraordinarily talented in all social groups by using the soundest techniques at their disposal” (Booth & Stanley, pp. 154 - 155). School districts should start providing a menu of educational opportunities for gifted learners, and stop ignoring exceptional students. Opportunities should be in place for gifted learners so they realize their own potential (Booth & Stanley).

“Without changes in the level of classroom teaching, the outlook for promising mathematic students is bleak” (Reed, 2004, p. 90). Rimm and Lovance (1992) declare, “if we do not provide a challenging environment, we are, in a de facto way, teaching our children to underachieve” (p. 10). Restricting appropriate stimuli from children limits the ability for humans to develop creative skills and brilliance (Clark, 2008). This critical need for appropriate stimulation and the knowledge of the consequences that result when
exposure is denied or limited makes the rationale for gifted education even more important (Clark, 2008). To achieve this goal, it follows that society must have a belief in equity of opportunity for gifted learners and not just a select few.

Excellence for all, if it is to mean the same standards and same curriculum, becomes inequitable for all because it fails to recognize individual differences (Clark, 2008). Van-Tassal-Baksa (1997) states, “Equity is present when all student have equal access to potential opportunities based in reasonable standards of competence” (p. 11). Therefore Clark (2008) suggests the mission of gifted education has two critical tasks, (a) “to support and enhance the appropriate education of gifted learners, those who function or show the ability to function at high levels of intelligence, so they can make continuous progress towards their greatest potential,” and (b) “to support and enhance the ability and talent of all learners who show evidence of being able to develop their intelligence so that they may realize their potential to the highest level possible” (p. 6).

Supporters of gifted education must encourage the development and enhance the pursuit of both excellence and equity for all learners (Clark, 2008). When human beings are limited in their development, physical and physiological dysfunction may be a consequence (Clark). When humans are prohibited from extending what has already been mastered, they often get bored, frustrated and angry. To have high levels of ability and to feel a power in the mind that is limited and/or restrictive can be traumatic (Clark). Schools must examine their current gifted policy and current models to ensure equity for all. School leaders can start this process by examining their curriculum models for gifted and talented students.
Curriculum and Models

The design of curriculum for gifted and talented students should be thoughtful to the desires of the population. The most effective intervention should be kept in mind when developing a curriculum and model for gifted students (Booth & Stanley, 2004).

In order to design appropriate curricula for any target group, it is necessary to understand their nature and needs as they relate to curriculum design. This is especially true for gifted learners, whose major characteristics of advanced development immediately renders (sic) them at risk in a school system committed to a rigid age-grade curricular model. (Booth & Stanley, p. 167)

There is no single curriculum for the gifted student, however, there is sufficient empirical data to suggest there is a single set of principles or elements that represent an appropriate challenging, differentiated curriculum for gifted learners (Kaplan, 2009). According to Kaplan (2009), these principles can be applied to many different curriculum models.

The different models used to formulate the curriculum regulate and shift the emphasis among the principles or elements that differentiate the curriculum. The emphasis given to the set of principles or elements within a model does not suggest that there is only a single way by which to create curriculum for the gifted. It does imply that there are multiple ways to configure a differentiated curriculum for the gifted applying the single set of principles or elements that constitute differentiation. (Kaplan, 2009, p. 259)

The stress of using pacing guides (timelines and detailed overviews of curriculum) and standardized testing has strengthened the case for the development of a
single curriculum (Kaplan, 2008), especially in this era of national standards. Concerns for equity and access to equal resources also reinforce a single, national curriculum. The curriculum debate continues as many states have implemented the Common Core standards. The question gifted proponents must ask is “in what ways does the differentiated curriculum designed or chosen for our gifted students respond to their needs, interest, and abilities” (Kaplan, 2009, p. 258). Recognizing that a differentiated curriculum for the gifted is only a partial step on the pathway to design and align a curriculum for the gifted. The next step on the pathway according to Kaplan (2009) is to individualize the curriculum or program for the entire population of gifted students. Hirsch, Vialle, Rogers, and McCormick (2010) suggest that schools are failing to address the learning needs of gifted students in the tradition academic setting.

Teachers are unprepared to reach all levels of learners in one class and differentiating in the regular education classroom is not enough (Caldwell, 2012; VanTassel-Baska & Stambaugh, 2005). “Classrooms should be places where teachers uncover and foster talent in all students by finding pathways into content through students’ interests and ways to scaffold learning so that rich, high-level concepts are accessible (Hertberg-Davis, 2009, p. 251). The reality is that teachers do not have the time to differentiate the curriculum for a classroom of mixed-ability learners (Caldwell, 2012; VanTassel-Baska & Stambaugh, 2005). Many teachers perceive differentiation as time-consuming and research suggests that teachers assigned to mixed ability classrooms with a wide variety of learning demands tend to ignore the needs of gifted learners (Hertberg-Davis, 2009). Lack of attention of the gifted learner not only influences the
talent development, but also affects their social and emotional development (Hirsch et al., 2010). A curriculum that is not challenging and lacks grouping cannot only harm the gifted student’s self-worth, but will encourage underachievement (Siegle & McCoach, 2001; Winebrenner, 2001).

Students who are gifted and talented are found in many different placements including all day homogenous grouping options, magnet and pullout programs and tradition classroom settings. “No matter where they obtain their education, they need an appropriately differentiated curriculum designed to address their individual characteristics, needs, abilities, and interests” (Berger, 1991, p. 2). When school districts develop a curriculum for gifted learners, it is vital that the pace and content matches students’ needs. The social and emotional factors of gifted students are so unique that they must be considered when making decision about certain programming and curriculum models (Berger). It is very challenging to make generalizations about gifted students because they are unique and their needs are personal. As a group, however, gifted students are generally able to comprehend complex ideas, learn more rapidly, and exhibit interests that differ from same-aged peers (Berger). Gifted students must be provided with an opportunity for in-depth exploration about topics of interest. A program should be developed that considers modified content, process, product and environment. Berger elaborates on the essential elements of curriculum modification. First, content consists of ideas, concepts, descriptive information, and facts. Content, as well as learning experiences, can be modified through acceleration, compacting, variety, reorganization, flexible pacing, and the use of more advanced or complex
concepts, abstractions, and materials. When possible, students should be encouraged to move through content areas at their own pace. (p. 2)

Next, to modify process, activities must be restructured to be more intellectually demanding. For example, students need to be challenged by questions that require a higher level of response or by open-ended questions that stimulate inquiry, active exploration, and discovery. (p. 2)

Third, gifted students learn best in a receptive, nonjudgmental, student-centered environment that encourages inquiry and independence, includes a wide variety of materials, provides some physical movement, is generally complex, and connects the school experience with the greater world. (p. 2)

And finally, teachers can encourage students to demonstrate what they have learned in a wide variety of forms that reflect both knowledge and the ability to manipulate ideas. For example, instead of giving a written or oral book report, students might prefer to design a game around the theme and characters of a book. (p. 2)

Additionally, Booth and Stanley (2004) argue that delivery models for gifted students should be grounded on certain condition. The following assumptions are critical when ensuring gifted students are receiving the appropriate services. “All children can learn, but in different ways at different times in different contexts” (p. 169). Gifted advocates (Booth & Stanley, 2004; Clark, 2008; Hirsch, Vialle, Rogers, & McCormick, 2010)
support this claim and believe it is a necessary principle that will improve education. Although all students can learn, school districts must be flexible and provide accommodations as necessary when implementing common standards. Gifted children, in general, learn more rapidly than typical peers, an assumption that has been documented and researched for years (Booth & Stanley). “Gifted students can learn new material at least twice as fast as typical learners. If the curriculum is reorganized in larger chunks, learning rates can often increase exponentially” (p. 170).

Gifted learners are diverse in nature and differ in areas of interest, talents, and gifts. They even differ in the rate at which they can learn. “Gifted learners vary as much from one another as they do from the normal population, both in rate of learning and areas in which they may be ready for advanced learning” (p. 170). This means schools must provide a continuum of services in “all areas to ensure equity in developing different academic talents” (p. 170). Gifted students also vary among themselves when it comes to the desire to learn. The differences in gifted students’ motivation and readiness to learn new concepts vary greatly across the gifted population. Because of this, every gifted student will not attain the same level of mastery as other gifted students. “Many students, including some of the gifted, cannot handle advanced mathematics and science, both very abstract subject matters. Other gifted students encounter difficulty in interpreting complex passages of written text” (p. 171). These differences in learning style and preferred learning modality can be addressed by providing a differentiated curriculum designed for the gifted learner (Booth & Stanley). Because gifted students can possess a certain skill, students can be identified with a specific academic aptitude within
a certain subject (i.e., math, science, reading, and/or social studies), and can also be identified as superior cognitively gifted. The differences among these students’ learning styles and preferred learning modalities can vary greatly and grouping options can help relieve some of the academic stress associated with being gifted.

Demitriou and Valnides (1998) note, “classrooms are developmental mixers in which each student’s developmental dynamics constrain and are constrained by the developmental dynamics of every other student and of the classroom as a whole” (p. 195). Developing a curriculum model that is sufficiently rigorous for gifted learners can result in well-educated and knowledgeable students who can think clearly and critically about the content they have mastered (Berger, 1991). Developing such a curriculum and setting high expectations for gifted learners will result in satisfaction for student, teachers, and parents alike (Berger). The next section will discuss two highly debated grouping strategies (i.e., cluster and homogeneous). The section will begin with a general overview of grouping and discuss opposing and supporting views of each type of grouping arrangement.

**Grouping Gifted Students**

“Grouping gifted children is one of the foundations of exemplary gifted education practice” (NAGC, 2009, p. 1). Research on the many available grouping strategies is overwhelmingly positive when implemented in an appropriate manner. Some literature suggests that grouping the gifted creates more damage to their self-esteem and creates an elite group that is established undemocratically and at times biased (NAGC). Fiedler, Lange, and Winebrenner (2002) contend that
keeping one or two highly gifted students in a classroom of mixed abilities actually may have the effect of creating snobbery. Scattering gifted students throughout all of the classrooms in the school may lead them to feel far superior to their classmates and promote arrogance. (p. 88)

Fiedler, Lange, and Winebrenner also note that grouping the gifted together provides a less elitist perspective because being educated with intellectual peers becomes more humbling for the gifted learner. According to the NAGC (2009), the purpose of grouping is fourfold. Grouping should ease the delivery of appropriately differentiated curriculum to learners with similar educational needs...facilitate the use of appropriately differentiated instructional strategies to learners with similar educational needs...facilitate addressing the differential affective needs of these children in the most conducive manner and allow for learners of similar abilities or performance levels to learn from each other. (para. 2)

Grouping gifted students, in some capacity, results in the least restrictive environment (LRE), a place where gifted learners can work together and build on the strengths of their group and allow group members the ability to work on challenging coursework at an advanced level (NAGC, 2009).

The terms ability groups and tracking are often confused to have the same definition; however, both have very different meanings and implications (Clark, 2008; Loveless, 1998). Ability grouping occurs when like ability students are grouped together for instruction (Loveless). These groups are flexible and do not remain stagnant. Other
students can be assigned to the group while some may test out of the group. By contrast, tracking refers to the practice in which students are tested and placed on certain academic tracks. There are typically three tracks: high, middle, and low (Clark, 2008; Loveless, 1998). In general, once assigned to a track, students cannot move in either direction.

According to Reed, (2004) tracking creates inequities for the lower performing students; citing that these students are often left out of high quality instruction and other enriching opportunities. The heterogeneously grouped classroom also poses a different challenge. According to Reed, “the more variety exhibited by a group of students, the greater the potential challenge educators face in meeting their instructional needs” (p. 90). Clark (1997) notes that schools can create optimal learning spaces by coordinating the rate of instruction to the learning needs of their students. Strong evidence supports the effectiveness of grouping (Kulik & Kulik, 1997; NAGC, 1991), which enables students with higher levels of abilities to work like-minded peers and receive enriching and appropriate curriculum. Grouping options include all day homogeneous arrangements, cluster and flexible grouping options (MEGT). There is abundant evidence that supports grouping gifted students in some manner and a correlation to an increase in academic achievement (Goldring, 1990; Hattie, 2002; Rogers, 1993, 2007; Shield, 2002) and some evidence for the social development of the gifted learner (Preckel, Gots, & Frenzel, 2010).

Proponents for homogeneous grouping for the gifted. Proponents for placing gifted students in homogeneous settings argue this structure efficiently addresses the varying achievement needs of gifted students (NASSP, 2006). When a student who is
gifted is placed in a homogeneous setting with other gifted students, motivation to learn increases. Some proponents support ability grouping for gifted and high achieving learners. These supporters suggest that ability grouping is easier for the teacher because the teacher can focus more on daily lessons, which will address fewer academic levels (NAASP, 2006). Gifted and high ability students show positive results when grouped by ability. According to Principal’s Partnership (2012), gifted students show the greatest academic gains when they are grouped together and experience an accelerated curriculum. Loveless (1998) concludes that when gifted learners are assigned to a homogeneous setting without an adjusted or accelerated curriculum, a limited impact on student achievement is observed. However, when the curriculum is modified and the pace of instruction is accelerated, there appears to be an improvement in student achievement for the gifted learner (Loveless).

Most proponents for homogeneous ability grouping claim that it benefits both teacher and student. According to Kulik (1992) educators do not have to plan multiple lessons for a variety of learning demands that is above or below their level of understanding. Advocates for grouping find it easier for students to learn and for teachers to concentrate on certain mastery levels. Kulik and Kulik’s (1984b) research and Kulik’s (1992) meta-analysis show that higher ability students show greater academic progress when provided specialized instruction. “Academic benefits for higher aptitude students are positive but usually small when grouping is done as a part of a broad program for students of all abilities” (Kulik, 1992, p. 17). Kulik’s research closely examined five grouping strategies and subsequently reported effect sizes.
When students within a grade level are separated into ability arrangements (i.e., high, middle, and low) and receive daily instruction the effect size reported by Kulik (1992) for XYZ classes is 0.1. Effect size is often reported in research studies to express the difference between two or more groups and the effect of a treatment.

For each study in a meta-analysis, the treatment effect is expressed in standard deviation units, or as an effect size. In principle, the computation of effect sizes is simple. A reviewer simply divides the gain or loss for an experimental group by an estimate of the population standard deviation on the outcome measure. An effect size is positive when there is a gain from the treatment and negative when there is a loss. An effect size is large when its absolute value is around 0.8, medium when around 0.5, and small when around 0.2 (Kulik and Kulik, 1992, p. 74).

Kulik (1992) continued to report effect sizes in other grouping arrangements. Cross-grade grouping occurs when learners from different grades, with the same ability level, are assigned to the same class to receive instruction. The effect size reported by Kulik (1992) for cross-grade grouping is 0.4.

Another approach to grouping reported by Kulik (1992) is within-class grouping. This occurs when teachers form in-class ability groups and provide instruction within these grouping arrangements. The effect size reported in Kulik for within-class grouping in 0.3. Kulik reports an effect size of 0.9 for accelerated classes for the gifted and talented. “Students who are high in aptitude in a subject receive instruction that allows them to proceed more rapidly through their schooling or to finish schooling at an earlier
age than other students” (Kulik, p. 2). Kulik furthermore, reports an effect size of 0.4 for students receiving instruction within specialized enrichment classes. “Students who are high in academic aptitude receive richer, more varied educational experiences than would be available to them in the regular curriculum for their age level” (Kulik, p. 2). Benefits are positive and moderate in effect size for enriched classes with an effect size of 0.4 and strikingly large at 0.9 for accelerated classes for the gifted (Kulik). Additional research (MEGT, 2006) shows significant academic achievement gains for high ability and gifted students who are grouped with other students of similar abilities and interest. Shields (1995) and Goldring (1990) both report that gifted students have significantly higher achievement when placed in homogeneous settings. Holloway (2003), Kettler (2011), and Rogers (1993) also found considerable academic gains for gifted students when grouped with like ability peers.

In addition, ability grouping is shown to have positive effects on motivation and attitudes towards learning (MEGT, 2006). Grouping by similar ability enables students to work with like-minded peers that have similar interest so their learning can be appropriately facilitated and challenged. However, grouping without curriculum acceleration is not sufficient to impact student achievement (Clark, 2008). The content of the curriculum and lesson delivery must be adjusted and enriched for the gifted learner. The results of these changes are shown to have increasing gains in academic and social achievements for the gifted learner (Clark).

The strongest and clearest effects of grouping were in programs designed especially for talented students. The talented students in these programs gained
more academically than they would have if they had been taught in heterogeneous classes. . . . Separating talented students into homogeneous groups apparently enabled teachers to provide learning opportunities for the students that were unavailable in more heterogeneous groups. Programs that were designed for all students in a grade - not solely for the benefit of talented learners - had significantly lower effects. (Kulik & Kulik, 1987, p. 28)

Shields (1995) reports that gifted students should be served in homogeneous classrooms with an enriched curriculum. Shields (1995) also notes that students served in regular education classrooms do not suffer when gifted learners are homogeneously served in separate classrooms. When gifted students are heterogeneously mixed with lower level learners, teaching to the low level reinforces the problem of underachievement of high-level learners. Additionally, instructing to the average learner encourages low-level learners to fall farther behind (Reed, 2004). Shore and Delcourt (1996) content when gifted children were heterogeneously grouped within classes, they received less than 20% of the teacher’s attention and no curricular differentiation in 84% of their learning activities…At best, only minor modifications to the regular curriculum were made for gifted students, even when there was a formal within-class gifted program in these schools. (p. 142)

Rogers (1993) examined pullout programs, full-time/homogeneous programs, cross-grade grouping, and cluster grouping and concluded that all types of learners benefit academically when gifted students are grouped homogeneously (Rogers 1993, 2006; Tieso, 2005).
**Opponents of homogeneous grouping for the gifted.** Opponents of homogeneous ability grouping like Macqueen (2013), Rubin (2006), and Slavin (1990a, 1990b, 1991, 1993) argued that grouping the gifted population negatively impacts the low and middle track students. NAASP (2006) states the low and middle tracks are largely comprised of low-income and minority students, therefore, ability grouping is unfair and re-introduces segregation. When gifted student are grouped together, the instruction tends to be more engaging, reflective, and challenging, whereas in lower ability tracks the teacher emphasizes good behavior and mental skills (NAASP, 2006). Moreover, low track students are generally taught by low-skilled teachers while gifted students are assigned to the best teachers. Some authors (Brulles, Saunders, & Cohn, 2010; Burris & Welner, 2005; Slavin, 1991, 1993) contend that only grouping students by ability alone provides no observable advantages. Proponents of ability grouping (Kulik, 1992; Kulik & Kulik, 1982, 1997) support that grouping alone does not provide sufficient effects for the gifted learner. For a gifted learner to benefit within an ability group setting, appropriate curricular adjustment and accommodations must be made for the gifted learners.

Nomi (2010) claimed that when students are grouped by ability, low-ability groups tend to be taught less challenging material and are held to lower expectations. Students in the lower ability group spend more time on rote skills and are asked lower level questions related to content material. Chorzempa and Graham (2006) indicate that teachers express concern that lower ability groups spend more time on non-instructional activities than their high-ability counterparts.
Grouping gifted students has faced much criticism from some researchers (Preckel, Gots, & Frenzel, 2010) citing the Big Fish Little Pond Effect (BFLPE). Preckel et al. (2010) further explain that students use the average ability of academic achievement of their classmates to create a frame of reference to evaluate their own academic success. When the brightest and most successful students are removed from the classroom, students can only compare themselves to lower and middle level learners. “In addition, with increasing ability level of a reference group…teachers will compare individuals within classes with intellectually more able classmates” (Preckel et al., 2010, p. 453). This negatively affects the feedback students receive from the teacher resulting in less praise and in lower academic self-concept (Preckel et al., 2010). The BFLPE has received attention with a large amount of empirical data supporting this claim, however, decreases in academic self-concept do not take place evenly over time, but rather seem to be more pronounced shortly after students change from a lower ability group reference to a high ability group reference (Preckel et al.). Preckel and Brüll (2008) and Huguet, Duman, and Monteil (2001) found these effects typically happen during the early years of school because this is when students typically change from a low ability group to a higher ability group.

**Cluster grouping.** Roger (2001) refers to grouping the top five to ten gifted learners within a certain grade assigned to a heterogeneous classroom as cluster grouping. This form of grouping is similar but not synonymous with tracking where students are tracked or grouped into three separate but not equal tracks (Kulik, 1992). Additionally, within-class grouping is similar to clustering in which teachers group students within a
mixed-ability classroom. In Kulik’s (1992) meta-analysis, 11 within-class grouping studies were explored. Nine studies within Kulik’s analysis indicate a higher overall achievement for students working in ability groups. Two of Kulik’s studies resulted in higher overall achievement for students working in mixed ability classrooms.

**Proponents of cluster grouping.** “Cluster grouping is a widely recommended and often-used strategy for meeting the needs of high achieving/gifted/high ability students in the regular education classroom” (Gentry, 1999, p. 16). Cluster grouping is an instructional grouping option that permits gifted learners to receive daily instruction in the regular education classroom with few financial implications for a district (Brulles, Saunders, & Cohn, 2010). In a cluster model, a small group of gifted learners are placed in a regular education classroom and receive differentiated instruction. With this arrangement, gifted learners at each grade are scheduled to be in the same class and work with a teacher designated to teach the clustered students (Brulles, Saunders, & Cohn, 2010). This method is successful when gifted students are clustered with regular education and or higher ability students and removed from inclusion situations that serve a wide range of student abilities. This approach narrows the range of abilities and allows for easier delivery of a modified curriculum. Research has shown benefits to cluster grouping (Brulles, Peters, & Saunders, 2012; Brulles & Winebrenner, 2012; Delcourt & Evans, 1994; Kulik, 1992; Rogers, 1991). Winbrenner and Devlin (1998) indicate that gifted learners have a better chance to receive differentiated learning opportunities when grouped in cluster arrangements than when assigned individually to separate classrooms. “The practice of cluster grouping allows educators to come much closer to providing
better educational services for groups of students with similar exceptional learning needs” (para 9). Cluster arrangements reduce the range of achievement in the classroom and provide gifted learners with the chance to work with other similar ability students as they nurture and celebrate their gifts and talents.

Brulles, Saunders, and Cohn (2010) grouped students in cluster arrangements and reported that this service model (cluster arrangement) produces higher academic gains for gifted learner than their non-clustered counterparts. When gifted students are grouped within cluster arrangements, improvements in achievement are apparent. Swiatek (2001) reported that clustered students made greater yearly progress than non-clustered groups.

Differences in the achievement gains between the cluster and non-cluster classroom[s] may be primarily attributed to cluster teachers’ awareness and acceptance of the fact that students begin the school year at varying academic levels, along with the assumption that instruction must be directed toward those varying levels. (Brulles, Saunders, & Cohn, 2010, p. 344)

Goldring (1990) also notes that when gifted students spend time with like-minded students they achieve more than when placed in a mixed-ability classroom. “Assigning students to classes by ability and then providing them with the same curriculum has limited effect on achievement; but when the curriculum is altered, clustering and ability grouping benefits students” (Brulles, Saunders, & Cohn, 2010, p. 345). Clustering is a promising model that has shown to promote achievement among all groups of students. Additional analysis shows the increase in academic achievement in gifted students when arranged in clustered groups can be attributed to more rigorous and challenging
curriculum provided from the teacher (Brulles et al.). Cluster grouping narrows the range of abilities within a classroom, while increasing the level of difficult and appropriate challenging instruction (Brulles et al.). Cluster grouping allows the teacher to accelerate coursework, which enables gifted students to work through the curriculum at varying rates and to produce better quality work. For the cluster model to be effective, adjustments to the curriculum must be made based on each student’s ability level and readiness (Brulles et al.). Kulik’s (1992) meta-analysis argues that gifted students benefit the most when they receive a modified curriculum within an ability group setting. Hoover, Sayler, and Feldhusen’s (1993) qualitative research revealed that teachers believe cluster grouping of gifted students benefits both gifted and non-gifted peers.

**Opponents of cluster grouping.** The literature also reveals concerns with cluster grouping that “parallel [to] those concerns about the use of ability grouping in general” (Gentry, 1999, p. 20). Research findings reveal concerns about removing the high achievers from each classroom and the effect this has on other students (Hoover, Sayler, & Feldhusen, 1993; Oakes, 1985; Slavin, 1987a). Additionally, Slavin (1987b) expresses concerns about the method of selecting the teacher for gifted students, while Rogers (1991), Tieso and Margison (2004); Westberg, Archambault, Dobyns, and Slavin (1993) express concerns about whether gifted students actually receive differentiated instruction when placed in cluster groups.

The mixed ability classroom classroom is often not the most ideal placement for gifted students. Clark (1997) states that “inclusion of students in classrooms where they are not able to benefit from the experience being offered is of questionable value to them
and often a detriment to the pace, depth, and level of instruction of other students” (p. 95). Delcourt, Loyd, Cornell, and Goldberg (1994) found inclusion of students with special needs to be a significant problem when gifted students were assigned to the same classroom. This is a central reason why cluster grouping does not always benefit gifted students (Brulles, Saunders, & Cohn, 2010; Winebrenner & Devlin, 1998). When school administrators assign gifted students to a cluster arrangement, it is imperative that they are assigned to a regular education classroom and a teacher that can best meet their need for the least restrictive environment (Brulles, Saunders, & Cohn, 2010; Winebrenner & Devlin, 1998). “In this structure, students are purposefully placed into classrooms with no classroom having both extremes of the learning continuum. The model slightly narrows the range of abilities in each classroom” (Brulles, Saunders, & Cohn, 2010, p. 328). Ability grouping is a very controversial topic with some calling for its complete elimination.

Gamoran and the Wisconsin Center for Education (2009), Oakes (1985), and Oakes and Lipton (1999) call for a complete elimination of any type of grouping. These reports encourage the elimination of gifted courses or programs including advanced placement, honors, pull-out, and any opportunity that allows students to be grouped based on achievement or interest (Oakes, 1985; Oakes & Lipton, 1999). Delcourt and Evans’ (1994) analysis of 11 school districts using a variety of arrangements for their gifted population including cluster grouping reports that when gifted students receive instruction within a cluster arrangement, they receive the lowest scores when compared to other programs including pull-out and full resource classrooms. Delcourt et al. contend
“since [cluster programs] are [a] popular model in gifted education, their curricular and instructional provision for the gifted must be carefully maintained less they disintegrate into a no program format” (p. 77). Rogers (1991) acknowledged the insufficient research on grouping options, including the cluster model, of gifted students. Rogers argues that the teacher assigned to a cluster group must receive relevant professional development and have the desire to teach gifted and high achieving students.

**Strategies and Suggestions for Grouping**

Evidence supporting ability grouping is limited to certain scholars and studied less frequently due to the topic being so open to debate and controversy. With a lack of recent empirical data, few studies actually focus on ability grouping, which makes generalizations and conclusions difficult to make. VanTassel-Baska (1992) considers grouping the gifted one of the most acceptable strategies because “…grouping of the gifted will increase the likelihood of more acceptable opportunities” (p. 68). VanTassel-Baska’s (1992) meta-analysis provided the following suggestions:

Grouping the gifted during instruction should be considered an important method and instructional structure that provides gifted learners with an appropriate learning environment (VanTassel-Baska, 1992). Certain grouping options in conjunction with other “program provision such as curriculum modification, alternative choice of materials, and learning centers” (p. 71) should be considered. When schools decide to use ability groups to deliver instruction they must consider the student needs and should design flexible groups based on the readiness and abilities of students. “Dyads, small instructional groups, cooperative learning groups, and the seminar model all provide
important alternatives for teachers to employ depending on the learning task and the readiness of the learner…” (p. 71). “Gifted learners should have the opportunity to interact with others at their instructional level in all relevant core areas of learning in the school curriculum” (p. 71). At the elementary level, gifted students should minimally be grouped together for reading and math instruction (Van-Tassel-Baska, 1992). At the secondary level (i.e. grades 9 – 12), Advanced Placement (AP) and credit flex options should be made available. Van-Tassel-Baska (1992) also recommends grouping for science and social studies also be considered. When grouping gifted students, school leaders should consider grouping students with similar special interests. Occasions should be granted to gifted students allowing them to work with like-minded peers on projects that interest them (Van-Tassel-Baska, 1992). Van-Tassel-Baska further notes that “Gifted learners should have the opportunity for independent learning based on both capacity and interest” (p. 71). Some gifted students prefer to work alone while others prefer to work in cooperative learning groups. Both preferences should be honored and encouraged within an appropriate educational environment for the gifted learner (Van-Tassel-Baska, 1992).

NAGC’s position for grouping states:

The practice of grouping, enabling students with advanced abilities and/or performance to be grouped together to receive appropriately challenging instruction, has recently come under attack. NAGC wishes to reaffirm the importance of grouping for instruction of gifted students. Grouping allows for more appropriate, rapid, and advanced instruction, which matches the rapidly developing skills and capabilities of gifted students.
Strong research evidence supports the effectiveness of ability grouping for gifted students in accelerated classes, enrichment programs, advanced placement programs, etc. Ability and performance grouping has been used extensively in programs for musically and artistically gifted students, and for athletically talented students with little argument. Grouping is a necessary component of every graduate and professional preparation program, such as law, medicine, and the sciences. It is an accepted practice that is used extensively in the education programs in almost every country in the western world.

NAGC does not endorse a tracking system that sorts all children into fixed layers in the school system with little attention to particular content, student motivation, past accomplishment, or present potential.

To abandon the proven instructional strategy of grouping students for instruction at a time of educational crisis in the U.S. will further damage our already poor competitive position with the rest of the world, and will reneg on our promise to provide an appropriate education for all children. (NAGC, 1991, para. 1 - 5)

A grouping option for the gifted should be available at each stage of the student’s development (NAGC, 2009). It is key to offer a menu of choices for gifted students through elementary, middle, and secondary education. It is essential for school districts to choose program opportunities that are appropriate for the needs of their specific gifted population (NAGC). “In general, the more full-time options…require little more than additional professional development, differentiated curriculum materials, and a
reorganization of teacher responsibilities in order to be implemented appropriately” (NAGC, para 11).

Grouping the gifted provides an approach to learning that meets the learning demands of gifted students (NAGC, 2009). In addition, grouping strategies provide gifted students the opportunity to collaborate with like-minded peers. Grouping also helps the teacher plan and deliver effective instruction for more learners (NAGC).

**Cooperative Learning**

Cooperative learning is a highly used educational strategy that encourages students to collaborate with other classmates. “Cooperative learning is not an entirely new idea. The use of a variety of forms of group work for problem solving and learning dates back to early proponents of education including John Dewey” (Coleman & Nelson, 2009, p. 565). Cooperative learning (CL) has been researched for years and comes in many different forms. Many proponents of CL recommend that groups be created with mixed abilities however, this approach does not always have the gifted student in mind. Slavin (1990b) indicated that CL has been used in mixed ability classrooms and has shown to be successful.

Many scholars (Allan, 1991; Gallagher & Coleman, 1994; Huss, 2006; Johnson & Johnson, 1993; Melser, 1999; Nelson, 1995; Robinson, 1990, 2003; Sapon-Shevin & Schniedewind, 1993) have differing views regarding cooperative learning with gifted students in mixed ability classrooms. “High achieving students in a Singapore study were more concerned about the learning skills involved in group investigations than were their low-achieving counterparts” (Coleman & Nelson, 2009, p. 568). When CL is frequently
used in a mixed ability classroom, gifted students get frustrated and become anxious (Huss, 2006; Mills & Durden, 1992; Nelson, 1995; Robinson, 1991). According to Coleman and Nelson (2009) the following concerns were demonstrated in a national study that examined the use of cooperative learning (CL) with gifted learners: Gifted learners often worry that others within a cooperative learning group do not listen and help them complete the task and/or activity. They report feeling anxiety during cooperative learning because they feel the need to take over and dominate, but fear other students will not like their leadership and directives. They also report the feeling of frustration of being “dragged down by students who were not interested in learning” (p. 568) and annoyance of others by always asking for answers. Gifted students also feel anger when they receive a low-grade that reflects the group’s effort rather than their individual effort.

Relying too much on CL has been described as the sucker effect, where high ability students carry low ability students. In spite of all the difficulties gifted learners express when involved in CL activities, they feel CL provides them with an opportunity to be helpful and to be a leader (Coleman & Nelson, 2009). The use of CL must be maintained, monitored, and not used exclusively when instructing in a mixed ability classroom.

Section Summary

The above literature summarizes two often-debated approaches (i.e., cluster and homogeneous) to teaching the gifted student. Slavin, a well-known critic of ability grouping, and Kulik, a known supporter of grouping options have both published documents and research on this topic. Slavin and Kulik are leading scholars with gifted
proponents often citing Kulik’s (1992) research. Slavin and Kulik have both argued that with-in class or flexible grouping options can result in higher achievement for the gifted learner (Loveless, 1998), however serious charges have been made against school districts for the use of tracking and ability grouping. The present research study does not support the use of tracking or ability grouping for any other population except the gifted student. Several states and instructional models have completely abolished the use of any type of grouping with increased pressure from societal norms and inclusion models. Loveless (1998) claims that schools fear that ability grouping condemns low ability students, especially poor and minority students. In addition, Loveless does not “support the charge that tracking is inherently harmful, and there is no clear evidence that abandoning tracking for heterogeneously grouped classes would provide better education for any student” (p. 17).

District leaders must also remember that schools must be provided with autonomy when designing program options and delivery models for gifted learner (Loveless, 1998). Grouping the gifted has promising effects on student achievement and when combined with a modified curriculum, research suggests gifted students excel. School districts, therefore, must examine grouping strategies and curricular modifications such as acceleration and curriculum compaction.

**Acceleration and Curriculum Compaction**

Colangelo, Assouline and Gross, (2004) define acceleration as “an intervention that moves students through an educational program at rates faster, or at younger ages, than typical. It means matching the level, complexity, and pace of the curriculum to the
readiness and motivation of the student” (p. xi). Research shows a good effect size of 0.1 – 0.4 for using certain grouping strategies, however, a stronger effect size according to Kulik (1992) of 0.9 is achieved when gifted learners are arranged by similar ability and provided with an accelerated and/or compacted curriculum. Swiatek and Shoplik (2003) agree by implementing curriculum modifications for gifted learners allow them to be taught at a faster, accelerated pace. This approach allows gifted students to experience additional curriculum topics and skip formal instruction on topics already mastered. VanTassel-Baska (1991) states that acceleration benefits gifted learners and should match the students’ ability levels. Studies by Kulik and Kulik (1997) and Gavin, Casa, Adelson, Carroll, and Sheffield (2009) indicate that students can produce a year’s academic growth when acceleration and grouping are implemented properly and appropriately.

The American education system is known for providing attention to students’ who have known disabilities: learning, emotional, social, and limited English proficiency (Kulik, 1992). Students with certain disabilities may be assigned to certain classrooms or provided accommodations based on their learning profile (Kulik, 1992). Many educators believe gifted students should qualify for specialized services too. Classes for the gifted and talented are not as common, however, they do have a history. The first known courses designed for gifted students used and embraced the acceleration principle. Acceleration is a well-known and used instructional strategy to help support the gifted learner (Wood, Portman, Cigrand, & Colangelo, 2010). The Cambridge Double Track Plan of 1981 assigned the brightest students to courses that accelerated a six-year curriculum into four years (Kulik, 1992). Acceleration provides gifted learners with an
adjusted curriculum, so they can progress through the coursework at a quicker rate. According to Pressey (1949) acceleration is an instructional strategies used to present material at a more rapid and accelerated pace. Acceleration programs have been debated with interest declining in the 1930’s, 1940’s and 1950’s. Acceleration was later revived after Russia launched Sputnik (i.e., the initial artificial satellite launched into space) in 1957, which marked the beginning of a technological rivalry between the United States and Russia. Renewed interest in acceleration was stimulated after several publications (i.e., Begle, 1976; Ekstrom, 1961; Flesher & Pressey, 1955; Fund for Advancement of Education, 1957; Kulik & Kulik, 1984a; Passow, 1958; Stanley, 1980; Terman & Olden, 1947) renounced the advantage of acceleration specifically for gifted students.

Furthermore, Kulik’s (1992) meta-analysis reviewed 23 additional studies on acceleration, 13 of which were located in scholarly articles, seven in theses and dissertations and three in the ERIC database system. Kulik arranged the studies and categorized them into groups: same-age control groups and research that was conducted with older control groups. Kulik (1992) found the “11 studies with same-age control groups, the achievement was higher for students in the accelerated classes” (p. 55). Kulik’s analysis of the 11 studies revealed an effect size of 0.87 and the median to be 0.84. “This means that in a grade-equivalent scale the scores of the accelerated students would be approximately one grade higher than the scores of bright, non-accelerated students of the same age” (Kulik, 1992, p. 37).

One of the key features in meta-analytic reviews is the use of effect size statistics to describe study findings. Cohen (1997) has described a number of different
effect-size statistics, but the one used most frequently in meta-analytic reviews is the standardized difference between treatment and control means on an outcome. Sometimes called Glass’s effect size, this index gives the number of standard-deviations units that separate outcome scores of experimental and control groups. It is calculated by subtracting the average outcome score for the control group from the average score for the experimental group and then dividing this difference by the standard deviation of the measure (Kulik 1992, p. 35).

The results of Kulik’s (1992) meta-analysis clearly show gifted students are able to accept the rigor of acceleration and show greater signs of academic progress. American public schools cannot afford to foster underachievement of talented youth. VanTassal-Baska (1992) offers some suggestions to school districts and local boards of education when adopting an acceleration plan for gifted learners. “Each learner is entitled to experience learning at a level of challenge, defined as task difficulty level slightly above skill mastery” (VanTassal-Baska, 1992, p. 71). For gifted learners, this can be achieved after teachers administer diagnostic testing and observe the gifted learner’s level of mastery based on performance assessments. Gifted learners need “the opportunity for continuous progress through the basic curriculum based on demonstrated mastery of prior material” (VanTassal-Baska, 1992, p. 71). Teachers and district leaders must ensure that gifted learners are assigned to certain classrooms so their cognitive demands can be met. This means gifted learners must be “afforded the opportunity to begin school-based experiences based on readiness and to exit them based on proficiency” (VanTassal-Baska, 1992, p. 71). The gifted learner requires a learning experience that must be
flexible where options of early entrance and grade acceleration should be considered.

Some gifted learners may benefit from telescoping which means compacting “2 years of education into one or by-passing a particular grade level” (VanTassal-Baska, 1992, p. 71). Finally, when placing and assigning a student for gifted services, multiple criteria should be considered. VanTassal-Baska (1992) recommends considering the gifted learner’s capacity to learn, readiness, and motivation.

Ability grouping combined with acceleration are important components of any gifted program. In an era of standardization and pacing guides, acceleration and grouping strategies are coming under attack (Clark, 2008; Macqueen, 2013; Slavin, 1986). When gifted students are provided accelerated opportunities, some research suggests there can be academic benefits (Kulik, 1992). Gifted students must have the opportunity to select educational programs that are challenging and meet their needs (Clark, 2008). For profoundly gifted students, acceleration is essential. Profoundly gifted students have an IQ at or above 180, score within the 99.9th percentile on IQ tests, and have exceptional intellectual prowess (Davidson Institute for Talent Development, 2013). The works of Hargrove (2102), Seon-Young, Olszewski-Kubilius, and Peternel (2010), and Stanley (1979) validate the importance of acceleration especially for the mathematically gifted student. Steenbergen-Hu and Moon’s (2011) explored the academic and social development of gifted students taking accelerated classes. They reaffirm the positive effect on the gifted student’s cognitive and emotional well-being when provided accelerated opportunities. When considering an educational program for gifted children, school districts must keep in mind grouping and instructional strategies. Instruction for
gifted learners should take place in what is termed the least restricted environment as elaborated on below.

**Least Restrictive Environment and Gifted Students**

An important and powerful concept that has been debated in the educational field is the term least restrictive environment (LRE). The LRE is derived from the mandated law established by the Education of All Handicapped Children Act, Public Law 94-142 in 1974. This Act is now often referred to as the Individuals with Disabilities Education Improvement Act (IDEIA) Public Law 108-446. According to the Learning Disabilities Association of America,

IDEA guarantees that a child with a disability will receive a free appropriate public education in the least restrictive environment (LRE) appropriate. This principle reflects IDEA’s strong preference for educating students with disabilities in general education classes with the access to general education curriculum. (2004, para 4)

“Essentially, LRE means that children should be removed from the general classroom only so far as necessary for them to obtain maximum educational benefits” (Gallagher, 1997, p. 153).

“Programs for the gifted did not emerge in America’s schools from internal discussions but from desperate societal concern spawned by a deadly rivalry with the Soviet Union…” (p. 154). “The fear that our best and brightest students were not the equal of similar students from around the world encouraged American education to take some specific steps to shore up the education of these students” (p. 154). The inclusion
model and differentiation have been forefront at making progress toward a establishing the LRE for students with certain disabilities, but little progress has been made for gifted education. Classrooms are becoming more heterogeneous and gifted students are often being ignored. Advocates for students with disabilities argue for the LRE and cite vertical equity or what Gallagher (1997) calls “the unequal treatment of unequal’s in order to make them more equal” (Gallagher, p. 156). Students receiving special education need and deserve specialized instruction that meets their educational needs. When gifted advocates argue a least restrictive environment, “vertical equity” (p. 156) should not be considered because gifted learners are not intended to become more average. “It is clear that special attention to gifted students would not result in making these children more equal to the average students but would, and does in actuality, make them more different” (Gallagher, p. 156). All children should have their need met in both public and private schools settings (Gallagher, 1997). Because the needs of gifted children differ greatly from their peers, both typically developing and those with disabilities, content modification and different instructional methods should be considered to effectively reach and nurture these students (Gallagher, 1997).

Many scholars continue to debate ability grouping and the effects on gifted students (Colangelo et al., 2005; Feldusen & Moon, 1992; Holloway, 2003; Hunt, 1994; Kettler, 2011; Kulik & Kulik, 1982; MEGT, 2006; NAGC, 2009; Slavin, 1990a, 1990b). The literature is clear and provides evidence to suggest that gifted students benefit from accelerated and specialized learning environments. “Teaching advanced economic concepts might excite gifted students but leave the rest of the general classroom
“stupefied” (Gallagher, 1997, p. 157). In a mixed ability classroom, a teacher may be hesitant to discuss more advanced topics that would entertain and hold the interest of gifted students, but not of other students. These topics would be easily taught in a specialized classroom specifically targeted for the gifted learners (Gallagher).

Some gifted advocates wonder what happens to gifted students placed in inclusive classrooms. In theory, such placements should not be harmful to any student if the teacher is using a differentiated approach (Gallagher, 1997). In actual practice, however teaching a classroom of 30 students with an entire bell curve of abilities is daunting and research suggests the regular education teacher does not adjust the content for gifted learners (Davis, 2009; Gallagher, 1997; Troxclair, 2000; Sisk, 2009; VanTassel-Baska, 2012; VanTassel-Baska & Stambaugh, 2005). The result is the feeling of boredom and underachievement of gifted youth.

One such reason for pressing the LRE for the gifted is almost certainly a desire to save the expenditures of scarce public money. It has been said that money drives most or all education decisions. It is probably more accurate to say that it is the lack of money that drives such decisions. (Gallagher, 1997, p. 159)

Reports by O’Connell-Ross (1993), Rogers (2007), and Stamps (2004) reveal that gifted learners have mastered much of the curriculum even prior to the start of the academic year. Minimum modifications to the curriculum are made by classroom teachers to reach the gifted population (Gallagher, 1997). Karnes and Beans (2009) argue that “the response to giftedness and talent is not simply differentiation, but qualitative differentiation: doing different kinds of things, not more of the same things” (p. 635).
Inclusion, an educational construct, and LRE, part of the IDEA are both readily applied to students with disabilities, but often ignore gifted students. These constructs were clearly set in place to create equitable opportunities for students with disabilities and are extremely important and valid. The work done to support youth with disabilities is inspiring and the same efforts should be in place for gifted youth. When teaching in mixed-ability classroom, teachers are encouraged to use a differentiated approach. According to Tomlinson (1999) differentiation is organized in a flexible, proactive manner in which the lesson delivery and classroom activities are changed to meet the requirements of all learners. This approach can be effective when grouping strategies are examined. Differentiation will be further addressed in the next section.

**Differentiation**

“The term differentiation is used in a variety of contexts in fields such as special education, gifted education, and English as a second language instruction, to describe how teachers modify the general curriculum and instruction” (Linn-Cohen & Hertzog, 2007, p. 227). Within any classroom, students could have varied levels of abilities, interest, and readiness that requires the use of differentiated learning opportunities. Educators will minimize their chance to reach all learners if they choose not to a differentiated approach. Differentiation involves and requires finding multiples ways to deliver instruction so that students have the chance to experience a moderately challenging curriculum (Linn-Cohen & Hertzog, 2007).

“Differentiated instruction refers to a systematic approach to planning curriculum and instruction for academically diverse learners” (Tomlinson, 2003, p. 3). Teachers can
differentiate their instruction by adjusting the content, process, product, and environment according to students’ readiness and learning profiles. Successful differentiation can occur in a classroom setting when a variety of key instructional fundamental are offered. According to Adam and Pierce (2006) essential elements include “classroom management techniques, planned use of anchoring activities, a variety of differentiated instructional strategies, and differentiated assessments” (p. 3). Instructional strategies that are used in a differentiated classroom include but are not limited to compaction, learning contracts, cubing, and tiered lesson planning (Adam & Pierce). Compaction refers “a process of giving students credit for what they already know. Compacting also occurs when advanced students are allowed to work more quickly through grade-level material” (Brulles & Winbrenner 2102, p. 44). This can be accomplished by tiering lesson plans, which occurs when teachers plan lessons for varying abilities in one classroom.

Differentiation starts when educators acknowledge that each student in a classroom has unique learning needs. “A differentiated classroom is one in which the teacher utilizes differentiated strategies such as acceleration, open-ended responses, and enrichment to match the level of academic challenges to each student’s ability” (Linn-Cohen & Hertzog, 2007, p. 231). Several studies (Kanevsky, 2011; Reis & Westburg, 1994; Reis, Westber, Kulikowich, & Purcell, 1998) found that when differentiation was used in the classroom, the teacher could eliminate much of the content for high ability students. When a teacher embraces the philosophy of differentiation, gifted learners are acknowledged as a unique group whose needs cannot necessarily be met with one approach to learning (Davis). Differentiated lessons for the gifted learner embrace greater
A review of the literature on differentiation emphasizes the need for differentiated instruction to address varied abilities and readiness of students in each classroom. Teachers need to be prepared to engage a variety of learning styles and students with different interest and abilities (Linn-Cohen & Hertzog, 2007). It becomes imperative for educators to design learning activities that consider each student’s ability level and readiness to learn (Linn-Cohen & Hertzog). Within a cluster arrangement, the teacher must provide gifted students with a differentiated curriculum. Gifted students “differ in their educational needs and are best served through individualized programs that provide for flexible placement and pacing of instruction, effective articulation of out-of-school learning with in-school learning, and access to supplemental opportunities” (Booth & Stanley, 2004, p. 138).

Chapter Summary

“Perceptions and practices that largely ignore the learning needs of gifted students carry a heavy cost to society” (Brulles & Winbrenner, 2011, p. 45). Most schools group students by age rather than intellectual ability and when gifted learners are assigned to a classroom without intellectual peers, they feel isolated and become frustrated (Clark, 2008). However, when gifted students are put in a classroom that allows them to interact and socialize with intellectually able students, Clark (2008) found gifted students value their mental ability, and their social-emotional and intellectual growth will flourish. “We must assure gifted learners that we are concerned with their social interaction with others,
not just their social adjustments to others” (Clark, 2008, p. 139). The impact of rigorous programs with intellectual peers cannot be overstated. Gifted students often start the school year showing mastering in grade-level content. In order to show annual progress or growth, these students need and deserve a challenging curriculum (Booth & Stanley, 2004).

Whether a school district chooses to group gifted students within a cluster arrangement or within homogeneous arrangements, they must also recognize the need for an accelerated and/or differentiated curriculum in conjunction with grouping strategies. As a nation, we must prepare gifted youth to be productive citizens who solve global problems. To do this, attention must be placed on providing appropriate services and grouping strategies.
Chapter 3: Methodology and Research Design

This chapter explains the methodology the researcher used to obtain quantitative and qualitative data, which assisted in answering the research questions posed by this study. Included in this chapter are descriptions of the study’s methodological assumptions and its design. These more general concerns explain choices about study participants, instrumentation, data collection procedures, and approaches to data analysis. The primary purpose for this case study was to examine the academic achievement of mathematically gifted fifth grade students when placed in a homogeneous or clustered arrangement. The homogeneous group received an accelerated and compacted curriculum whereas the cluster group received differentiated instruction within a mixed ability classroom. All participating students received instruction that aligned with the same academic content standards (See Appendix A) addressed in the studied unit; however, students received instruction within different grouping arrangements. The following questions helped guide this research study:

**Question 1:** Is there a difference in the academic achievement of mathematically gifted fifth grade students who receive geometry instruction in cluster groups and those instructed in homogeneous groups?

**Null Hypothesis 1:** There will be no statistically significant difference between gifted fifth grade students’ mathematics achievement when grouped in homogeneous or cluster arrangements.
**Alternative Hypothesis 1:** There will be a statistically significant difference between gifted fifth grade students’ mathematics achievement when grouped in homogeneous or cluster arrangements.

**Research Question 2:** What processes do administrators and teachers currently use in making grouping decisions of gifted students in the target district?

This study used two middle schools in a suburban Ohio school district with a total population of 50 students identified as gifted. The district considers middle school to be grades five and six. The researcher investigated the academic achievement of identified gifted 5th grade students within various arrangements. Two groups were formed to include those in homogeneous and cluster arrangements. During the research period, students received specific instruction within their grouping arrangements. At the onset of the research study, students were administered a pre-test and upon completion of the unit, a post-test was administered. The collected information enabled the researcher to compare the academic achievement of gifted students within two highly supported (NAGC, 2009) instructional grouping arrangements for gifted students (i.e., cluster and homogeneous). Cluster grouping allows gifted students to receive instruction within a mixed ability classroom with other gifted students, while homogeneous grouping allows gifted students to receive instruction with like-minded peers/similar ability students. In addition, the researcher also collected qualitative information by interviewing participating teachers and principals of the studied schools. Semi-structured interviews took place before and after the teacher-delivered instruction, which allowed respondents to discuss issues they believed to be important. An instrument guiding the interviews was
developed and used during the interview process to help guide the conversation (See Appendix B).

**Research Design**

After a review of existing research, (Baskas, 2011; Creswell, 2009; Denzin & Lincoln, 2005; Johnson & Christensen, 2012; National Center for Technology Innovation, 2012; Shadish, Cook, & Campbell, 2002) the researcher determined it was appropriate to use a mixed/multiple method approach by combining quantitative and qualitative methods. A mixed methods approach allowed the researcher to better understand the variables under investigation (Johnson & Christensen, 2012). “Mixed methods research involves the mixing of quantitative and qualitative research methods, approaches, or other paradigm characteristics” (Johnson & Christensen, 2012, p. 33). “Mixed methods research provides strengths that offset the weaknesses of both quantitative and qualitative research” (Creswell & Plano-Clark, 2006, p. 9). Interviews allowed the voices of participants to be heard which are not captured in quantitative research. Furthermore, “quantitative researchers are in the background, and their own personal biases and interpretations are seldom discussed. Qualitative research makes up for these weaknesses” (p. 9). A mixed method approach to this research study allowed the researcher to combine multiple forms of data and helped provide answers to the comprehensive research question.

Mixed methods research provides more comprehensive evidence for studying a research problem than either quantitative or qualitative research alone.

Researchers are given permission to use all of the tools of data collection
available rather than being restricted to the types of data collection typically associated with qualitative research or quantitative research. (Creswell & Plano-Clark, p. 9)

By incorporating both methods, the researcher was able to “collaborate across the sometimes adversarial relationship between quantitative and qualitative [research]” (Creswell & Plano-Clark, p. 9). A mixed methods approach encouraged the use of multiple viewpoints of participants and other paradigms that would have been otherwise overlooked. A mixed methods approach provided greater depth of discovery and provided the researcher with a deeper level of inquiry for generalizability and conclusions to be made. Furthermore a mixed method approach allowed the researcher to gain access to the empirical world of data collection, which allowed for a better interpretation of the data (Denzin & Lincoln, 2005). Quantitative information was collected from both pre- and post-test scores and qualitative information was obtained from interviews with district teachers and administrators.

According to Johnson and Christensen (2012) quantitative methods rely largely on the interpretation of quantitative data and/or information.

Quantitative research approach primarily follows the confirmatory scientific method because its focus is on hypothesis testing and theory testing. Quantitative researchers consider it to be of primary importance to state one’s hypotheses and then test those hypotheses with empirical data to see if they are supported. (Johnson & Christensen, 2012, p. 33)
The researcher investigated and compared the achievement of identified mathematically gifted fifth grade students within homogeneous and cluster arrangements. "When comparing relationships among variables, where objective theories are tested, the most logical method would be quantitative design" (Baskas, 2011, p. 3).

This research study gathered quantitative data in the form of pre- and post-tests scores. Quantitative methods involve “collecting, analyzing, interpreting, and writing the results of a study” (Creswell, 2003, p. xxiv). This multi-site case study used a pre-post-test design that allowed the researcher to examine the effects of an intervention on a given population both before and after the intervention. The pre-test was administered before the teacher-delivered instruction and the post-test was administered after teacher-delivered instruction following the timeline directed by the school district’s pacing guide. The quantitative collection of data was appropriate for this study and allowed the researcher to statistically measure the difference in means between the test scores obtain from the pre- and post-test. The primary goal of this study was to determine and observe the effect of grouping during instruction on gifted students’ achievement. Using pre- and post-test scores, the researcher compared the means of students’ tests scores to help measure student achievement.

Qualitative information, obtained from the semi-structured interviews, allowed the researcher to appreciate and understand social phenomena from the perspective of those involved. The researcher felt that qualitative methods added a dimension to the study that allowed different perspectives to be heard. This approach to research allowed for the participatory paradigm to be established in which participants offered their unique
perception on certain topics and allowed the researcher to form generalizations (Glesne, 2006). Qualitative methods allow researchers to contextualize issues and apply knowledge gained to transform or change social conditions (Glesne, 2006). “Qualitative research is used when little is known about a topic or phenomenon and when one wants to discover or learn more about it” (Johnson & Christensen, 2012, p. 33). The qualitative data collection portion of this study included interviews with teachers and administrators focused on the processes used for grouping gifted students for instruction. Interviews with the participating teachers and principals allowed the researcher to better understand the information used in deciding how to group students for instructional purposes along with the challenges and benefits of delivering instruction within the two grouping arrangements.

“Interviewing is necessary when [researchers] cannot observe behavior, feelings, or how people interpret the world around them” (Merriam, 2009, p. 88). Interviewing allows a researcher to conduct intensive interviews with individuals or small groups while trying to explore respondents’ perspective on a particular idea or situation (Boyce & Nelae, 2006). Researchers decide to use interviews because everything is not observable; people cannot observe feelings, thoughts, intentions and how people organize their world (Patton, 2002). Interviews often provide the researcher with context to other data, which contributes to a more complete analysis of what happened in a situation (Boyce & Nelae, 2006). Interviews are useful when researchers needs comprehensive evidence about an individuals thoughts and actions rereading certain situation. The primary reason for an interview is to allow the researcher to discovers what participants
think about a certain topic. Patton (2002) describes three types of interviews: informal/conversational, standardized open-ended interview, and/or a combination of the two often termed semi-structured. The format of the interviews for this study was semi-structured, to allow uniformity across the interviews.

[A] combined strategy offers the interviewer flexibility in probing and in determining when it is appropriate to explore certain subjects in greater depth, or even to pose questions about new areas of inquiry that were not originally anticipated in the interview instrument’s development. (Patton, 2002, p. 347)

Case Study

A mixed methods case study design was utilized to capture an “in-depth understanding of the situation and meaning for those involved” (Merriam, 2001, p. 19). Merriam (2009) describes a case study as “offer[ing] a means of investigating complex social units consisting of multiple variables of potential importance in understanding the phenomenon” (p. 50). Creswell (2009) extends this definition by explaining case studies are in-depth studies of programs, events, activities, or one or more individual. “Cases are bound by time and activity, and researchers collect detailed information using a variety of data collection procedures…” (p. 13). Baxter and Jack (2008) recommend using a case study design when:

(a) the focus of the study is to answer how and why questions; (b) [the researcher] cannot manipulate the behaviour of those involved in the study; (c) [the researcher] want[s] to cover contextual conditions because [the researcher]
believe[s] they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context. (p. 545)

This study used a single-case design that used embedded units of analysis. When a single case represents the critical case in testing a well-formulated theory, the single case design can “confirm, challenge, or extend the theory” (Yin, 2009, p. 47). “The single case can then be used to determine whether a theory’s propositions are correct or whether some alternative set of explanations might be more relevant” (p. 47). An additional rationale for conducting a case study is the argument of representative or what Yin (2009) calls a typical case. “Here, the objective is to capture the circumstances and conditions of an everyday or commonplace situation” (p. 48). In a case study, the researcher could be exploring more than one unit of analysis (Yin, 2009). In this case study, the researcher included a homogeneous group and a cluster group within one single case. These grouping arrangements were separate units of analysis within the same case, therefore, the embedded unit of analysis design was utilized. Furthermore this study used two different locations during the investigation period resulting in a dual site case study design. Two different sites were utilized during this investigation, which allowed the researcher to include additional participants and increase the sample size.

A multi-site case study investigates a defined, contemporary phenomenon that is common to two or more real-world or naturalistic settings. As well, a multi-site case study offers a means of understanding an individual, event, policy, program, or group via multiple representations of that phenomenon. In other words, by illuminating the experiences, implications, or effects of a phenomenon in more
than one setting, wider understandings about a phenomenon can emerge.

Typically, the research design in a multi-site case study is the same across all sites. (Bishop, 2010, p. 1)

A multi-site investigation was used to increase the sample size and utilize additional participants. Moreover the researcher also used quantitative measures to help answer the research question thus utilizing an embedded unit of analysis.

“Embedded case studies involve more than one unit, or object, of analysis and usually are not limited to qualitative analysis alone” (Scholz, 2002, p. 9). “The multiplicity of evidence is investigated at least partly in subunits, which focus on different salient aspects of the case” (Scholz, pp. 9 - 10). An embedded case study allows for a “multiplicity of methods” (p. 10) that can be applied within subunits. Hypotheses may be formulated and quantitative analysis may be applied with qualitative methods (Scholz, 2002). The embedded case design allows for both qualitative and quantitative data collection to be used as a strategy to synthesize knowledge integration. This type of knowledge integration helps explain the data under consideration, “thereby making data and inferential processes more transparent (Scholz, 2002, p. 14). In addition, this case study utilized a descriptive approach. A descriptive study uses reference theory to direct data collection and case description (Scholz, 2002). A descriptive case study can help a researcher describe an intervention that occurs in an authentic context (Yin, 2003).

**Transferability**

A case study for this investigation was chosen because the researcher investigated an issue and gathered data that can help district leaders make informed decisions
regarding programming for gifted students. A case study research strategy allowed the researcher to provide details about the description of the case and setting along with generalities of the findings so the targeted school district can use the data to make informed decisions (Creswell, 2007). Because this study focused on one case, the issue of transferability could be an issue. Generalizations made using the data would benefit the target school district and offer data they could use to inform programming decisions for gifted learners. Therefore, transferability could be limited to the boundaries of the targeted school district. Merriam and Associates (2002) acknowledge the need for case studies and argue that the rich data obtained from case studies is still beneficial regardless of the limited transferability. “It is the reader...who determines what can apply to his or her context” (Merriam & Associates, 2002, p. 179).

In addition to identifying the case and the specific type of case study to be conducted, researchers must consider if it is prudent to conduct a single case study or if a better understanding of the phenomenon will be gained through conducting a multiple case study. (Baxter & Jack, 2008, p. 549)

Case studies “can be a disciplined force in setting public policy and in reflecting on human experience” (p. 460). This case study sought to represent the case and lead to generalizations. “The utility of case research to practitioners and policy makers is in its extension of experience” (p. 460).

Summary of Research Design

Quantitative research studies typically use the “confirmatory scientific methods because its focus is on hypotheses testing and theory testing” (Johnson & Christensen,
Collecting quantitative information allowed the researcher to examine the effects of an intervention on a given population both before and after the intervention. “Qualitative research [was] used to describe what [was] seen locally and… [helped the researcher]…generate new hypothesis or theories” (Johnson & Christensen, 2012, p. 33). Qualitative research, such as interviews, were used to help understand the participants experiences and to allow teachers and principals to express their perspective about certain issues (Creswell, 2007; Johnson & Christensen, 2012). This approach to research allowed for the participatory paradigm to be established in which participants offered their unique perception on certain topics. Qualitative methods allowed the researcher to contextualize issues and apply knowledge gained to transform or change social conditions (Glesne, 2006).

Moreover a mixed methods approach to research uses both exploratory and confirmatory methods to gather evidence and make assertions about a particular topic. In a qualitative design study, the researcher becomes the research tool by asking questions, collecting data, and making interpretations from that data (Johnson & Christensen, 2012; Creswell, 2007; Denzon & Lincoln, 2005). “By combining two (or more) research methods with different strengths and weaknesses in a research study, you can make it less likely that you will miss something important or make a mistake” (Johnson & Christensen, 2012, p. 51). A mixed/multiple methods design allows the researcher to collect qualitative and quantitative data, which helps the researcher answer the questions posed by this study. By collecting and analyzing both quantitative and qualitative data,
the strength of the study increases. The next section of this chapter will define the
variables for this particular study.

**Definition of Variables**

In this study, the treatment group was the homogeneous class while the control
group was defined as the cluster arrangement. In a pre-post-test design, one group is
provided treatment while the other group receives no treatment. This occurs over the
same period of time, and all participants experience the same test (Shadish, Cook, &
Campbell, 2002). After the post-test, analysis of data was completed to determine the
effect of the grouping arrangement (Shadish et al.). The pre-test, for all groups, was
administered at the beginning of the unit and focused on the standards taught during the
unit of study as defined by the district’s pacing guide. The post-test was administered
once the instructional period ended, and occurred within the instructional timeframe as
defined by the district’s pacing guide. The pre- and post-test contained exactly the same
questions and the protocol for administration was similar for both administration periods.
The independent variable for this study was described as the grouping arrangement:
homogeneous or clustered and the dependent variable was described as student
achievement which was determined by the difference between the pre- and post-test
scores. "When comparing relationships among variables, where objective theories are
tested, the most logical method would be quantitative design" (Baskas, 2011, p. 3).
Quantitative and qualitative information was collected to help the researcher identify
strengths and limitations with certain grouping arrangements.
 Procedures

At the onset of the school year, the researcher provided principals with a list of qualified students to ensure students were placed in the correct classroom and students received proper instruction. In this case study, students were grouped and instructed using two different teaching approaches. One group of gifted students was assigned to a homogeneous classroom while the other group received instruction in a cluster arrangement. Students were purposefully assigned to each group based on their gifted identification. Six to seven identified gifted students were assigned to each cluster group within their home school, resulting in a total population of 25 (n = 25). The remaining gifted students were assigned to their respective homogeneous classroom within their home school, resulting in a population of 25 students (n = 25). At the onset of the school year, the researcher provided the principals of the two middle schools with a list of students identified as gifted. The principals then assigned the students to a cluster arrangement using a non-random process. Many of the cluster students were placed on a waiting list for the homogeneous group due to not having enough availability (further discussed in the qualitative section). Although all cluster group students were identified with a specific academic ability in math, they were denied programming due to limited capacity and the unpopular matrices (discussed in the qualitative section) used to place students.

Furthermore, the type of instruction in each grouping arrangement was predicted to effect the students’ academic achievement and precedes any measure of effect. This allowed the researcher to gain insight into the grouping strategies implemented in the studied schools. Cluster grouping and homogeneous grouping strategies are both
supported by the gifted community and are not often compared to each other. This study adds to the limited empirical data available to compare these two grouping strategies. School districts are faced with budget cuts and are eliminating gifted programs. This study identified problems and strengths of using certain grouping arrangements by presenting both quantitative and qualitative information about two highly used grouping strategies.

**Participants**

This study took place in two different middle schools located in a suburban Midwestern school district. The studied district considers students enrolled in grades five and six as middle school students and students enrolled in grades seven and eight as junior high students. This study focused on identified gifted 5th grade students at two middle schools. Each middle school consisted of at least one 5th grade cluster group, however, only one middle school was used for the homogeneous group. Six to seven identified gifted students were assigned to each cluster group within their home school, resulting in a total population of 25 (n = 25). Cluster group one was located at setting one (described below) and contained seven students with an average intelligence quotient (IQ), as measured by the school district’s testing instrument, of 123. Cluster groups two, three, and four were located at setting two (described below) and each contained six 5th grade students. The average (IQ), as measured by the school district’s testing instrument, were reported as 118.5, 118.5, and 123.6 for cluster groups two, three, and four, respectively. The overall average IQ measure for all clustered students was reported as 121.
The remaining gifted students were assigned to their respective homogeneous classroom within their home school, resulting in a population of 25 students (n = 25). The homogeneous group was located at setting one (described below) with student’s average IQ reported at 124. This is important to note because the average IQ measures for each group are relatively similar. At the onset of the school year, the researcher provided the principals of the two middle schools with a list of students identified as gifted. The principals then assigned the students to a cluster arrangement using a non-random process.

Students enrolled in the district are identified as gifted and talented by using a variety of instruments. Students who score in the 95th percentile or higher on the Stanford Binet assessment and/or 126 or higher in the Otis Lennon School Ability Test (OLSAT) are identified as gifted. The Stanford Binet is a set of achievement tests used to measure academic knowledge (Riverside Publishing, 2013). The OLSAT is an ability test that measures a student’s abstract thinking and reasoning skills (Pearson, 2009) and provides the district with an IQ measure. All participating students were identified gifted in math and had similar mathematics aptitudes. Some participating students also carried a superior cognitive gifted identification, which is earned by scoring a 126 on the OLSAT. Students that have been identified in both areas were assigned to both cluster and homogeneous groupings.

To ensure confidentiality of the participants, the researcher assigned a unique letter to each school and a number to each student. The researcher chose the district because of the program in place that serves mathematically gifted students and because
the researcher has access to the necessary information about students’ academic history and achievement. The researcher did not have any direct instructional influence and was not a participating teacher during this study.

**Setting One**

Schools one and two are both part of the same district and have received excellent ratings according to the State Department of Education. The district has three middle schools and is located in a suburban community in the Midwest. The researcher chose to only use two of the three middle schools within the district because the teacher assigned to the mathematically gifted students at the third middle school retired upon completing the school year prior to implementation. An educator that was not familiar with the gifted program was assigned to deliver instruction in the third middle school. To increase internal validity, the researcher maximized the expertise of the remaining two teachers at the other two middle schools.

According to the district’s website, the district has grown from a shared one-room school in a log cabin to over 10 modern facilities educating over 10,000 students. The district is one of the highest performing districts in the state. The district received an Excellent rating from the Department of Education, and School one received an Excellent with Distinction rating in the year 2012 – 2013.

The National Center for Educational Statistics (NCES) states that during the 2011 – 2012 school year, School 1 served over 470 students: 49% were 5th graders and 51% were 6th graders. The population distribution by race/ethnicity during the 2011 – 2012 school year was: 0.2% American Indian/Alaskan, 2.5% Asian/Pacific Islander, 10.6%
Black, 5.3% Hispanic, and 74.9% White. Among the enrollment, over 66 students were eligible for free lunch and over 19 were eligible for reduced lunch prices. According to NCES, School 1 had 28 classroom teachers with a student-teacher ratio of 16.82:1 during the 2011 – 2012 school year.

**Teacher in Setting One**

The teacher at setting one has been teaching for 18 years and has previous experience instructing mathematically gifted students. The pseudonym “Shelly” was assigned to the teacher in setting one and used throughout the study. Shelly previously taught 3rd and 4th grade math and science and currently teaches 5th grade math and science in setting one. Shelly has been teaching gifted students for more than five years and developed the geometry unit used during this study in collaboration with the teacher at setting two. Shelly received a most effective rating according to her Value Added measure during the 2012 – 2013 school years and remains a most effective and accomplished teacher under the revised teacher evaluation system. According to the Ohio Department of Education (2014) “Value-added analysis is a statistical method that helps educators measure the impact schools and teachers have on students’ academic progress rates from year to year” (para 3). In the Midwestern state where this study took place, Value Added is used to formulate a certain percentage of teachers overall rating for some schools district during the 2013 – 2014 school year (Blevins, 2013).

**Principal in Setting One**

The principal in setting one has been an administrator for three years and has worked for 15 years in public education. The pseudonym “Katie” was assigned to the
principal of Setting 1 and used throughout the study. Katie started her teaching in the
target district as a 7\textsuperscript{th} and 8\textsuperscript{th} grade reading and English teacher before accepting a
position as a 6\textsuperscript{th} grade English teacher. Katie recently accepted an administrator position
and has been the administrator assigned to setting 1 for the past three years.

\textbf{Setting Two}

School two is one of three middle schools serving this very large district in a
Midwest state. The NCES states that during the 2011 – 2012 school year, school two
served over 540 students: 52\% were 5\textsuperscript{th} graders and 48\% were 6\textsuperscript{th} graders. The population
distribution by race/ethnicity during the 2011 – 2012 school year was: 0.18\% American
Indian/Alaskan, 5.1\% Asian/Pacific Islander, 18.5\% Black, 4.4\% Hispanic, and 64.4\%
White. Among the enrollment, over 80 students were eligible for free lunch and over 20
were eligible for reduced lunch prices. According to NCES, school 2 had 25 classroom
teachers with a student-teacher ratio of 21.6:1 during the 2011 – 2012 school year.

School one was assigned one cluster arrangement and one homogeneous group
while school two was assigned three cluster arrangements. The teacher assigned to school
one delivers instruction on a two-person team, so the teacher delivers both math and
science instruction. The teacher assigned to school two works on a four-teacher team and
only delivers math instruction; therefore, school two had greater ability to have additional
cluster groups. The researcher used data from all cluster groups to form a sample
population of 25 students. The homogeneous group at school two formed a sample
population of 25 students.
**Teacher in Setting Two**

The teacher in setting two has been teaching for 10 years and has previous experience teaching the mathematically gifted student. The pseudonym “Kelly” was assigned to the teacher at setting two and used throughout the study. Kelly currently teaches four periods of math at setting two and has one homogeneous group of 30 mathematically gifted students and three additional math classes with five to ten identified gifted students in each class. Kelly has been teaching gifted students for more than five years and developed the geometry unit used during this study in collaboration with the teacher at school 2. Kelly received a most effective rating according to her Value Added measure during the 2012 – 2013 school years and remains a most effective and accomplished teacher under the revised teacher evaluation system.

**Principal in Setting Two**

The principal in setting two has been in administration for ten years and has worked in public education for 20 years. The pseudonym “Holly” was assigned to the principal of setting two and used throughout the study. Holly started her teaching career outside of the state in which the study took place before accepting a teaching position in a neighboring school district. Holly started her administrative career in the target district and has been the principal in setting two for six years.

**Quantitative Instrumentation**

The main instrument in this study used to collect quantitative data was the pre- and post-test. The researcher used the school district’s Instructional Information System (IIS) to create the pre- and post-tests. The district piloted the ThinkGate IIS during the
2013 – 2014 school year and the researcher is a district level administrator and had access to questions aligned with the academic content standards addressed in this investigation. The district used ThinkGate IIS to create common assessments used district-wide in non-tested subjects (i.e., science and social studies). The researcher had access to mathematic questions aligned with the academic content standards because of his district level clearance. The researcher is a district level trainer and helped train select teachers on how to use the system. The teachers involved in the investigation did not have the same access to the IIS and were not chosen to pilot the IIS for the district, so questions appearing on the assessment were in original form. The ThinkGate system organizes questions by individual academic content standard and contains over 9000 potential questions that could have been used on the pre- and post-test. Questions on the assessments were selected to align with the academic content standards as established by the State Department of Education. A minimum of eleven questions per academic content standard appeared on the pre- and post-test and all were multiple-choice in format. To ensure the reliability of the pre- and post-test, a Kuder-Richardson (1937 formula) test was conducted. The following formula was applied to measure the pre- and post-test reliability coefficient $KR_{20} = (k/k - 1) (1 - \Sigma pq/\sigma^2)$.

In this equation, $k$ is the total number of test questions, $p$ is the proportion of students that passed the test question, $q$ is the proportion of students that missed the test question, $\Sigma$ represents the sum of the two proportions multiplied, and $\sigma^2$ is the variation of the items used on the test. (Kelly, 2013, p. 47)
Reliability measures were used to ensure the instrument’s ability to produce a constant measure (Kimberlin & Winterstein, 2008). “The process of developing and validating an instrument is in large part focused on reducing error in the measurement process” (p. 2277). Patock (2004) states, “this statistic [Kuder-Richardson] measures test reliability of inter-item consistency…A higher value on the Kuder-Richardson formula indicates a strong relationship between items on the test” (Patock, 2004, p. 3).

The results of the Kuder-Richardson test are displayed in tables 1 - 5 for the cluster and homogeneous groups. Tables 1 and 2 show the results for the pre-test and Table 3, 4, and 5 show the results for the post-test.

Table 1

<table>
<thead>
<tr>
<th>Item Numbers</th>
<th>k</th>
<th>Σpq</th>
<th>var</th>
<th>KR-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-44</td>
<td>44</td>
<td>9.1168</td>
<td>63.1456</td>
<td>0.87552076</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Item Numbers</th>
<th>k</th>
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<th>var</th>
<th>KR-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-44</td>
<td>44</td>
<td>9.3088</td>
<td>42.5664</td>
<td>0.79948111</td>
</tr>
</tbody>
</table>
Table 3

*Reliability Test Results for Cluster Group Post-Test*

<table>
<thead>
<tr>
<th>Item Numbers</th>
<th>k</th>
<th>Σpq</th>
<th>var</th>
<th>KR-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-44</td>
<td>44</td>
<td>7.7024</td>
<td>31.2895</td>
<td>0.771366</td>
</tr>
</tbody>
</table>

Table 4

*Reliability Test Results for Homogeneous Group Post-Test*

<table>
<thead>
<tr>
<th>Item Numbers</th>
<th>k</th>
<th>Σpq</th>
<th>var</th>
<th>KR-20</th>
</tr>
</thead>
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<td>1-44</td>
<td>44</td>
<td>5.6448</td>
<td>15.0496</td>
<td>0.639453</td>
</tr>
</tbody>
</table>

Table 5

*Reliability Test Results for Total Sample Post-Test*

<table>
<thead>
<tr>
<th>Item Numbers</th>
<th>k</th>
<th>Σpq</th>
<th>var</th>
<th>KR-20</th>
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</thead>
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<td>44</td>
<td>7.0624</td>
<td>29.4196</td>
<td>0.777615</td>
</tr>
</tbody>
</table>

According to Lamour (2008) the preferred coefficient for a Kuder Richardson (KR) test is 0.70. The Kuder Richardson for the cluster and homogeneous groups pre-test shown in Tables 1 and 2 were reported as 0.87 and 0.79, respectively. The Kuder Richardson coefficient for the cluster group, homogeneous, and total population for the post-test are shown in Tables 3, 4, and 5. The coefficient values for the cluster, homogeneous, and total sample population for the post-test were reported as 0.771,
0.639, and 0.777, respectively. Although the KR coefficient for the homogeneous group was reported as 0.639, which is slightly below the preferred value of 0.70; it is still considered moderately reliable and is considered a satisfactory testing instrument (Kelly, 2013).

Classroom tests seldom need to have exceptionally high reliability coefficients. As more students master the content, test variability will go down and so will the coefficients from internal measures of reliability. Further, classroom tests don’t need exceptionally high reliability coefficients. A reliability coefficient of .50 or .60 may suffice. (Rudner, L. and W. Schafer, 2002, p. 17)

Validity of Instrumentation

“Assessment validity refers to the accuracy of score-based inference. Assessment validity does not refer to the accuracy of tests themselves” (Popham, 2012, p. 7). In other words, tests are not valid but rather inferences made from a particular test can be considered valid. When a test is administered to a student, a score is reported. A teacher can then make score-based inferences from that assessment. Score based inferences are an “interpretation of a student’s knowledge or skill, based on that student’s test performance” (Popham, 2012, p. 8). To ensure assessment validity, the researcher considered the principle of content-related validity.

“Content-related evidence of validity refers to whether a test accurately represents the skills and/or knowledge being measured” (Popham, 2012, p. 12). This study utilized a pre- and post-test, which measured student achievement. To arrive at a determination regarding the alignments between an assessment and curricular expectation, Popham
(2012) suggests four criteria. The first criterion is categorical concurrence, which focuses on the same or consistent categories in both curricular expectations and assessments. The developed test was aligned with the content statements taught during the unit of study and built using the school district’s IIS.

The next criterion set by Popham (2012) is depth of knowledge (DOK). DOK “considers the levels of cognitive demand found in the curricular expectation in relation to those in the assessment” (p. 16). The system used to generate the assessment defines the DOK for each question. Popham (2012) recommends, “at least 50 percent of the items corresponding to a curricular aim are either at or above the cognitive level of the curricular aim” (p. 16). Seven percent of the assessment questions were labeled remembering, 39% were categorized as understanding, 32% were considered applying, 14% were labeled analyzing, 2% were evaluative, and 7% were considered at the creative level. The system used to build the assessment clearly labels the DOK for easy reference (See Appendix D).

The next validity criterion presented by Popham (2012) is called range of knowledge correspondence. This criterion “deals with the correspondence between the span of knowledge present in the curricular aim and the span of knowledge represented on the assessment” (p. 17). This means that each objective or standard should be provided equal weight or consideration when making an assessment. At minimum, eleven questions per standard appeared on the assessment. Questions in the IIS are directly aligned with one specific content statement, so this criterion was easily met.
Balance of representation is the final criterion set by Popham. This criteria is also concerned with the balance of representation of each standard and correlating question. Popham emphasizes that each standard or objective taught during a unit should be given equal consideration when designing an assessment.

**Qualitative Methods**

When conducting qualitative research (i.e. interviews), the researcher becomes the tool by asking questions, collecting data, and making interpretations from the collected data (Johnson & Christensen, 2012). The primary method used to collect qualitative data was semi-structured interviews conducted with the two participating teachers and two participating principals. Semi-structured interviews took place during the teacher delivered instruction, which allowed respondents to discuss issues they believed to be important. An interview guide was developed with 26 probing questions and was referenced during the interviews (See Appendices B and C). The questions were arranged within the following categories: Grouping-Related Questions, General Service Related Questions, Teacher-Related Questions, Parent-Related Questions, Student-Related Questions. Each interview took approximately 60 minutes.

The researcher recognized the importance of establishing a trusting environment when conducting interviews. This allowed the interviewees to provide information about their own personal experience. The researcher set-up a time with each interviewee and provide her with a written copy of the questions. This allowed the interviewees to process the questions in advance and develop a response. The interviews took place in a location chosen by each interviewee to allow for a more comfortable environment. The researcher
recorded and took notes during the interviews and later transcribed and analyzed the interviews. Interpretation of the interviewee’s perspective on the treatment and grouping strategies used during this investigation-helped answer the second research question.

**Treatment**

Students assigned to the homogeneous arrangement received an accelerated and compacted curriculum while students in the cluster arrangement received differentiated instruction. The academic content standards (See Appendix A) taught to each group were the same, however, all students within the homogeneous group were identified gifted. This means that all students within this arrangement received instruction that addressed the geometry standards studies during this unit. The students within the cluster group received instruction within a mixed-ability classroom which required a differentiated approach because the identified gifted students received instruction on standards addressed during this study.

**Student Participants**

All participating students had similar mathematics aptitudes or abilities and were label gifted based on criteria set by the State Department of Education. Students in the district of study are identified gifted based on multiple criteria. Students who score in the 95th percentile or higher on the Stanford Binet assessment and/or 126 or higher in the Otis Lennon School Ability Test (OLSAT) are identified as gifted. Some participating students also carried a superior cognitive gifted identification. Students that were identified in both areas were assigned to both cluster and homogeneous groupings. Students are offered formal gifted services in elementary (grades 3 - 4) and middle grades (grades 5 - 6) until they reach junior high (grades 7 - 8). Students then have the chance to
take high school level classes as a 7th and/or 8th grader (e.g. algebra, geometry). After junior high, students have the opportunity to take honors, Advanced Placement, and/or other college level courses.

**Homogeneous group.** The homogeneous group received a compacted and accelerated curriculum that incorporated advanced content (i.e., above grade-level content) at an accelerated pace. Students in the homogeneous class are grouped together during math instruction as well as other core subjects (e.g. science, social studies, and English). Each math class was equal in length to the cluster group at lasted approximate 60 – 70 minutes every day. The standards were selected by the district’s Teaching and Learning Department and the educators interviewed in this case study helped establish the course of study, which included above-grade level content standards. The district has a program called MathPlus, which accelerates and compacts the math curriculum. This program is used at the elementary level (i.e., grades 3 - 4) and middle levels (i.e., grades 5 - 6) for the purpose of providing enrichment for gifted learners. This program is how the district formally serves mathematically gifted students and has been in effect at the middle school level (grade 5 and 6) since the 2011 – 2012 school year.

**Cluster group.** The cluster group received differentiated instruction that focused on the same content standards as students within the homogeneous classes. Like students in the homogeneous group, the cluster students are grouped together during math instruction as well as other core subjects (e.g. science, social studies, and English). The mathematics content standards addressed in this study focused on certain standards as defined by the district’s pacing guide (See Appendix A). Because the homogeneous
group of students were grouped together, the teachers focused exclusively on the standards to be addressed. The students within the cluster arrangement were instructed on the same standards, but were educated within a mixed-ability classroom. Each teacher involved in this study received lesson plans and activities that addressed the specific content standards to be taught during this study. The teachers worked together to developed the unit of study and used the same resources throughout the instructional timeframe. The participating teachers covered the same material within the same amount of time. Each math class was equal in length to the homogeneous group and lasted approximate 60 – 70 minutes every day. Students within the homogeneous group received an accelerated curriculum, and the teachers used similar, differentiated activities (e.g., choice board activities, independent studies, small group instruction, station activities) to address the gifted students in the cluster arrangements.

**Treatment fidelity.** To ensure program fidelity, the researcher checked-in with each teacher at least once per week during the intervention period. During these meetings, the researcher had participating teachers complete a checklist of standards taught and discuss the lesson activities. Adjustments to scheduling, due to calamity days, were considered after meeting with all participating teachers. A pre-test was administered preceding instruction, which lasted approximately six weeks. At the end of the six week period, each group was administered a post-test. All participating classroom teachers received the same instructional materials and covered the same content standards within the study timeline. The timeline of instruction was established with the assistance of participating teachers.
**Quantitative Data Collection**

Following IRB approval and prior to engaging in this study, the researcher gathered background information about the student participants, schools, and teachers involved in this study. Because the research was conducted in a commonly accepted educational setting and the students were not receiving instruction that negatively impacted their educational experience, parent permission was not necessary. The researcher obtained prior consent from the building principals to access the participating students’ informational files (See Appendix E).

The researcher worked closely with district level administrators to collect students’ demographic data. The researcher requested information for all identified gifted 5th grade students in the district. During this research study, the researcher gathered quantitative data in the form of pre- and post-test scores and qualitative information in the form of interviews. At the beginning of the unit of study, all participating students were given a pre-test that concentrated on the academic standards to be studied during this investigation. Students within the homogeneous and cluster groupings were administered the same pre-test prior to any teacher-delivered instruction. During the investigation, students were assigned a number to ensure confidentiality.

Prior to the six-week unit, participating teachers administered the pre-test to students in a standardized manner providing students 50 minutes to complete the test. Consistent with testing protocols set by the State Department of Education, students were not provided extra time, formula sheets during assessments, nor were they permitted to
use a calculator. The procedure for administering the pre- and post-test were similar to state-testing procedures to ensure validity.

The researcher provided participating teachers with hard copies of the pre-test approximately one-day prior to administration. Once the students were administered the pre-test, the researcher obtained the tests from participating teachers within one school day. The researcher then scored the pre-test and recorded data using the application Microsoft Excel and SPSS. Information including student number, age, IQ, previous elementary school, previous test scores, and current teacher were also recorded in the researcher’s database.

After the six-week instructional period, participating teachers administered the post-test. The researcher again delivered hard copies of the assessment to participating teachers approximately one-day before administration. The test addressed the content students learned throughout the instructional period. Participating teachers administered the post-test within a 50-minute class period following the same protocol as the pre-test. Students were not provided extra time, were not permitted to use a formula sheet, or calculator.

Once the post-test was completed, the researcher obtained the test from the participating teachers within one school day. The researcher then scored the post-test and recorded scores in the Excel and SPSS spreadsheet. The researcher also used an electronic cloud to back-up the data in the event the original source was lost or corrupted. All data, physical and electronic, were destroyed and/or eliminated after the researcher’s results were defended.
This study presented some data collection issues mainly because a variety of teachers participated in this study. It was imperative for teachers to administer the pre- and post-test in a standardized fashion following the criteria set by the researcher. It was also imperative for teachers to deliver appropriate instruction and follow the standards set by the local school district.

**Quantitative Data Analysis**

Upon receiving data from participating teachers, the researcher used a statistical program (e.g., Microsoft Excel and SPSS 22) to record data. Once all data was obtained, the researcher then imported the data into the statistical program SPSS 22 and screened it for any duplications and/or errors, which were removed. The researcher collected nominal/categorical variables, “variables with values that are categories rather than numbers” (Aron, Aron, & Coups, 2011, p. 6) and numerical/quantitative variables whose values are numbers. The researcher input nominal/categorical variables including: student number and current teacher into SPSS in addition to numerical variables including student’s age and pre- and post-test scores. The researcher then analyzed the pre- and post-test scores using a variety of regressions including a t-test model of regression.

The researcher used the pre-test score to establish a baseline for each group and the post-test score to compare academic achievement between the two sample populations. The independent variable was described as the grouping arrangements and the dependent variable was described as the students’ achievement, which was measured by test scores. The researcher computed basic descriptive statistics. The researcher
calculated and reported descriptive statistics including the mean, median, and mode. Descriptive statistics allowed the researcher to report univariate data.

To help answer the research question, the researcher performed a dependent samples t-test for each group. This helped the researcher determine if the individual groups’ pre- and post-test scores were significantly different. The dependent samples t-test allowed the researcher to compare each cluster and homogeneous groups’ pre- and post-test scores. The researcher first performed a dependent samples t-test for the cluster group to determine if the tests scores for the cluster arrangements were significantly different. The researcher then performed a dependent samples t-test using the tests scores for the homogeneous group to determine if the scores were significantly different in the homogeneous grouping. The researcher also performed an independent samples t-test to decide if the scores of students’ in the cluster and homogeneous groups were statistically different from each other. Both t-tests allowed the researcher to report bivariate data.

The purpose of collecting data was to determine if a statistically significant difference exists in the achievement of mathematically gifted students who received instruction in cluster groups and those who received instruction in homogeneous groups. The researcher used a t-test to determine if the two means were significantly statistically different at the selected p-value of 0.05. The independent t-test helped the researcher answer the research question.

Validity

In this section, internal and external validity issues are addressed along with limitations and delimitations. The term validity refers to the estimated truth about the
researcher’s inferences (Shadish, Cook, & Campbell, 2002). When something is valid, a researcher is making a decision about the “extent to which relevant evidence supports that inference as being true or correct” (Shadish, Cook, & Campbell, 2002, p. 34).

“Assessing validity involves human judgments and researchers can never be certain that all of the inferences drawn from a single experiment are true or even that other inferences have been conclusively falsified” (p. 34). The following section details factors that a researcher must consider to limit dangers to internal validity.

First, history refers to “extraneous events occurring during the course of the experiment that may affect the participants’ responses on the dependent measure” (Strohmetz, 2010, p. 3). This is an unintended difference with the test scores that may affect and/or influence the students’ response or academic growth. Experience between each group did not differ, however, the grouping arrangement used during the course of investigation was defined as the independent variable. All participants were considered mathematically gifted and all students qualified for this label using the same or similar testing instrument. Students within each cluster arrangement received differentiated instruction within a regular education classroom during previous academic school years. Some of the clustered students received pullout services in grade three. Students within the homogeneous group received specialized services and many received pullout services in grades three and four. “In field research… the plausibility of history can be reduced… by selecting groups from the same general location and by ensuring that the schedule for testing is the same in both groups” (Shadish et al., 2002, p. 56). These
students are all considered mathematically gifted and were administered the same
assessment and received instruction that addressed the same content standards.

Second, maturation is a “threat [that] results from differential rates of normal
growth between pre-test and post-test for the groups” (Trochim, 2006, para. 5). Students
within this study were assigned to same-age groupings with no cross-age grouping
occurring. Threats to maturation can be significantly reduced by ensuring that
participants within each group are the same age so that their maturation rates stay about
the same throughout the study. Selecting participants from the same location can also
reduce this threat, so that local trends can be consistent (Shadish et al., 2002). This
investigation examined 5th grade mathematically gifted students with very similar
academic histories. All students were roughly the same age and enrolled in the same
school district. Using schools within the same school district ensured that students were
following the same curricular pacing chart and experienced similar external factors. It is
also noted that maturation is not usually a concern for short studies (Shadish et al., 2002).

Third, statistical regression occurs when participants who received extreme scores
on the pre-test and have less extreme scores on the post-test (Tochim, 2006). This is the
result of participants scoring extremely high on the pre-test, but regressing toward the
mean on subsequent testing (Strohmetz, 2010; Tochim, 2006). This study used statistical
regression including the t-test to draw conclusions from the data. Students in this study
all received their gifted identification using the same testing instrument and received
instruction on the same content standards. The test made for this study has significant
stretch with the highest score for the pre-test reported as 82 percent and the highest score on the post-test reported as 93 percent.

Fourth, subject mortality, also known as attrition, is “differential dropping out of some subjects from the comparison groups before the experiment is finished, resulting in differences between the groups that may be unrelated to the treatment effects” (Strohmetz, 2010, p. 3). This could happen if subjects are removed from the control and/or experimental groups; and could also occur if a student moves to a different school district. This study did not consider the scores of students who moved in or out of the school district during the course of the investigation. However, all participating students remained in the study from beginning to end and no move in students were considered. If it had occurred, these scores would have been eliminated from the data set.

Fifth, selection bias is “any bias in selecting and assigning participants to groups that results in systematic differences between the participants in each group” (Strohmetz, 2010, p. 3). According to Johnson and Christensen (2012) sometimes it is not possible to randomly assign students to classrooms because of a variety of factors; for example, the school year may have already begun, and the school system might not be willing to allow the researcher to reassign students to different classrooms. This means the researcher would have to conduct the study making use of existing classes of students, which precludes the use of random assignment.

Finally, selection interaction occurs when participants in the control and experimental groups are selected from dissimilar settings. This means students would receive different interactions or treatment, which could affect the results or outcome of
the study (Johnson & Christensen, 2012). The researcher reduced selection bias by assigning students to the same teacher within each grade level’s independent variable group, thereby reducing selection interaction threats.

**Statistical Conclusion Validity**

Statistical conclusion validity “is concerned with the appropriate use of statistics to arrive at accurate decisions about accepting or rejecting hypotheses” (Parker, 1993, para. 1). In general, the null hypothesis declares no differences between the two groups average scores when considering the dependent variable. “Type I error, which is called alpha (α), is the probability of falsely rejecting the null hypothesis” (Parker, para. 1). “Type II error, beta, is the probability of failing to reject a false null hypothesis” (Parker, para. 2). This section will describe threats to statistical conclusion validity and state how the researcher maximized statistical conclusion validity.

First, “Statistical power is equal to the quantity 1.0 - Beta, or the probability of rejecting a false null hypothesis” (Parker, 1993, para. 2). This means a researcher determines a statistically significance difference exist between the sample means when in fact the sample comes from a different population. To reduce this threat, the researcher examined the power, sample size, and effect size for the current study. “Increasing the alpha level, sample size, and effect size, singly or in combination, increases statistical power” (Parker, para. 2). The sample size of this study was equivalent for both control and experimental groups. The researcher used approximately 50 identified gifted students and used the same school district during this investigation.
Next,

Running many statistical tests on one data set is called fishing. Fishing produces error rates that are higher than the preset alpha. Running one statistical test on a data set results in a Type I error rate equal to the preset alpha. Running two or more statistical tests, however may inflate alpha above the predetermined rate. (Parker, 1993, para. 3)

The researcher exclusively relied on the t-test to draw conclusions from statistical regressions. The best method for addressing whether cause and effect co-vary is null hypothesis significance testing. To do this, the researcher performed a t-test on the treatment and comparison group means at posttest, with the usual null hypothesis being the difference between the population means as zero. “A test of this hypothesis is typically accompanied by a statement of the probability that a difference of the size obtained would have occurred by chance in a population in which no between group difference exist” (Shadish et al., 2002, pp. 42-43).

Third, “Measures with low reliability increase error variance and reduce the power of statistical tests” (Parker, 1993, para. 4). When a researcher uses simple gain scores from pre-test to post-test as a measure of a dependent variable, it may decrease reliability. “Residual gain scores (posttest scores with pre-test covariance partialled out) frequently are preferable to simple gain scores” (Parker, para. 4).

Fourth, low reliability of treatment implementation is a “threat is due to the lack of standardization of procedures used to administer the treatment” (Parker, 1993, para. 5). When a researcher uses different participants and different settings, this threat is
increased. During this study, the researcher used two different schools, because there were not enough gifted students enrolled in one school. The researcher performed this study within the same school district, which minimized this threat and the researcher worked closely with district level administrators and participating teachers to ensure program fidelity. The treatment provided to participating students was administered following the same timeline and specific protocols were followed during implementation. The researcher defined the standards to be addressed during instruction and the teachers involved administered the pre- and post-test in a standardized fashion.

Next, random irrelevancies in the experimental setting occur when “scores on the outcome variable may be affected by aspects of the experimental setting other than the treatment” (Parker, 1993, para. 6). To minimize this threat, the researcher conducted this investigation in the natural setting. All participating students received instruction within the same school district and instruction came from their assigned math teacher.

Finally, random heterogeneity of respondents is a threat that “occurs when respondents are heterogeneous on variables related to the outcome variable. This problem may be controlled by selecting participants who are homogeneous on all variables related to the dependent variable, excluding the independent variable” (Parker, 1993, para. 7). To minimize this threat, the researcher only considered mathematically gifted students. Although gifted students are not to be considered a homogeneous group, these students have qualified as mathematically gifted using the same or very similar instruments.
**Section Summary**

Specific threats to statistical conclusion validity include: small sample size, increased error from irrelevant, unreliable, or invalid measures, high variability due to participant diversity, violation of statistical assumptions, repeated statistical test, violation of statistical assumptions, and biased estimates of effect. To limit these threats, a researcher should consider the following: increase sample size, improve measurements, control individual differences or use repeated measures, transform data or use different analysis method, and/or use correlated values to estimate effect in population (Shadish, Cook & Campbell, 2002). Furthermore, Shadish et al. (2002) suggest to increase the number of participants to avoid floor and ceiling effects. Low power is a major cause of false null conclusions in certain studies, and the researcher must take extra precautions to assume a large enough sample population.

**External Validity**

“External validity…[refers] to which the results of a study can be generalized to and across populations of persons, settings, times, outcomes, and treatment variations” (Johnson & Christensen, 2012, p. 256). To generalize the results from a research study, a researcher would have to identify a “group of individuals, settings, times, outcomes, and treatment variation and then randomly select from these population so that [a researcher has] a sample representative of these populations” (p. 257). Some studies cannot randomly sample from the population of individuals, settings, times, outcomes and treatment variations because of time and money (Johnson & Christensen, 2012). Because of these circumstances, all studies have threats to external validity. This section describes
certain risks to external validity and explains how the researcher maximized external validity.

First, population validity “refers to the ability to generalize from the sample of individuals on which a study was conducted to the larger target population of individuals across different subpopulations with the larger target population” (Johnson & Christensen, 2012, p. 257). This study enhanced population validity by selecting an appropriate sample. Gifted students are not a homogeneous group, and each has unique skills. This study focused on 5th grade mathematically gifted students, which is important to note for population validity. A case study research design helped provide a detailed description of the case and setting along with generalizations so the target school district can use the data to make informed decisions (Creswell, 2007). Because this study focused on one case, the issue of generalizability can be an issue. Generalizations made using the gathered data can benefit the studied school district and offer data they can use to inform certain programming decision. Generalizability is limited to the boundaries of the studied school district. Merriam and Associates (2002) acknowledge the need for case studies and argue that the rich data obtained from case studies is still beneficial regardless of the limited generalizability. “It is the reader...who determines what can apply to his or her context” (Merriam & Associates, 2002, p. 179).

Cluster grouping and homogeneous grouping are two supported strategies in the gifted literature and are not often compared. This study provides data that will allow district leaders to make decisions about grouping strategies employed with their gifted population.
Second, ecological validity “refers to the ability to generalize the results of a study across settings” (Johnson & Christensen, 2012, p. 259). This study maintained ecological validity because it took place in a natural setting. It would be more difficult to generalize the results to more diverse groups of students, however, the researcher used control variables in order to maximize ecological validity.

Third, temporal validity “refers to the extent to which the results of a study can be generalized across time. Temporal validity is an issue because most educational research studies are conducted during one time period” (Johnson & Christensen, 2012, p. 260). Temporal validity was addressed and maintained by establishing a timeline and sequence of events. Students received treatment within their defined groups followed by a post-test to determine academic achievement. Treatment variation validity “refers to the ability to generalize the results across variations of the treatment. Treatment variation validity is an issue because the administration of the treatment can vary from one time to the next” (Johnson & Christensen, 2012, p. 260). The independent variable tested in this study was the type of grouping. This type of treatment is easy to reproduce because it is simply grouping students in either homogeneous and/or cluster arrangements.

Fourth, outcome validity “refers to the ability to generalize results across different but related dependent variables” (Johnson & Christensen, 2012, p. 260). Most studies examine the effect of one independent variable on one or more dependent variables. “Outcome validity refers to the extent to which the independent variable influences a number of related outcome measures” (p. 260). To help determine if differences occurred between the two groups, a t-test was used. The researcher used a t-test to determine if the
two means were significantly statistically different at the selected p-value. The t-test determined if a difference exists between the group’s pre- and post-test scores.

**Qualitative Data Collection**

The qualitative part of this study consisted of interviews with two teachers and two principals of the target schools. Semi-structured interviews took place during the teacher delivered instruction, which allowed respondents to discuss issues they believed to be important. The researcher arranged interviews with the respective participants and provided a written copy of the questions in advance. The teachers and principals were notified of the protocol and procedures for the semi-structured interview, and provided with the questions prior to conducting the interview to allow them time to consider their responses.

A researcher-developed interview guide with probing questions was used during the interview process (See Appendices B and C). The researcher recorded and took notes during the interviews for later analysis and interpretation of participants’ perspectives on the processes used for decisions related to instructional grouping arrangements for gifted students in the district. The primary advantage of using interviews when conducting research is that they provide much more detailed information than can be obtained through other methods such as surveys (Boyce & Nelae, 2006). Interviews also provide a relaxing atmosphere in which participants feel comfortable discussing difficult topics (Boyce & Nelae, 2006). Each interview was audio recorded and later transcribed. Interviews are time-intensive, and the process of transcription can be tedious; however, interviews provided valuable information for the researcher.
Qualitative Data Analysis

“Qualitative analysis transforms data into findings. No formula exists for the transformation” (Patton, 2002, p. 432). The challenges involved with analyzing qualitative information “lies in making sense of massive amounts of data. This involves reducing the volume of raw information…[and]… identifying significant patterns (Patton, 2002, p. 432).

After conducting interviews, the researcher organized and prepared the data. Transcription of the interviews was documented using Microsoft Word. Once the data was transcribed, the researcher read through all of the interviews and reflected on the overall meaning (Creswell, 2009). This allowed the researcher to look for patterns and note the impressions that appeared throughout the data. The researcher then began a detailed analysis of the transcribed interviews and began a coding process. Coding is the process of organizing data into meaningful segments that allows the researcher to find patterns within the information (Creswell, 2009). The researcher went through the interview answers and assigned a certain letter when patterns or themes appeared. The researcher noticed similar themes/patterns that had been identified in the interview protocol such as grouping and service options. Once the qualitative information was coded, the researcher analyzed and interpreted the data to help report major themes. Three major themes emerged each having their own sub-themes.

Trustworthiness

Lietz and Zayas (2010) identify the work of Lincoln and Guba, which they declare sets the foundation of trustworthiness in qualitative research. “…qualitative
studies should achieve trustworthiness; a study that represents as closely as possible the perspectives of the research participants” (Lietz & Zayas, 2010, p. 191). To ensure trustworthiness, researchers should consider: “credibility, transferability, auditability, and confirmability” (p. 191). The following section details how this research study maintained trustworthiness.

Credibility is maintained when the study’s findings “represent the meaning of the research participants” (p. 192). This means that interpretation of the research findings must remain authentic and accurate and not represent false ideas of the participants. This research study maintained credibility by using the member check strategy. Member checking involves including participants in the analysis process. The researcher returned to each participant after the transcription, coding, and identification of themes had occurred to ensure an accurate and authentic depiction had been obtained. Each participant reviewed the materials to ensure his/her perspective was correctly represented. No changes were necessary and all participants agreed to the transcriptions and identification of themes (Appendix F). In addition to member checking, triangulation of data was used. Triangulation is the process of using a variety data sources to help answer the research question. This research study utilized what Lietz and Zayas (2010) call data triangulation by including four participants during the interview process. The researcher interviewed four participants to obtain their perspectives on grouping students and gifted programs currently in place within the studied schools. The next criterion to ensure trustworthiness is called transferability.
Transferability is the degree in which outcomes can be transferred to other areas and how the findings can be related to future research (Lietz & Zayas, 2010). “Although qualitative researchers do not seek generalizability, transferability is achieved when the findings have applicability to another setting, to theory, to practice, or to future research” (p. 195).

Qualitative research studies are not generalizable according to quantitative standards, because probability sampling is not employed. Instead, qualitative studies typically use purposive sampling to seek a specific group of participants who have experienced the phenomenon being studied. (p. 195)

To increase the transferability of these research findings, thick description were provided. Thick description according to Lietz and Zayas (2010) is “a thorough representation of the phenomenon of inquiry and its context as perceived and experienced by study participants (p. 198). The researcher provided a thick description of the context to allow the reader to “understand ways findings may be applicable to other settings” (p. 195).

This approach enabled the researcher to point out details of the context to show an accurate and detailed description of the studied school district, so other districts can adjust their gifted grouping options based on the results of this investigation.

Auditability is the next criteria to ensure trustworthiness. Auditability is the extent to which the researcher’s techniques and processes are recorded. Strategies used to increase auditability according to Lietz and Zayas (2010) “include keeping an audit trail” p. 196). “An audit trail is a written account of the research process that includes a reporting of what occurred throughout the research project…” (p. 196). The researcher
maintained auditability of the qualitative data by keeping notes during the interview process along with recording the member checking process. “An audit trail is of particular relevance for post-positivist qualitative research…” (p. 196).

The final criterion to ensure trustworthiness is confirmability, which is the capacity to authorize the research findings (Lietz & Zayas, 2010).

To achieve confirmability, a study demonstrates that the findings and data are clearly linked. There are several strategies that a researcher can use to increase a study’s confirmability. Already discussed were the benefits of member checking and audit trails. These strategies allow collaborators external to the research team an opportunity to evaluate or confirm the research procedures. (p. 197)

To increase trustworthiness, the researcher used member checking (Appendix F), audit trails, triangulation, and thick description strategies. The next section discusses validity factors that affect this research study and how the researcher addressed those issues.

**Data Analysis Summary**

The mean differences of scores from the two instructional groups were calculated and reported as the descriptive statistics for the study. This study was primarily interested in the achievement students made when comparing the pre and post-test scores. The pre-test scores were important to this study because they established a baseline score to which the researcher compared the post-test score. This allowed the researcher to observe and analyze the achievement growth between students assigned to the cluster and homogeneous arrangements. The data was analyzed to determine if a significance statistical difference exist between the students’ test scores.
A statistical program (e.g., SPSS 22) allowed the researcher to derive statistics and compare scores obtained from the pre- and post-test. The researcher then used the results from the independent sample t-test to determine if a difference in mean scores and gains between the pre- and post-tests for each group. “Independent samples t-tests are commonly used to make a comparison between scores of two different groups” (Kelly, 2013, p. 49). The independent t-test helped compare the tests scores administered to the homogeneous and cluster groups. The independent variable in this study was described as the grouping arrangements and the dependent variable was described as the students’ achievement determined by the pre- and post-test.

In observe whether the null hypotheses could be rejected or whether the researcher could fail to reject the null hypothesis, the appropriate t-values for the t-test were identified and compared to the corresponding critical values. The t-values were used to compare the students’ tests scores.

The p value is not the probability of the null hypothesis being true; instead, the p value gives the probability of a statistical difference due to a sampling error between two samples from a single population if there is no statistical difference discovered. (Kelly, 2013, p. 56)

Qualitative information was collected through semi-structured interviews. For this study, the researcher interviewed two participating teachers and two principals of the target schools. Semi-structured interviews took place before and/or after the teacher-delivered instruction, which allowed respondents to discuss issues they believed to be important. Researcher-designed interview guides were used during the interview process.
to help guide the conversations (See Appendices B and C). The researcher audio recorded the interviews and scribed during the interview process for later analysis. The next section of this chapter addresses assumptions, delimitation and limitations to this study.

Assumptions

Assumptions in this study include the responsibilities of the teachers and the role of the students during the time of the investigation. The researcher assumed participating teachers and students provided honest and accurate answers when completing the pre- and post-test. It was also assumed that the teacher delivered the instruction in the specified manner. The researcher also assumed participating students had very similar academic histories and came from supportive homes that encourage good study habits and school attendance.

Delimitations and Limitations

The primary limitation was the use of only two middle schools and the focus on mathematically gifted students in one grade level. The small sample size within the cluster groups also posed a limitation. The sample size is a limitation because the researcher had no control over the gifted population within a school district. To maximize validity, the researcher chose to use two middle schools within the same school district. Although this posed a limitation to generalization, it maximized the internal validity. Because the researcher was focused on the mathematically gifted student, it resulted in a small sample size. To obtain a larger sample, the researcher would have had to use additional grade levels, schools, or district, which would limit the internal and external
validity. The decision to use a smaller sample and obtain data within the same district offset the consequences of jeopardizing the validity of this study.

The academic content standards taught during the unit of study were also a limitation because these were defined by the state’s education departments. The investigation timeline also is considered a limitation because the researcher followed and used the district’s pacing guide.

This study did not take into account the influence of individual educators on achievement, but rather the effect of grouping students in certain ways and the impact of a specific type of instruction. Each teacher involved in this study had experience teaching gifted students. While teacher participation is considered to be a delimitation, obtaining teachers with experience teaching the gifted learner maximized internal validity. Another decision made by the researcher to maximize internal validity of this study was that this study was limited to a suburban school district that focuses solely on gifted students. The student population for this study is defined for the researcher and the study only includes mathematically and/or superior cognitively gifted students. Often a student can carry multiple labels of giftedness or other exceptionalities, however, this study did not acknowledge other exceptionalities that might inhibit a student’s ability in the math class.

The researcher used the district’s IIS to design the pre- and post-test. This is considered a delimitation because the researcher did not chose the IIS but had control over the types of questions appearing on the assessments. Generalization may not apply to schools in other regions with a wider range of diversity or abilities. The conclusions
made after obtaining statistical data can help many school district make data-driven decisions about gifted programming models.

**Conclusion**

This mixed methods study compared the academic achievement of mathematically gifted fifth grade students when receiving instruction within certain arrangements. One class was instructed in a homogeneous group and the other class was instructed in a cluster-group. The purpose of this case study was to explore the academic achievement of mathematically gifted fifth grade students when placed in a homogeneous or clustered arrangement. The homogeneous group received an accelerated and compacted curriculum whereas the cluster grouped received differentiated instruction within a mixed-ability classroom. Quantitative data for this case study included a pre- and post-test, used to examine the effects of grouping strategies. Analyses were performed using t-test models of regression. Qualitative information was collected through semi-structured interviews. For this study, the researcher interviewed the two participating teachers and the two principals of the target schools.
Chapter 4: Analysis of Data

The purposes of this mixed-methods case study were: (1) to decide if there is a variance in the academic achievement of mathematically gifted fifth grade students when receiving geometry instruction in cluster groups versus those instructed in homogeneous groups; and (2) to discover the processes administrators and teachers use when making grouping decisions about gifted students. “Mixed methods research provided strengths that offset the weaknesses of both quantitative and qualitative research” (Creswell & Plano-Clark, 2006, p. 9). Interviews allow the voices of participants to be heard which are not captured in quantitative research. Furthermore, “quantitative researchers are in the background, and their own personal biases and interpretations are seldom discussed. Qualitative research makes up for these weaknesses” (p. 9). A mixed method approach to this research study allowed the researcher to combine multiple forms of information and helped answers the comprehensive research question.

This study used two middle schools in a suburban Midwestern school district. Each middle school had one 5th grade cluster group; however, only one middle school contained a homogeneous group. Six to seven identified gifted students were assigned to each cluster group within their home school, resulting in a total population of 25 (n_c = 25). Cluster group one was located at setting one (described in Chapter 3) and contained seven students with an average intelligence quotient (IQ), as measured by the school district’s testing instrument, of 123. Cluster groups two, three, and four were located at setting two (described in Chapter 3) and each contained six 5th grade students. The average (IQ), as measured by the school district’s testing instrument, were reported as
118.5, 118.5, and 123.6 for cluster groups two, three, and four, respectively. The overall average IQ measure for all clustered students was reported as 121.

Many of the cluster students were placed on a waiting list for the homogeneous group due to not having enough availability (as discussed below). Although all cluster group student were identified with a specific academic ability in math, they were denied programming due to limited capacity and the unpopular matrices (as discussed below) used to place students. The remaining gifted students were assigned to their respective homogeneous classroom within their home school, resulting in a population of 25 students ($n_h = 25$). The homogeneous group received a compacted and accelerated curriculum that incorporated advanced content (i.e., above grade-level content) at an accelerated pace. The studied district’s Teaching and Learning Department selected the standards in collaboration with the participating teachers. The cluster group received differentiated instruction that focused on the same content standards as the students within the homogeneous classes. The students within the cluster arrangement were instructed on the same standards, but were grouped within a mixed-ability classroom. Cluster students received a differentiated instructional approach with use of choice board activities, independent studies, small group instruction, and station activities. Each teacher involved in this study received plans that addressed the specific content standards to be taught during this study. The participating teachers worked together to develop the unit of study and collaborated weekly during implementation. Participating teachers covered the same material within the same instructional time.
At the onset of the study, a pre-test was administered and after the six-week instructional period, a post-test was administered to determine which instructional group had the greatest academic gains. In addition to the quantitative data obtained from test scores, qualitative data was also obtained by interviewing the two participating teachers and two principals of the middle schools. The determine whether to accept or reject the research hypotheses, the researcher investigated the following questions:

**Question 1:** Is there a difference in the academic achievement of mathematically gifted fifth grade students who receive geometry instruction in cluster groups versus those instructed in homogeneous groups?

**Null Hypothesis 1:** There will be no difference between gifted fifth grade students’ mathematics achievement when grouped in homogeneous or cluster arrangements.

**Alternative Hypothesis 1:** There will be a difference between gifted fifth grade students’ mathematics achievement grouped in homogeneous versus cluster arrangements.

**Research Question 2:** What processes do administrators and teachers currently use in making grouping decisions of gifted students in the target district?

**Quantitative Research Tools**

The main instruments used to collect quantitative data were the pre- and post-tests. The researcher used the school district’s Instructional Information System (IIS) to form the pre- and post-tests. The questions appearing on the test were selected to align with the academic content standards as established by the State Department of Education.
Eleven questions per academic content standard appeared on the pre- and post-test resulting in a 44-question assessment.

Assessment is an important element of instructional design that enables [educators] to gauge what students are learning and provides information that can be used in designing more effective lessons. Pre- and post-tests are especially useful in that they can demonstrate the degree to which specific instructional strategies affect student learning (Bryan, & Karshmer, 2013, p. 574).

Different types of assessment are used by educators every day. Pre-assessments allow teachers to determine what skills have been learned by students and what skills still need to be taught. Post-assessments allow teachers to determine if the necessary skills have been learned after formal instruction. The use of a pre-test helped the researcher establish base line scores, thus determining the level of knowledge students knew prior to any form of instruction. Pre-tests can be compared to post-test results to determine if an educational setting or procedure produced certain outcomes (Bryan & Karshmer, 2013).

Pre- and post-test are considered “viable methods to assess the extent to which intervention has had an impact on student learning” (Newton, 1999, para. 1). Students come to each classroom with different skill and background sets, and teachers need to establish a base measure of knowledge and understanding of a topic for each student. This helps “quantify the extent of any changes in this knowledge by the end of a particular period of learning” (para. 3). “By comparing pre- and post-tests, teachers can see what students actually learned from the lessons that were developed” (Burr, 2010, p. 88). Pre-tests can help educators determine academic gaps thus drive instruction to
address these development gaps. A pre-test allowed the educator to determine what skills students still needed in order to understand the additional concepts. Alternatively, the post-test provided a measure of what students learned during the specific unit of study.

The post-test was used as a measure of achievement and mastery of the academic content standards identified for this research study. “[Post] test are…designed to provide teachers with diagnostic information and to assist school systems in identifying strengths and weaknesses to enable them to establish priorities in designing curriculum maps and pacing guides” (p. 89). The post-test used in this study helped the researcher determine what grouping option had the greatest impact on academic achievement as determined by gains in test scores.

Quantitative Data Analysis

The primary method this study utilized was the analysis of the pre- and post-test scores to determine if grouping mathematically gifted students in clusters arrangements or homogeneous arrangements results in different achievement. The researcher used the Statistical Program for the Social Sciences 22 (SPSS) to analyze the following data.

First, the researcher examined the descriptive and inferential statistics of the cluster group data alone through summary statistics collection, a dependent t-test, and a skewness and kurtosis analysis. Second, the researcher examined the descriptive and inferential statistics of the homogeneous group data alone, through the same statistical tests. These first and second data sets (a) presented the researcher with an overall view of the data; (b) allowed the researcher to find any irregularities or outliers within the data; (c) provided information about the achievement levels for each grouping strategy relevant
to the second qualitative research question; and (d) allowed the researcher to find issues related and tangential to the research questions to present for further study.

Third, the researcher examined the differences between the cluster group data and homogeneous group data for both the pre- and post-tests, using Levene’s Test for Equality Variances and independent t-test. Assessing differences in the pre-test data between the groups allowed the researcher to establish a baseline and determine if the groups were starting at different levels of achievement. Likewise, assessing differences in the post-test data between the groups allowed the researcher to determine if the groups ended at different levels of achievement. The third set of data, thus, helped the researcher answer the first, quantitative research question, based on the differences shown in the ending levels of achievement between the homogeneous and cluster groups.

The primary method of this study was analysis of the pre- and post-test scores to determine if grouping mathematically gifted student in cluster arrangements or homogeneous arrangement resulted in greater achievement. The pre-test data were analyzed by using a t-test, and the six-week post-test information were examined by conducting an independent t-test. The test scores collected were results from the 5th grade mathematics pre- and post-test assessments designed for the specific academic content standards addressed in the school’s geometry unit. The pre- and post-test assessment data helped answer the research question. The post-test used in this study helped the researcher determine what grouping options had the greatest academic achievement as determined by the gain in test score.
To determine if a significant difference exist between the cluster and homogeneous groups’ test scores, the Statistical Program for the Social Sciences 22 (SPSS) was used to explore the data. T-tests were performed to help declare if a statistical difference of the average scores of achievement exists between the cluster and homogeneous groups. The independent samples t-test helped “evaluate the mean difference between two populations using the data from two separate samples” (Gravetter & Wallnau, 2008, p. 307). In other words, the researcher used an independent t-test to decide is a significant difference exists between the cluster and homogeneous scores on the post-test. The purpose was to determine if a difference between the means existed between the achievement gains of the studied groups.

Outcomes of Testing Procedures

This section describes the outputs of certain descriptive statistics and results from independent and dependent t-tests. The researcher first conducted dependent t-test for the cluster and homogeneous groups followed by an independent t-test.

Cluster group data: Pre- and post-test descriptive statistics. The cluster group’s results for the pre- and post-tests can be found in Table 6, Figure1, Figure 2, and Figure 3. The mean percent correct for the pre-test was 46.00% while the mean score for the post-test was 61.63%. The median scores are reported as 47.72% and 63.63% for the pre- and post-test, respectively. The mode score for the cluster group pre-test is reported as 38.64% while the mode for the post-test increased to 63.64%. Student 10, the first student on the histogram (Figure 1), received the lowest score on the pre-test with 4% which increased to 64% on the post-test. Student 1 had the highest pre-test score of 75%
percent with an 82% percent post-test score. Students assigned to the cluster group demonstrated significant gains on the post-test (Aron, Aron, & Coups, 2011), which is illustrated in the dependent t-test shown in below in Table 9.

Table 6

**Descriptive Statistics for Cluster Group**

<table>
<thead>
<tr>
<th></th>
<th>Pre-Test Percent</th>
<th>Post-Test Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>46.0000</td>
<td>61.6364</td>
</tr>
<tr>
<td>Median</td>
<td>47.7273</td>
<td>63.6364</td>
</tr>
<tr>
<td>Mode</td>
<td>38.64a</td>
<td>63.64a</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>18.32660</td>
<td>12.86184</td>
</tr>
<tr>
<td>Range</td>
<td>65.91</td>
<td>68.18</td>
</tr>
</tbody>
</table>

*Note.* a. Multiple modes exist. The smallest value is shown.

*Figure 1.* Cluster group pre- and post-test scores.
**Figure 2.** Cluster group pre-test scores

**Figure 3.** Cluster group post-test scores.
Table 7 illustrates the skewness and kurtosis of the cluster groups pre-and post-test scores. I found most of the students’ scores were concentrated to the right of the mean with a left skewed distribution for both the pre-and post-tests as indicated with a -.297 and -2.223 skewness, respectively. According to Westfall (2014), kurtosis measures the peakedness of a distribution of scores. Higher values indicate a higher sharp peak as represented by the kurtosis of the cluster group’s post-test scores. The cluster group’s pre-test scores report a -.699 kurtosis which indicates a low degree of peakedness.

Data sets with high kurtosis values tend to have a peak around the mean, with the curve declining rapidly. Data sets with smaller kurtosis values have a flattened top around the mean. The narrower a distribution, the better the mean is as a predictor; and the broader a distribution (more variable the data), the less reliable the mean becomes. (Shirley, 2009 p. 16)

Table 7

<table>
<thead>
<tr>
<th>Cluster Group Skewness and Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Pre-Test Percent</td>
</tr>
<tr>
<td>Post-Test Percent</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
</tr>
</tbody>
</table>

Cluster group data: Dependent t-test. The cluster group showed significant differences in test scores when comparing the pre-and post-test data. Descriptive statistics along with dependent t-test results will help explain this conclusion. Table 8
displays the results of the dependent t-test for the cluster group, which compares the results of the pre- and post-test. Table 8 shows a strong positive correlation between each student’s pre- and post-test within the cluster group as shown by the 0.570 correlational value. This is indicative of a strong positive correlation between students’ tests scores with a significant value of 0.003 (p < .05). This can be significant because the post-test data is predicted by the pre-test data and therefore could be indicative of a weak instructional grouping arrangement. Curricular programs should not predict a student’s outcome based on pre-test data because this would negate the importance of instruction and/or grouping arrangements.

Table 8

<table>
<thead>
<tr>
<th>Pair</th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre- and Post-Test</td>
<td>25</td>
<td>.570</td>
<td>.003</td>
</tr>
</tbody>
</table>

*Note. p < .05*

The results of the dependent t-test shown in Table 9 indicates a statistically significant difference when comparing the cluster group’s pre- and post-test scores as shown by the p-value being less than the set alpha level (i.e., 0.000 < 0.05). Thus, students assigned to the cluster group demonstrated significant gains on the post-test (Aron, Aron, & Coups, 2011).
Table 9

*Paired Samples Test for Cluster Group*

<table>
<thead>
<tr>
<th>Pair</th>
<th>Pre- and Post Percent</th>
<th>Paired Differences</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-15.63</td>
<td>15.250</td>
<td>-21.93 - 9.34</td>
<td>-5.12</td>
<td>24</td>
<td>.000</td>
</tr>
</tbody>
</table>

*Note.* $p < .05$

**Descriptive statistics for homogeneous pre- and post-tests.** Descriptive statistics provide a clear overall picture of the collected data. The results of the pre- and post-tests for the homogeneous group can be found in Table 10, Figure 4, Figure 5, and Figure 6. The mean percent correct for the pre-test is 51.27%, while the mean score for the post-test is 73.63%. The median scores are reported as 54.54% and 72.72% for the pre- and post-test, respectively. The mode score for the homogeneous group pre-test is reported as 56.82%, while the mode for the post-test increased to 72.73%. Student 4 received the lowest pre-test score of 20% and a post-test score of 84%. Student 2 reported the highest pre-test score of 82% with a post-test score of 86%. The outcomes of the dependent t-test shown in Table 13 indicate a statistically significant difference with the homogeneous group’s pre- and post-test score. Thus, students in the homogeneous group showed significant gains between the pre- and post-test.
Table 10

Statistics for Homogeneous Group

<table>
<thead>
<tr>
<th></th>
<th>Pre-Test Percent</th>
<th>Post-Test Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>51.2727</td>
<td>73.6364</td>
</tr>
<tr>
<td>Median</td>
<td>54.5455</td>
<td>72.7273</td>
</tr>
<tr>
<td>Mode</td>
<td>56.82</td>
<td>72.73</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>15.13370</td>
<td>8.65429</td>
</tr>
</tbody>
</table>

Figure 4. Homogeneous group pre- and post-test scores.
Figure 5. Homogeneous group pre-test scores.

Figure 6. Homogeneous group post-test scores.
Kurtosis and skewness help provide an overview of the distribution of scores. Table 11 illustrates the skewness and kurtosis for the homogeneous groups pre- and post-test scores. Most of the students’ scores were concentrated to the right of the mean with a left skewed distribution of scores as made evidenced -.484 statistic. The post-test results for the homogeneous group are concentrated to the left of the mean with a right skewed distribution as indicated by the .225 statistic. Furthermore, the kurtosis values for both the pre- and post-test are close to 0, which indicates a shape close to normal. The kurtosis value for the pre-test is reported as .236 which is indicative of a slightly flatter than normal distribution. The post-test kurtosis value of -.144 is indicative of a slightly more peaked distribution.

Data sets with high kurtosis values tend to have a peak around the mean, with the curve declining rapidly. Data sets with smaller kurtosis values have a flattened top around the mean. The narrower a distribution, the better the mean is as a predictor; and the broader a distribution (more variable the data), the less reliable the mean becomes. (Shirley, 2009, p. 16)

Table 11

<table>
<thead>
<tr>
<th>Homogeneous Group Skewness and Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>Statistic</td>
</tr>
<tr>
<td>Statistic</td>
</tr>
<tr>
<td>Pre-Test Percent</td>
</tr>
<tr>
<td>Post-Test Percent</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
</tr>
</tbody>
</table>
Dependent t-test for homogeneous group. The homogeneous group showed significant differences in test scores when comparing the pre-and post-test data. Descriptive statistics along with dependent t-test results will help explain this conclusion. T-tests were performed for the data for the homogeneous group. Table 12 show the outputs of the dependent t-test for the homogeneous group which compares the results of the pre- and post-test.

Table 12 shows a weak-positive correlation between each student’s pre- and post-test results within the homogeneous group as shown by the 0.282 correlational values (Aron, Aron, & Coups, 2011). This indicates that there was not a strong correlation between student’s pre- and post-test scores with a significant value of 0.173. This is important to note because the pre-test data is not a good predictor of post-test data which could indicate that homogeneous grouping is better for instruction.

Table 12

<table>
<thead>
<tr>
<th>Paired Samples Correlations for Homogeneous Group</th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1 Pre- and Post-Test</td>
<td>25</td>
<td>.282</td>
<td>.173</td>
</tr>
</tbody>
</table>

Note. = p < .05

The results of the dependent t-test shown in Table 13 indicate a statistically significant difference in the homogeneous group’s pre- and post-test score because the p-value of 0.000 is less than the pre-determined alpha value of 0.05. Thus, students in the homogeneous group showed significant gains on the post-test. This is important because
it shows that when students are grouped homogeneously for instruction, greater achievement levels are obtained when compared to students in the cluster group.

Table 13

*Paired Samples Test*

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
</table>

*Note.* = $p < .05$

**Descriptive Statistic for Cluster and Homogeneous Groups**

Overall, the homogeneous group obtained a greater average on the post-test than the cluster group. Table 14 compares the mean score for each group (i.e., cluster and homogeneous). The mean score for the pre-test was 46% and 51% for the cluster and homogeneous groups, respectively while the post-test mean scores were 62% and 74% for the cluster and homogeneous groups, respectively. “The standard deviation is a numerical index of variability of the dispersion of data around the mean, and is the prevalent measure of variability” (Shirley, 2009, p. 18). The standard deviation for the cluster and homogeneous groups pre-test are reported as 18.32660 and 15.13370,
respectively. Furthermore, the standard deviation for the cluster and homogeneous groups post-test are reported as 12.86184 and 8.65429, respectively.

Table 14

*Means and Standard Deviation of Cluster and Homogeneous Scores*

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Test</th>
<th>Post-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster</td>
<td>Mean</td>
<td>46.0000</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>18.32660</td>
</tr>
<tr>
<td>Homogeneous</td>
<td>Mean</td>
<td>51.2727</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>15.13370</td>
</tr>
<tr>
<td>Total</td>
<td>Mean</td>
<td>48.6364</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>16.84561</td>
</tr>
</tbody>
</table>

Figure 7 shows the mean scores for the four cluster groups and the homogeneous group. The blue line shows cluster group one which was at setting one. The green, orange, and purple lines show cluster groups two, three, and four all of which were at setting two. Lastly the yellow line shows the homogeneous group which was at setting one. The graphs shows the groups average pre-test score and then plots the groups average post-test score.
Figure 7. Estimated marginal mean.

**Independent t-test for Homogeneous and Cluster Groups**

The two groups started out at a similar baseline measures, however, the scores from the post-test indicates a statistically significant difference between the groups. To assist with answering the first question, the researcher used an independent t-test to determine if a differences between the cluster and homogeneous group achievement scores could be observed. Before doing so, the researcher conducted Levene’s Test for Equality of Variances to determine the validity of the independent t-test itself.

Levene’s Test assesses whether there is a significant difference amongst the variances of different data sets, in this case between the variances of the homogeneous and cluster groups’ data. The third and fourth columns of Table 15 show the results of Levene’s Test. Because both significance levels (0.140 and 0.495) are greater than the alpha value of 0.05, there is not enough evidence to show that there is a difference
between the variances in either the pre- or post-tests. The researcher may, thus, conclude that an independent t-test is valid.
Table 15

**Independent Samples Test For Percents**

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Pre-Test Percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances not</td>
<td></td>
<td></td>
</tr>
<tr>
<td>assumed</td>
<td>-1.109</td>
<td>46.342</td>
</tr>
<tr>
<td>Post-Test Percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variance not</td>
<td></td>
<td></td>
</tr>
<tr>
<td>assumed</td>
<td>-3.870</td>
<td>42.035</td>
</tr>
</tbody>
</table>

*Note. = p < .05*
Pre-test results. The outputs of the independent t-test for the pre-test results demonstrate that there is no significant difference between the cluster group and homogeneous group baseline. This is true because the significance level of 0.273 is greater than the alpha level of 0.05; likewise, the t-value of 1.109 is below the critical value of 2.0106. This is not sufficient evidence to suggest the baseline scores were different. This is important because this test indicates that both groups have a similar baseline or starting point.

Post-test results. The outputs of the independent t-test for the post-test results demonstrate that there is a significant difference between the cluster group and homogeneous group achievement levels. This is true because the significance level of .000 is less than the alpha level of 0.05; similarly, the t-value of 3.870 is greater than the critical value of 2.0106. Because there is sufficient evidence to reject the null hypothesis of no difference between the groups, the research rejects this hypothesis and concludes that there is a difference between the cluster and homogeneous groups’ achievement levels. This result is important because it shows that the homogeneous group’s achievement on the post-test was significantly greater than the cluster arrangement.

Effect Size

When comparing the mean difference for the post-test for each group a Cohen’s D effect size of 1.09471 was obtained. Effect size is often reported in research studies to express the difference between two or more groups and the effect of a treatment. Cohen (1988) described the following effect sizes with a corresponding value: small 0.2,
medium 0.5, and large 0.8. “[Effect size] is particularly valuable for quantifying the effectiveness of a particular intervention, relative to some comparison” (Coe, 2002, p. 1)

**Summary**

To help answer the research question, the research obtained descriptive and inferential statistics. The results of two different dependent t-tests indicate a statistically significant difference between the cluster group’s pre- and post-test scores and a statistically significant difference between the pre- and post-test scores within the homogeneous group. In addition, the independent t-test for the homogeneous and cluster groups confirm a statistically significant difference between each group’s post-test, but not the pre-test. This suggests that the homogeneous group performed better on the assessment when compared to the cluster group.

**Qualitative Research Tools**

When conducting qualitative research, the researcher becomes the tool by asking questions, collecting data, and making interpretations from the collected data (Johnson & Christensen, 2012). Semi-structured interviews were the primary method used to collect qualitative data for this research study. The interviews took place during the time the teachers taught the geometry unit and lasted approximately 60 minutes each. Interviews with the two principals and two participating teachers helped answer the second research question. All participants provided in-depth answers during a semi-structured interview process, which helped clarify the instructional strategies and grouping methods used in the studied school.
Qualitative Data Analysis

To help answer the second research question, the researcher analyzed the qualitative data by looking for major themes. The following three themes were identified: Current Grouping System and its Challenges; Benefits of the Existing System; Improvements to the Current System. First, the researcher will discuss sub-themes related to the current grouping system and challenges associated with it. Second, the researcher will discuss sub-themes related to the current system’s benefits that should remain. Third, the researcher will discuss sub-themes related to the ways participants hope to improve the current system. In discussing the first theme - the current grouping system and its challenges - the researcher identified three sub-themes:

- Principals and teachers make grouping decisions using an arbitrary matrix (i.e. achievement scores, IQ data, etc.) of data with which they are unfamiliar
- Some students who qualify for gifted programming receive inadequate services.
- Teachers do not have enough instructional time to provide direct instruction to the students in cluster-groups.

In discussing the second theme – the current system’s benefits – the researcher identified three sub-themes:

- Accelerated, compacted curriculum provides academic benefit for gifted students.
- Parents care about service options for gifted children.
- Homogeneous grouping has a positive effect for gifted and typical learners.

Finally, the researcher identified three sub-themes with respect to the third theme – possible improvements to the current system:
• Gifted students would benefit academically if they were grouped homogeneously.
• Principals should have more autonomy in making grouping decisions, and students would benefit from a more-defined set of requirements for gifted identification.
• Gifted teachers should be flexible, understanding, and exhibit risk-taking.

Current Grouping System and its Challenges

Based on interviews with principals and teachers, the current grouping system appears to present challenges. One of the key sub-theme is that principals and teachers make grouping decisions using an arbitrary matrix of data with which they are unfamiliar. Shelly noted that “it seems like some of the kids that are identified … gifted are just kind of sprinkled into the other classrooms.” Kelly agreed, arguing that the “magic formula in the matrix” makes it such that “some kids are left out that should be in the homogeneous group, and some kids are assigned to the homogeneous group that maybe shouldn’t be.” Therefore, it was the perception of participants that some of the grouping decisions are made arbitrarily and some students are not receiving the services they should be receiving due to misidentification and improper placement.

Adding to these challenges the second key sub-theme emerged. Some students who qualify for gifted programming receive inadequate services. As the system is currently designed, the three middle schools assign students to the gifted program based on the number of students being served at the elementary level, each with a maximum capacity of 15 gifted students. This results in some gifted students who actually meet the criteria are not being served at the middle school level in the homogeneous group, thus
forming the cluster groups and waiting list for gifted services. According Katie, principal at setting 1, “We have gifted kids that are in regular ed[ucation] classrooms that would get a lot more if they were all together, but we do not have that programming, adding that they “cannot speak with confidence [gifted students] are getting what they need.”

Likewise, Kelly said parents raise concerns about their children not receiving the proper services: “We have parents year after year ask for their kid to get tested…we basically said your kid qualifies but we are full.” In this study, teachers and principals suggested they do not have adequate programming or space indicating that some gifted students are receiving inadequate services.

A final challenge for educators and students is that educators do not have enough instructional time to provide direct instruction to the students in cluster-groups. One teacher noted that, theoretically, cluster grouping allows teachers to “pull these students” and differentiate assignments. However, the same teacher indicated that “there is not enough time to prep for all of the groups. It is like prepping for three groups in one class.” Therefore, teachers need additional time to work one-on-one with the cluster group as well as additional time and resources to prep for the varying abilities in one classroom in order to provide the necessary instruction for gifted students within a cluster group. One principal added that using a co-teaching model similar to inclusion would help ease the cluster delivery model. “[It would help] if we had a gifted specialist that could come into the classroom that could work with the students and the teacher.”
**Benefits of the Existing System**

The second major theme emerging from the data consists of benefits related to the existing system. Three sub-themes were identified. The first was that participants believe gifted students need and deserve an accelerated and compacted curriculum. Curriculum compaction meets the demands of the gifted learner by providing them with above-grade level content and learning at a faster pace. Katie stated, “[Gifted students] should receive a specialized program because they have different needs than regular education and special education students.” Implementing curriculum modifications for gifted learners allows them to be taught at a faster, accelerated pace. This approach allows gifted students to experience additional curriculum topics and skip formal instruction on topics already mastered. The other principal, Holly, argued that if gifted students have already shown mastery of their current grade level, then they should be exposed to the next grade level curriculum and should not still be receiving grade level material they have accomplished. This research study along with Kulik (1992); Kulik and Kulik (1987) show that when gifted students are provided accelerated opportunities, there are clear benefits. Ability grouping combined with acceleration are important components of any gifted program (Kulik 1992; Kulik & Kulik, 1987).

The second key sub-theme was that parents of students in the studied district care about the services provided to their gifted child. One teacher contends that parents would prefer to see their child assigned to the homogeneous group indicating, “…They want their kids in a homogeneous gifted group. I think they feel better when there are several [gifted students]…together.” However, in contrast, Katie stated that “[I] think if parents
see their kid as gifted they want that gifted programming. As long as they have gifted programming, I do not think they care how they are grouped.” While grouping may not be a pressing issue for parents, the service option seems to be. One principal argued that parents are not happy when their children get put on a waiting list while other parents press for additional testing opportunities. “[Parents] want that label of my kid is gifted, my kid attends the gifted class.” Thus, parents seem to care about the gifted options for their kids.

A third key sub-theme for this theme (benefits to the existing system) was that principals and teachers alike agree that homogeneous grouping benefits both gifted and typically developing students. Proponents for placing gifted students in homogeneous settings argue this structure efficiently addresses the varying achievement needs of gifted students (NASSP, 2006). One principal, Katie, argued, “Gifted students should be grouped for academic instruction they should be with like-minded peers because of their ability.” When a student who is gifted is placed in a homogeneous setting with other gifted students, motivation to learn increases. Some proponents of grouping argue that ability grouping allows the teacher to focus more on their daily lessons, rather than designing multiple lessons to cover varying levels of academic readiness (NAASP, 2006). In line with the quantitative results of this study, homogeneous grouping has a positive effect for gifted and typical learners. When gifted and talented learners are grouped during instruction, the curriculum can easily be accelerated and compacted to meet their learning demands. Holly declared “[A teacher] can accelerated the curriculum, [the teacher] can provide a completely different depth of questioning that the typical and
lower students would not respond to.” When gifted learners are assigned to work with like-minded peers, they provide a natural motivation and help drive each other’s learning.

   Overall, teachers and principals believed homogeneous grouping allows the teacher to concentrate on certain ability groups while providing students with the necessary challenge. The participants also agreed that cluster grouping highlights difference among peers because only a small percentage of student are provided a modified and/or differentiated curriculum. One teacher argued, “I think the regular education students [placed in the cluster group]…get jealous sometimes…they notice that these kids [gifted students] get different assignments or these kids get pulled out every once in a while to learn something different.”

**Improvements to the Current System**

Finally, the data revealed four sub-themes with respect to the third theme, of possible improvements to the current system. Teachers and principals agreed that gifted students benefit when grouped homogeneously as previously discussed. Eliminating the cluster model and expanding the homogeneous model could make improvements to the current system. One teacher, Shelly, reported, “I think [with] homogeneous grouping we can have a whole group discussion and everyone is on the same page and you are not trying to think what problems did I give this group and what problems did I give that group?”

Kelly agreed by stating, “There are huge challenges to delivering instruction in cluster arrangements. [The teacher can] feel pulled in three directions because you truly have three separate groups of students. You have students that need lots of help and
support and intervention. Then you have your typical students that can follow the pace and understand most of what you are doing, and then you have your gifted students that are bored and really need the acceleration but it’s hard to be with all three groups at the same time and not feel like you are leaving some of the kids out.” Grouping gifted students together for instruction seems to result in the LRE. Grouping provides a place where gifted learners can work together and build on the strengths of their group and allow group members the ability to work on challenging coursework at an advanced level (NAGC, 2009).

In the studied district, principals argued for more autonomy when placing gifted children in groups. “We have gifted kids that are in regular ed[ucation] classrooms that would get a lot more if they were all together, but we do not have that programming. One participant indicated, “As a principal, I do not really have the authority to make those decisions.” Principals face scheduling conflicts when trying to place gifted students into classrooms. According to the teacher contract, no more than 28 students can be assigned to a classroom, which forces the school to create a waiting list for the homogeneous group. If principals were provided more autonomy or perhaps the eligibility requirements were strengthened or modified, this problem would not exist.

In fact, the principals agree that a more defined programming option is needed within the district. The suggestion for a more specific program is the next key sub-theme identified in the data. Students would benefit from a more-defined set of requirements for gifted identification. One principal argued for a more consistent set of guidelines and expectations: “There should be standards and we should stick to those standards no
matter who you are.” Program requirements should not be bent even with parental pressure. This type of system is necessary to ensure program fidelity.

Lastly, participants indicated the teacher of the gifted and talented must be flexible, understanding, and willing to take risks. Teaching the gifted and talented can be exhausting work: Katie, principal at setting 1, mentioned “Teaching gifted kids is extremely difficult and you have to be able to be confident in how you teach and what you teach and differentiate your instruction.” Teachers must have knowledge of the gifted child and be open to a variety of instructional strategies. “[Teachers] have to be open to a variety of learning and teaching strategies. [Teachers] have to…go with the flow in the classroom. If students show an interest in an area that maybe just a little off topic, you have to be willing to be more of a guide and allow them to explore their learning.” To successfully address the psychological and social and emotional needs of gifted and high achieving learners, teachers must develop nurturing and positive environments for student learning. The teacher is key when developing a supportive environment so gifted students can grow academically and socially (Hunt & Seney, 2009). Teachers must allow gifted learners to express their own unique talents and embrace their gifts, however, also address their social and emotional needs. When gifted learners are assigned in cluster and/or homogeneous groups, their social and emotional development must also be considered. One teacher stated, “They [gifted students] can get into a little bubble where they do not really see, the real-world aspect, different types of people and learners and how to respect and handle the differences.” It becomes the school’s responsibility to not
only teach the gifted student academic concepts, but also how to interact socially and
develop into culturally responsible citizens.

**Summary**

There are some existing conditions of the current system that both teachers and
principals would like to see continue; however, there are areas in the current
programming model that need improvement. All participants agree that a specialized
curriculum is needed for gifted students and grouping options can be beneficial. The most
significant issues presented by the school administrators include how students are
grouped and the inconsistency across the district. The studied school district uses a
cluster and homogeneous arrangement, and principals are not provided the autonomy and
flexibility of how to group these students. The teacher contract has put some limitations
on grouping arrangements and parental influence seems to have an effect. Both teachers
cite instructional time as the biggest culprit and disadvantages to delivery instruction
within a cluster arrangement. They also feel that grouping gifted students within a cluster
arrangement highlights differences more so than grouping homogeneously because only a
small percentage of students receive enrichment. It is consensus among participating
teachers and principals that grouping gifted students in a homogeneous way for
instruction eases instructional pressures. Additional conclusions will be made in chapter 5
of this research study.
Chapter 5: Findings and Conclusions

“Education policy in recent decades has been focused primarily on ensuring that all children — especially poor and minority children — attain at least a minimum level of academic achievement” (Finn, 2014, p. 50). Educators, administrators, and policy makers attempt to close achievement gaps to “ensure equal opportunity through education, however, many of the country’s most talented young people—rich and poor alike—are left unable to surge ahead, languishing in classes geared toward universal but modest proficiency” (Finn, 2014, p. 50). The purpose of this case study was to explore a current practice in one school district and distinguish how grouping strategies used for gifted students affect achievement. This section starts with a summary of the research study, preceded with the outcomes of the study, and then a discussion for further action and research.

Research Overview

According to Adam-Byers, Squiller-Whitsell, and Moon (2004), grouping gifted learners in homogeneously versus heterogeneously classroom for learning has received mixed reviews for many years. “Supporters of mixed ability grouping believe it provides gifted students with social development benefits for gifted students while providing less able students with increasing motivation, self-esteem, leadership opportunities, and academic benefits” (p. 8). Those with an democratic viewpoint often argue against grouping the gifted because they believe it creates a group of elitist students and also believe gifted students can service themselves without a specialist form of instruction (Adam-Byers et al., 2004). Egalitarians also believe that other students suffer
academically when high-able students are removed from the regular education classroom because they can provide the mental stimulation and academic competition (Adam-Byers et al., 2004). Others believe that grouping the gifted provides them with the necessary academic and social/emotional benefits they cannot receive in a mixed-ability classroom. Proponents of homogeneous grouping challenge the “idea that less advanced students are negatively affected by the absence of highly able classmate models, citing research that indicates individuals model themselves after people they perceive to be similar ability, not those they believe to possess more advanced abilities” (Adam-Byers et al., 2004, p. 8). When highly able students are removed from the regular education classroom, less-able students have the opportunity to rise to the top and take on more leadership roles (Adam-Byers et al., 2004).

Homogeneous grouping is an option for providing gifted students an experience that meets their academic and emotional needs.

According to Miller (2011) homogeneous teams will only work, however, in a middle school environment where the school is large enough to support at least three teams, one being the honors team. Homogeneous teaming allows middle school teachers with core content knowledge the opportunity to work in depth with gifted students in the teacher’s content area. These teachers need to be trained in strategies that may be effective when working with a gifted adolescent. (p. 62)

Homogeneous grouping allows students to receive instruction with like-minded peers while being part of a regular middle school environment. Gifted students placed on a
team within a homogeneous group have the opportunity to participate in in-school activities yet remain separate for instruction. This seems to be the best way to service the gifted students academically, socially, and emotionally (Miller, 2011). One principal in the current study stated,

Gifted students should be grouped for academic instruction. They should be with like-minded peers because of their ability. For other situations they need to be grouped with all peers. Because we also know that gifted students also need to work on social interactions and that sort of thing, so they also need to be with typical peers in those social environment[s].

Gifted students do not necessarily need additional money spent on their schooling, but rather the opportunity to learn at a pace that meets their needs (Finn, 2014). This will require school districts and school leaders to form classrooms and programs at the elementary and middle levels and offer additional higher level, honors and Advanced Placement opportunities at the high school level (i.e. grades 9 – 12) (Finn, 2014).

In our effort to leave no child behind, we are failing the high-ability children who are the most likely to become tomorrow’s scientists, inventors, poets, and entrepreneurs — and in the process we risk leaving our nation behind. This failure is due more to ideology, political correctness, distorted priorities, and fallacious theories of education, than it is to scarce resources, as many administrators and politicians would have us believe. (Finn, 2014, p. 50)
Results from the Study

There is ongoing controversy about the best type of programming for gifted students in the studied district. The interviewed participants all agree that a consistent program needs to be put in place. Overall, the participants agree that homogeneous grouping helps ease instruction and allows gifted students to be placed with like-minded peers; however, concerns about social and emotional development were shared among some participants. These sentiments are expressed well by one quote from one of this study’s participants.

…[gifted students] should receive a specialized program because they have different needs than regular education and special education students. And the goal of education is to meet the needs of every student…For academic time, they would be together.

Grouping arrangements for school principals have proven to be difficult. Both principals interviewed acknowledged the academic benefits of grouping the gifted in certain arrangements and agreed both types of arrangements can be successful if prepared correctly, however, both acknowledge that homogeneous grouping is easier for scheduling and instruction purposes. The following section discusses the conclusion of the quantitative and qualitative information retrieved from this case study. This case study addressed two questions during this investigation.
Research Question 1

Is there a difference in the academic achievement of mathematically gifted fifth grade students who receive geometry instruction in cluster groups and those instructed in homogeneous groups?

The quantitative data indicated that homogeneously-grouped students outperformed students in cluster arrangements. The researcher concluded this because while the students started at a similar level of achievement on the pre-test, students in homogeneous groups achieved statistically significant higher scores than the cluster-group students on the post-test.

Given the mixed results of the current literature, the researcher started with the assumption that there would be no difference in the achievement between the cluster and homogeneous groups. Statistically, the researcher aligned the null hypothesis (H₀) with this assumption and conducted an independent t-test to determine whether to accept or reject the null hypothesis.

To observe whether the null hypothesis could be rejected or accepted, alpha values were established at 0.05, which provides the probability of a statistical difference. This means that the conclusion can be made with 95 percent confidence. The results shown in table 15 from the independent t-test confirms there was no significant difference between the cluster and homogeneous groups’ assessment results on the pre-test. This suggests that both groups started out statistically equal to each other, confirming the assumption that both groups began at equivalent levels. The results of the independent t-test also indicate a significant difference in assessments scores when
Comparing the results of the post-test. This means students assigned to the homogeneous groups showed statistically significant greater achievement on the post-test when compared to the students assigned to the cluster groups. As a result, the $H_0$ can be rejected while $H_a$ can be accepted because of the statistically significant difference in post-test score of the two studied groups. Overall, the students assigned to the homogeneous group showed greater achievement on the post-test. “Researchers are aware that grouping students by prior knowledge may result in moderate gains in intermediate grade students' mathematics achievement” (Tieso & Margison, 2004, p. 236). Holloway (2003), Kettler, (2011), Kulik (1992), Loveless (1998) and Rogers (1993) all report that gifted students have significantly higher achievement when placed in homogeneous settings.

**Research Question 2**

What processes do administrators and teachers currently use in making grouping decisions of gifted students in the target district?

It was a consensus among the studied teachers and principals that gifted students should be grouped in some manner during instruction. Both teacher participants see the academic and instructional benefit of grouping students in homogeneous groups. These teachers identified time as the biggest challenge when instructing in cluster arrangements and students are left out because there is not enough time to reach all levels of students within a cluster arrangement. Similarly, with inclusion/co-teaching of students qualifying for special education services, having a gifted specialist assigned to the cluster group would help ease the pressure of reaching all levels in one class. Grouping gifted students
together for instruction provides the opportunity for them to work with like-minded students (Miller, 2011; Van-Tassel-Baska, 1992). Grouping in a cluster arrangement seems to highlight differences among typical and gifted peers because only a small percentage of students within a cluster arrangement receive enrichment services.

Teachers expressed concern about providing too many variations of one assignment as this minimizes the typical and lower achieving students’ self-confidence. Clustering also limits students’ partnerships within the classroom. It was noted that gifted students often get frustrated when paired or partnered with typical or low achieving students, and the option for like-minded peers is limited within a cluster arrangement. A Colman and Nelson (2009) study confirm this by stating, “High achieving students … were more concerned about the learning skills involved in group investigations than were their low-achieving counterparts” (p. 568). When cooperative learning (CL) is frequently used in a mixed ability classroom, gifted students get frustrated and become anxious (Huss, 2006; Mills & Durden, 1992; Nelson, 1995; Robinson, 1991). In general, both teachers and administrators agree that gifted students should be grouped homogeneously for mathematics instruction.

The study principals argued for more flexibility and autonomy when assigning gifted students to any sort of grouping arrangements. The teacher contract and the class cap of 28 students seem to be a significant barrier to this problem. The principals suggested a more clearly defined programming model and strict criteria be established for certain grouping arrangements. Both principals contend that they have limited control over how gifted students are assigned to classrooms. One principal mentioned a wait list
that is prepared for students to get in the homogeneous group. This practice appears to be withholding qualified students from entering the program and may need to be eliminated.

All four participants believe gifted students should be provided with an accelerated and/or specialized curriculum. It is not sufficient for gifted students to be exposed to a basic general curriculum and it ultimately becomes the responsibility of the school district to define and adopt course of study that addresses the needs of their gifted population. Both teachers believe that mathematically gifted students can handle an accelerated and compacted curriculum but are convinced that it is easier to deliver this type of instruction within a homogeneous arrangement. This viewpoint is supported by Horne (2003),

For many gifted students, acceleration is fulfilling both academically and socially. However, to be successful, acceleration must be understood as a program decision, not a placement decision. The curriculum must continue to be challenging for the accelerated student. In case studies of successfully accelerated students, subject matter was carefully planned and monitored, and it addressed the students’ social and emotional maturity as well as academic achievement. (p. 2)

One principal indicated that an accelerated curriculum allows gifted students to achieve their potential rather than sit in a classroom with materials that have already been mastered. The studied district uses an accelerated curriculum and has the pacing guide and unit plans available for teacher usage.

The general idea expressed by all participants is that educators that are assigned to teach gifted and talented must be flexible and willing to take risks. In the past, many
teachers in the studied district expressed the desire to work with gifted and talented learners because gifted learners are perceived as easier to teach. Now that the state has set a standard and accountability measures related to providing services for gifted students are included on the school district annual report card, many teachers have decided not to teach gifted students. The studied district recently received a D rating on the latest report card for gifted academic growth/progress. This means that the highest-achieving students in the district are not growing at one-year increments. With an accelerated curriculum in place, gifted students should be making more than one year’s growth during the academic year. To increase academic growth, principals and school leaders must carefully select a teacher who meets the needs of gifted students. Grouping options can also help minimize the challenges of selecting the right teacher. As one principal in this study indicated,

There is a certain type of teacher that is really good with gifted kids, there is a certain type of teacher that is really good with regular education kids, and there are certain type of teachers that are really good for special education kids.

Teaching to me is about the fit of a child [and I must assign teachers carefully and systematically].

Educators of the gifted need to understand the exceptionalities of gifted learners and be able to help them become socially and emotionally comfortable.

Hunt and Seney (2009) support this theme by arguing that teachers must develop and nurture the psychological and social emotional needs of gifted learners. An effective educator for the gifted becomes the facilitator and disseminator of knowledge. The teacher builds a nonthreatening environment that includes a “harmonious relationship
among the students, where all feel accepted and are encouraged to work together, help one another and learn from each other” (Hunt & Seney, p. 46).

According to the teachers and principals, parents in the studied district appear to really care if their students received services. One principal indicated that parental pressure may decide how students are grouped for instruction. The other principal seemed to believe that parents just want their children served and grouping does not seem to matter. Based on the results of this case study, participants believe that parents are somewhat satisfied with cluster grouping but would prefer their students to be in homogeneous arrangements. One middle school started a waiting list, and if a student withdrew from the homogeneous group, the next student on the waiting list would be scheduled in. This seems to be an inexplicable practice that perhaps should be avoided. It seems that there would be no need for a waiting list if two homogeneous groups could easily be formed.

The general consensus from all participants is that teachers and gifted students benefit from being academically grouped in some manner. Based on the findings, the two participating principals and two participating teachers all prefer homogeneous grouping during instruction because they believe gifted learners need to be provided the chance to learn in an environment with like-minded peers. Homogeneous grouping seems to have a positive effect for both typical and gifted students. When grouped homogeneously, typical students have the occasion to be the top of the class within their regular education classroom. According to Archambault, Hallmark, and Kenny (1995) when students are
grouped homogeneously for instruction “academic self-esteem improved for both gifted and non-gifted students, but more for non-gifted students” (p. xiv).

Meanwhile, based the findings of this study, the fast pace and/or arrogance of a gifted students did not seem to frustrate other students assigned to the cluster group. The major challenge and/or constraints mentioned by many participants were the social and emotional aspects of gifted learners. This is compounded when gifted learners are not taught how to deal with all types of individuals including students with disabilities. The curriculum for a homogeneous gifted group must then embed character development or provide an opportunity for these students to work with similarly situated (i.e., social and emotional, aptitude, etc.) students during non-instructional times. Gifted students are often interested in social issues and seem to want to view the world through a lens of fairness. Encouraging gifted learner to explore moral situation and character issues could “enrich the curriculum through topics that typically are of natural interest to students” (Berkowitz, & Hoppe, 2009). Additional discussion about the social and emotional well-being of the gifted learner can proceed the above mentioned activities.

**Implications**

Schools face the incredible challenge of educating all learners regardless of ethnicity, race, ability, and/or disability (Finn, 2014). It becomes their duty to provide an education that satisfies every student’s academic and social needs (Finn, 2014). “Getting onto the right educational path early is vital in today’s demanding global economy, but doing so requires guidance from someone knowledgeable and determined, whether at home or at school” (Finn, 2014, p. 54). Homogeneous grouping allows content teachers
to provide the rich, challenging, rigorous level of instruction that is demanded by gifted students. School districts must use data to make decisions about how to best serve their gifted students. In the studied district, this research indicates gifted students are better served in homogeneous arrangements unless cluster groups are more carefully developed. The results of this study indicate that the studied district should put more focus on how gifted students are grouped during instruction and strengthen the eligibility requirements.

Many educators believe that gifted students have the ability to accomplish success on their own. Contrary to this widely-held belief, “Although gifted students possess exceptional capabilities, most cannot excel without assistance” (Webb, Meckstroth, & Tolan, 1982, p. 10). This means schools must create academic courses that address the needs of gifted learners and schools should provide them with assistance during the process. According to this study, it is not enough just to group students with like-minded individuals, gifted students also need the opportunity to express their gifts with a curriculum that possesses challenge and demands students to stretch their thinking. “They need assistance academically, but they also need assistance emotionally through understanding, acceptance, support and encouragement” (Webb et al., p. 10). The literature shows that grouping gifted students together provides a social network and allows them to collaborate with like-minded peers (Webb et al.). When isolated in mixed-ability classrooms, gifted students can feel ostracized and start to withdraw due to academic, social, and emotional boredom.

Like all other students with special needs, gifted children require instructional adaptation to encourage full nurturance of their potential. The adaptation stems
from their educational needs as exceptional learners. To meet the advanced thinking abilities of gifted students, differentiated educational programs should encourage the development of higher level cognitive processes. If these needs are not met in the classroom, performance suffers and the risk for emotional distress, maladjustment and isolation from peers increases. (Yewchuk, 2012, para. 22)

Based on the findings and supported by theory, the studied district has many issues that need to be corrected. The primary concern is the lack of autonomy given to principals and inconsistency of grouping arrangements. Another consistent problem mentioned by participants was the length of time students spend waiting to be accepted into the gifted program.

Far more fashionable in education today is the concept of differentiated instruction, in which—in theory—every teacher instructs every student at his appropriate level of ability and prior achievement, all within the same classroom. This approach is understandably appealing in the abstract as both equitable and individualized. In practice, however, it is rare to find a teacher who can pull it off with 20 or 30 kids of widely differing levels of interest, aptitude, behavior, and previous learning (Finn, 2014, p. 57). This problem could be solved with separate schools for the gifted. Unable to reach every student at his present level, American instructors are likely to compromise by focusing on [low achieving] and middling students, leaving the brightest students to fend for themselves. (Finn, 2014, p. 57)
The studied school district should closely examine its current practice and make adjustments as necessary. According to the results of this case study, there are many key elements that enhance the system and others that need to be replaced. This case study sought to help school leaders critically analyze current procedures used for grouping students and to allow them to make informed decisions about instructional grouping practices currently in place.

**Recommendations for Action**

“Academic achievement and learning progress depend on the fit of the learning environment to the specific abilities and needs of the individual learner. The most prominent characteristic of the gifted is their high cognitive ability” (Vogl & Preckel, 2014, p. 51). Research on certain grouping strategies is well documented and findings from this case study reaffirm the present literature. Based on the data collected during this mixed-methods research study, it is recommended that school administrators (a) closely examine their current grouping practices; and (b) provide an accelerated and compacted curriculum for mathematically gifted students with proper professional development for teachers. Teachers acknowledge the academic and instructional benefit of grouping students in homogeneous arrangements and feel the delivery of instruction is easier. Teachers feel that time is the biggest challenge when instructing in cluster arrangements and gifted students often do not receive enrichment because there is not enough time to reach all levels of students within a cluster arrangement.

The results of this study indicate gifted students achieved at a significantly higher level when grouped homogeneously rather than assigned to cluster arrangements. It was
the consensus among teachers and principals in the district that gifted students should be
grouped in some manner during instruction. Additionally, school leaders must provide
professional development to educators to help them successfully instruct students within
any type of grouping arrangement. Teachers need to receive proper professional
development on differentiated strategies that are effective for the gifted learner.

Other findings support that differentiation is needed to address the readiness of
gifted students within each classroom. When school districts develop a gifted
programming model, it is important to not only examine the grouping strategy, but also
the curriculum within the program. Curriculum compaction and acceleration should be
considered factors when developing a gifted program. Acceleration is a form of
differentiation that can help raise the achievement level of gifted learners. NAGC (1994)
has suggested the provision of providing rigorous learning opportunities for gifted
children through differentiation that includes “acceleration of instruction, a high degree
of complexity, advanced content, and/or variety in content and form” (para. 4).

Differentiation in the form of acceleration can have great effects on gifted
students. Combining acceleration and grouping options results in a greater effect on
student achievement. “Grouping gifted children is one of the foundations of exemplary
practices fall into two general categories: those strategies that gather children of similar
potential or ability together (“ability grouping options”) and those strategies that gather
children of similar performance or achievement levels together…” (para. 3). Based on the
finding of this case study, educators prefer homogeneous grouping arrangements due to
the ability to deliver accelerated instruction at ease. Although this study examined grouping options, additional research and further action could add to the findings of this case study.

**Recommendation for Further Action and Research**

One of the major issues regarding full-time ability grouping is the social and emotional well-being of the gifted learner. “In gifted education, the process of transforming abilities into exceptional achievements requires psychosocial strength of students. In general, a positive socio-emotional development is related to cognitive outcomes in various ways” (Vogl, & Preckel, 2014, p. 51). Additional research on the social and emotional effect of grouping gifted learners when assigned to different grouping arrangements would add depth to the results of this study. Niehart (2007) argues …that grade skipping, early school entrance, and early admission to college have socioaffective benefits for gifted students who are selected on the basis of demonstrated academic, social, and emotional maturity, but may be harmful to unselected students who are arbitrarily accelerated on the basis of IQ, achievement, or social maturity. There is little research on the socio-affective effects of peer ability grouping. (p. 330)

Additional studies on the effect of learners not assigned to the homogeneous or cluster classes could also add to the limited data.

A continuation of this study to determine whether the teacher had an effect on student achievement would provide additional information about the validity of this study’s results. Creating a longitudinal study to follow the teachers could provide this
useful data. Additionally, further research regarding other areas of content-specific gifted identification could add to the paucity of research on other specific academic abilities (i.e., science, social studies, and/or reading). Likewise creating a study to determine the effect of removing the top performing students from the regular education class would provide support for school district programming decisions. Additional studies controlling for other exceptionalities could also be considered along with enlarging the study to see if findings hold true across grade levels and across districts. A researcher may also consider a longitudinal study that explores a longer instructional period and/or different units of study.

**Conclusion**

This mixed methods dual case study compared the academic achievement of mathematically gifted fifth grade students when receiving mathematics instruction within two specific grouping configurations. One group received mathematics instruction in a homogeneous (i.e., ability) group, and the other received mathematics instruction in a cluster-group arrangement. Quantitative data for this study included pre- and post-test scores, which were used to examine the effects of grouping strategies. Analysis of the data indicates a statistically significant difference in achievement scores when students were provided instruction within homogeneous arrangements. The researcher obtained qualitative information by interviewing the participating teachers and principals of two schools where the intervention occurred. The findings indicate that teachers, and principals acknowledge the importance of providing gifted learners with the chance to collaborate and learn with like-minded classmates and the option for acceleration.
Participants also perceived parents to be supportive of these same opportunities. Teachers report that homogeneous arrangements provide teachers with the ability to support their gifted students, which is likewise supported by the literature. When gifted students have the opportunity to learn and work together during enrichment and accelerated learning opportunity greater achievement level will be obtained (NAGC, 2008). School administrators argue for more flexibility and autonomy when assigning gifted students to any sort of grouping arrangements and suggest a more clearly defined programming model and strict criteria to be established for certain grouping arrangements. Both principals contend they have limited control on how gifted students are assigned to classrooms. Overall, mathematically gifted learners must be offered the chance to collaborate and work with like-minded students while experiencing a more complex and advanced curriculum.
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Appendix A: Academic Content Standards

National Governors Association Center for Best Practices, Council of Chief State School Officers (2010) define the following standards:

Solve real-world and mathematical problems involving area, surface area, and volume

6.G.1 - Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

6.G.2 - Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = l \times w \times h$ and $V = b \times h$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.

6.G.3 - Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

6.G.4 - Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.
Appendix B: Principal Interview Questions

Grouping-Related Questions

1. Do you believe gifted students should receive a specialized curriculum? Why or why not?

2. Do you believe gifted students should be grouped in a specific manner? Why or why not?

3. What challenges (if any) do you face when placing gifted students into classes?

4. What scheduling concerns (if any) have you experienced when grouping gifted students? Please explain

5. What are the academic advantages of grouping gifted students in cluster arrangements?
   a. for the gifted students
   b. for other students (typically developing) assigned to group

6. What are the academic disadvantages of grouping gifted students in cluster arrangements?
   a. for the gifted students
   b. for other students (typically developing) assigned to group

7. What are the academic advantages of grouping gifted students within homogeneous arrangements?
   a. for the gifted students
   b. for other students (typically developing) assigned to group
8. What are the academic disadvantages of grouping gifted students within homogeneous arrangements?
   a. for the gifted students
   b. for other students (typically developing) assigned to group

9. What other programming/grouping strategies would you recommend for gifted learners?

10. What would be a significant difference in achievement for you to consider cluster arrangements or homogeneous grouping to be a best practice?

11. What factors do you currently use to determine which grouping strategies to use?

12. What factors do you currently use to assign gifted students to specific grouping strategies?

General Service Related Questions

13. How do you believe the mathematically gifted student should be serviced in a school setting?

14. What concerns do you have (if any) about removing gifted students from the regular education classroom?
   a. affect on gifted students?
   b. affect on other students?

15. How do you make decision about delivery models for gifted student in your building?

16. What data is used when district leaders are making policy decisions regarding gifted service models?
17. How do you determine if a child should have gifted services? Do parents affect this decision making process?

**Teacher-Related Questions**

18. What characteristics do you feel are necessary for a teacher to have who delivers instruction to gifted students?

19. In your experience, how do teachers respond to these two grouping arrangements?
   a. teachers who deliver instruction within these arrangements
   b. teachers who do not deliver instruction within these arrangements

**Parent-Related Questions**

20. In your experience how do parents respond when their gifted student is grouped within cluster arrangements?
   c. with students in cluster arrangements
   d. with students not in cluster arrangement.

21. In your experience, how do parents respond when their gifted student is grouped within homogeneous arrangements?
   e. with students in homogeneous arrangements
   f. with students not in homogeneous arrangement.

**Student-Related Questions**

22. What social-emotional advantages does grouping the gifted students have on gifted students?

23. What social-emotional disadvantages does grouping the gifted students have in gifted students?
24. What social-emotional advantages does grouping the gifted students have on regular education students within the cluster arrangement?

25. What social-emotional disadvantages does grouping the gifted students have in regular education students within the cluster arrangements?

26. Is there anything that I have not asked that you would like to add?
Appendix C: Teacher Interview Questions

Grouping-Related Questions

1. Do you believe gifted students should be grouped in a specific manner? Why or why not?

2. What are the academic advantages of grouping gifted students in cluster arrangements?
   a. for the gifted students
   b. for other students (typically developing) assigned to group

3. What are the academic disadvantages of grouping gifted students in cluster arrangements?
   a. for the gifted students
   b. for other students (typically developing) assigned to group

4. What are the academic advantages of grouping gifted students within homogeneous arrangements?
   a. for the gifted students
   b. for other students (typically developing) assigned to group

5. What are the academic disadvantages of grouping gifted students within homogeneous arrangements?
   a. for the gifted students
   b. for other students (typically developing) assigned to group

6. What factors are currently used to determine which grouping strategies to use?
7. What factors are currently used to assign gifted students to specific grouping strategies?

**General Service Related Questions**

8. Do you believe gifted students should receive a specialized curriculum? Why or why not?

9. Describe how you feel the mathematically gifted student should be serviced in a school setting?

10. What other programming/grouping strategies would you recommend for gifted learners?

11. What concerns do you have (if any) about removing gifted students from the regular education classroom?
   a. affect on gifted students?
   b. affect on other students?

**Teacher-Related Questions**

12. What characteristics do you feel are necessary for a teacher to have who delivers instruction to gifted students?

13. Describe the challenges of delivering instruction within cluster arrangements.

14. Describe the advantages of delivering instruction within cluster arrangements.

15. Describe the challenges of delivering instruction within homogeneous groupings.

16. Describe the advantages of delivering instruction within homogeneous arrangements.
17. What does differentiation look like in your classroom within each arrangement setting?
   c. Cluster grouping  
   d. Heterogeneous grouping

**Parent-Related Questions**

18. In your experience how do parents respond when their gifted student is grouped within cluster arrangements?
   a. with students in cluster arrangements  
   b. with students not in cluster arrangement.

19. In your experience, how do parents respond when their gifted student is grouped within homogeneous arrangements?
   c. with students in homogeneous arrangements  
   d. with students not in homogeneous arrangement.

**Student-Related Questions**

20. What social-emotional advantages does grouping the gifted students have on gifted students?

21. What social-emotional disadvantages does grouping the gifted students have in gifted students?

22. What social-emotional advantages does grouping the gifted students have on regular education students within the cluster arrangement?

23. What social-emotional disadvantages does grouping the gifted students have in regular education students within the cluster arrangements?
24. Please describe the relationships between cluster students
   
   e. in the classroom
   
   f. during recess

25. Please describe the academic relationship between the gifted students and regular education students in the cluster group.

26. Is there anything that I have not asked that you would like to add?
Appendix D: Pre- and Post-Test

1. What is the area of the figure below?

A. 24 cm$^2$
B. 40 cm$^2$
C. 48 cm$^2$
D. 72 cm$^2$
2. Lauren cut this rectangle into two pieces and formed the parallelogram as shown.

![Parallelogram Diagram]

What is the area of the parallelogram?

A. 34 in\(^2\)
B. 68 in\(^2\)
C. 256 in\(^2\)
D. 288 in\(^2\)

3. Ana cuts a rectangle into 2 pieces as shown below.

![Triangle Diagram]

What is the area of the triangle?

A. 11 cm\(^2\)
B. 22 cm\(^2\)
C. 60 cm\(^2\)
D. 120 cm\(^2\)
4. What is the area of the figure below?

A. $25 \text{cm}^2$
B. $50 \text{cm}^2$
C. $62 \text{cm}^2$
D. $80 \text{cm}^2$

5. What is the area, in square units, of the trapezoid?

A. 68
B. 80
C. 96
D. 136
6. Barry drew this equilateral triangle.

What is the area, in square centimeters, of Barry’s triangle?

A. 90  
B. 116  
C. 390  
D. 780

7. This rectangle and right triangle have the same perimeter.

What is the difference in their areas?

A. 0 square cm  
B. 2.0 square cm  
C. 3.6 square cm  
D. 4.8 square cm

8. Cheryl marked off two triangular areas for her lambs. The two areas formed a parallelogram. The base of each triangle was 20 feet and the height of each was 6 feet. What is the area of the parallelogram formed?

A. 26 square feet  
B. 60 square feet  
C. 120 square feet  
D. 240 square feet
9. Nancy’s toy kite is shown with the side lengths labeled.

What is the area of her kite?

A. 20 square inches  
B. 24 square inches  
C. 25 square inches  
D. 40 square inches

10. What is the best estimate of the area of Oak Island, in square miles?

A. between 10 and 14 square miles  
B. between 18 and 22 square miles  
C. between 25 and 30 square miles  
D. between 50 and 55 square miles
11. Which expression represents the area of the trapezoid below?

![Trapezoid Diagram]

A. \( 4(3 + 5) \)
B. \( 4(6 + 10) \)
C. \( 4 + (3 \times 5) \)
D. \( 4 + (6 \times 10) \)

12. A small juice box is shown.

![Juice Box Diagram]

About how many cubic centimeters of juice will the box hold?

A. 20
B. 100
C. 200
D. 700
13. The length, width and height of a rectangular prism are shown below.

![Diagram of a rectangular prism with dimensions 6 1/2 ft, 4 ft, and 5 1/2 ft.]

\[ \text{Volume} = \text{length} \times \text{width} \times \text{height} \]

Which estimate is closest to the actual volume of the box?

A. 15 cubic feet
B. 60 cubic feet
C. 120 cubic feet
D. 144 cubic feet

14. Maria has a gift box shaped like a rectangular prism.

![Diagram of a rectangular prism with dimensions 2.5 inches, 10 inches, and 12.5 inches.]

What is the volume of the box?

A. 156.25 cubic inches
B. 181.25 cubic inches
C. 312.5 cubic inches
D. 362.5 cubic inches

15. The formula for the volume of a rectangular prism is \( \text{volume} = \text{length} \times \text{width} \times \text{height} \).

![Diagram of a rectangular prism with dimensions 2.9 units, 3.4 units, and 9.7 units.]

Which of the following is the best estimate of the volume of the rectangular prism below?

A. 16 cubic units
B. 54 cubic units
C. 90 cubic units
D. 120 cubic units
16. John has a storage bin in the shape of a rectangular prism. The storage bin measures \( \frac{3}{2} \) feet long, 2 feet wide, and 2 feet tall. John will put boxes that measure \( \frac{1}{2} \) foot on each side into the bin.

What is the greatest number of boxes John can put into the bin?

A. 14  
B. 56  
C. 112  
D. 224

17. Which expression can be used to find the volume, in cubic units, of a rectangular prism with the dimensions shown below?

- \( l \times w \times h \)
- \( l \times w \times h \)
- \( l \times w \times h \)
- \( l \times w \times h \)

A. \( 7x^3 \)  
B. \( 7x \)  
C. \( 8x^3 \)  
D. \( 8x \)
18. A builder will be pouring concrete for a rectangular patio that is 12 feet wide, 14 feet long, and \( \frac{1}{2} \) foot thick. The rectangular prism below will be used to determine the volume of concrete that will be needed for the job.

How many cubic feet of concrete will the builder need for the patio?

A. 52
B. 84
C. 168
D. 336

19. A box of plastic drinking straws is shown.

What is the volume of the box in cubic inches?

A. 8
B. 13 \( \frac{1}{4} \)
C. 26 \( \frac{1}{2} \)
D. 40
20. The edges of a cube measure \(3\frac{1}{3}\) inches each. What is the volume of the cube, in cubic inches?

A. \(73\frac{1}{3}\)
B. \(42\frac{2}{3}\)
C. \(12\frac{2}{3}\)
D. \(10\frac{1}{2}\)

21. Terry has a box in the shape of a rectangular prism. The box has a length of 1 meter, a width of \(\frac{1}{2}\) meter, and a height of \(\frac{3}{10}\) meter. Terry stacks \(\frac{1}{10}\) meter cubes in the box.

Which expression can Terry use to determine the volume of this box in cubic meters?

A. \(\frac{1}{2} \times \frac{3}{10} \times 10 \times 1\)
B. \(\frac{1}{2} \times \frac{2}{10} \times \frac{1}{10}\)
C. \(\frac{1}{2} \times \frac{3}{10} \times \frac{1}{1}\)
D. \(5 \times 3 \times 10\)
22. Kevin wants to fill the box below with shredded paper.

What is the best estimate of the total volume of the shoe box Kevin wants to fill?

A. 540 cubic inches  
B. 680 cubic inches  
C. 810 cubic inches  
D. 1,000 cubic inches

23. A figure has vertices at \((-3, 5), (-1, 8), (1, 5), (1, 1), (-1, -2), \) and \((-3, 1)\)

What is the correct name of this figure?

A. pentagon  
B. hexagon  
C. rhombus  
D. trapezoid
24. Which of the following coordinates lie on the triangle graphed below?

A. (−4, 2)
B. (−1, 3)
C. (2, −1)
D. (0, −7)

25. The coordinates for the vertices of Figure \(QRST\) are listed below.

\[Q(-3, -2), R(-1, 2), S(3, 2), T(5, -2)\]

What is another name for Figure \(QRST\)?

A. rhombus
B. rectangle
C. trapezoid
D. triangle
26. The grid below shows the location of Point $P$.

![Grid with Point P](image)

Point $P$ is one corner of a square. Which coordinates describe the location of the other 3 corners of the square?

A. $(6, 5), (8, 5), (6, 3)$  
B. $(3, 5), (8, 5), (6, 3)$  
C. $(3, 4), (5, 6), (6, 5)$  
D. $(4, 5), (6, 5), (6, 3)$

27. Sally graphed the points $A(-2, 1), B(0, 1), C(3, -2), D(-3, -2)$ on the coordinate plane below.

![Coordinate Plane with Points A, B, C, D](image)

Which term best describes the quadrilateral formed when line segments connect points $A, B, C,$ and $D$?

A. square  
B. trapezoid  
C. rectangle  
D. rhombus
28. Margo plotted the points \( A(1, -3), B(5, -3), C(4, -1), \) and \( D(2, -1) \) on a coordinate grid. She connected the points with line segments. Which of the following best shows the shape of the figure Margo drew?

A. 

B. 

C. 

D. 

29. Blanca drew 3 vertices of a rectangle on the coordinate plane.

Which of the following could be the coordinates for the fourth vertex of the rectangle?

A. \((-3, -2)\)
B. \((-3, 2)\)
C. \((-2, 3)\)
D. \((-2, -3)\)
30. Quadrilateral $QRST$ is an isosceles trapezoid. The coordinates for three of the vertices are given below.

$Q(-3, -2), S(3, 2), T(5, -2)$

Which of these points could be Point $R$?

A. $(−3, 2)$
B. $(−1, 2)$
C. $(0, 2)$
D. $(2, −1)$
31. The coordinates below represent the location of four points Maxine will plot on a grid.

\((-1, 4), (-4, 2), (-1, 0), \text{ and } (2, 2)\)

Which quadrilateral will be formed by connecting the four points Maxine will plot?

A. rectangle  
B. rhombus  
C. square  
D. trapezoid

32. The graph shows three vertices of Quadrilateral \(ABCD\).

In the graph, the dashed line represents the vertical line of symmetry for \(ABCD\). Which ordered pair best represents Vertex \(D\)?

A. \((6, 6)\)  
B. \((6, 8)\)  
C. \((8, 6)\)  
D. \((8, 8)\)
33. Jeff plotted some points on a coordinate graph and connected the points.

He realized that one more point would complete a parallelogram. Where should he plot the point?

A. (2, 0)  
B. (0, 2)  
C. (1, 2)  
D. (2, 1)

34. Manuela wants to make a cube from construction paper.

If she cuts out the design below and folds it to make a cube, what will be the surface area of the cube?

A. 25 cm²  
B. 70 cm²  
C. 125 cm²  
D. 150 cm²
35. Nicco folded the net below along the dashed line segments to form a cube.

Which measure of the cube is best represented by the shaded part of the net?

A. length  
B. volume  
C. perimeter  
D. surface area

36. Paul drew a net for a square pyramid. Which figure could be the one Paul drew?
37. Which figure below could be folded along the line segments shown to make a cube?

A. 
B. 
C. 
D. 

38. Which of the following two-dimensional objects could be used to create a three-dimensional pyramid?

A. 
B. 
C. 
D. 
39. Mr. Beck is making a box pattern using 4 rectangular pieces of wood that are the same size and 2 square pieces of wood of equal size as shown.

What is the surface area of the box that will be formed?

A. 170 cm²
B. 350 cm²
C. 1000 cm²
D. 1200 cm²
40. Which of the following shows the shapes that would be seen when looking at this object from the bottom and side?

A.  

B.  

C.  

D.  
41. Which of these figures could be folded along the dashed lines to make a triangular prism?

A. 

B. 

C. 

D.
42. Which figure could be folded along the dotted lines to form a cube?

A. 

B. 

C. 

D. 

43. Kevin has 1 piece of circular cardboard, 2 pieces of rectangular cardboard, 3 pieces of square cardboard, and 3 pieces of triangular cardboard. Which of the following 3-dimensional models could Kevin build with these pieces of cardboard?

A. cylinder  
B. pyramid  
C. rectangular prism  
D. triangular prism

44. Which three-dimensional solid can be formed from the net shown below?

A. rectangular prism  
B. right cylinder  
C. square pyramid  
D. triangular prism
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<tr>
<td>NWEA</td>
<td>100%</td>
<td>44</td>
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### Item/Rigor Distribution:

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<th>RBT</th>
<th>Assessment Item Summary</th>
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<td>Multiple Choice(3)</td>
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<tr>
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<td>Remembering</td>
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<tr>
<td>17 (39%)</td>
<td>Understanding</td>
<td>17</td>
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<tr>
<td>14 (32%)</td>
<td>Applying</td>
<td>14</td>
</tr>
<tr>
<td>6 (14%)</td>
<td>Analyzing</td>
<td>6</td>
</tr>
<tr>
<td>1 (2%)</td>
<td>Evaluating</td>
<td>1</td>
</tr>
<tr>
<td>3 (7%)</td>
<td>Creating</td>
<td>3</td>
</tr>
<tr>
<td></td>
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Appendix E: Informed Consent

Title of Research: Grouping the Mathematically Gifted: A Mixed Methods Investigation of Homogeneous and Cluster Arrangements

Researchers: Adam L. Hiebel

You are being asked to participate in research. For you to be able to decide whether you want to participate in this project, you should understand what the project is about, as well as the possible risks and benefits in order to make an informed decision. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your participation in this study. You should receive a copy of this document to take with you.

Explanation of Study

The purpose of this study is to examine the academic achievement of mathematically gifted fifth grade students when placed in a homogeneous or clustered arrangement. If you agree to participate, you will be interviewed about your perspective on the grouping strategies used in the study. The interviews will be audio recorded and will last approximately 1 hour.

Risks and Discomforts

The interview will last approximately 1-hour with no more than minimal risk. The questions asked will relate to daily events and job duties normally performed. Anonymity will be maintained by assigning pseudonyms. The discomforts associated
with this research study will be limited. Participants will receive a copy of the interview questions in advance and will select an interview location. Participants reserve the right to withdraw from the study at any time if the circumstances change.

**Benefits**

The purpose of this case-study is to focus on the mathematics achievements of gifted fifth grade students when provided instruction in homogeneous and/or clustered arrangements. The studied district is currently examining their gifted practices and the results of this study can assist school personnel in making decisions about service models for gifted students.

**Confidentiality and Records**

Your study information will be kept confidential. Anonymity will be maintained by assigning pseudonyms. Interviews will be audio recorded and later transcribed. The audio recording will be secured on a password protected computer and backed-up in a digital cloud. Cloud access is also password protected. The researcher will transcribe the audio recording by using the Microsoft Word program. This will occur after the interview process around January 2014. The audio recordings will be destroyed and erased from the researcher’s computer hard drive after dissertation defense. This will most likely occur in the fall/winter of 2014. Furthermore, the researcher will use a statistical application to record quantitative data collected from pre and post-test scores. This data will also be stored on a password-protected computer with an electronic cloud for backup. The electronic cloud is also password protected. All data, physical and
electronic, will be destroyed and/or eliminated after the researchers results are defended and as advised by the researchers committee.

Additionally, while every effort will be made to keep your study-related information confidential, there may be circumstances where this information must be shared with:

* Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;

* Representatives of Ohio University (OU), including the Institutional Review Board, a committee that oversees the research at OU;
Contact Information

If you have any questions regarding this study, please contact:
Researcher: Adam L. Hiebel
740-334-8380
adam_hiebel@plsd.us

Researcher’s Advisor: Dr. Dwan Robinson
614-419-8698
robinsd3@ohio.edu

If you have any questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, (740)593-0664.

By signing below, you are agreeing that:
• you have read this consent form (or it has been read to you) and have been given the opportunity to ask questions and have them answered
• you have been informed of potential risks and they have been explained to your satisfaction.
• you understand Ohio University has no funds set aside for any injuries you might receive as a result of participating in this study
• you are 18 years of age or older
• your participation in this research is completely voluntary
• you may leave the study at any time. If you decide to stop participating in the study, there will be no penalty to you and you will not lose any benefits to which you are otherwise entitled.

Signature________________________________________ Date__________

Printed Name________________________________________
Appendix F: Member Checking

Approval of transcript

X: ___________________________ Date: ______________

Disapproval of transcript

X: ___________________________ Date: ______________

Changes to be made: