ABSTRACT

Mark Savage, EXPLORING THE RELATIONSHIP BETWEEN DIFFERENTIATED INSTRUCTION AND STUDENT PERFORMANCE (Under the direction of Dr. Lynn Bradshaw). Department of Educational Leadership, August 2011.

Differentiated instruction (DI) is a collection of strategies utilized to increase student achievement and engagement. School districts are using the strategies of differentiated instruction to increase student academic achievement based on *No Child Left Behind* mandates. The purpose of this quantitative study, which utilizes two pre-existing data sources, was to determine if there was a difference between student standardized test scores as measured by the North Carolina End-of-Course (NC EOC) tests based on the level of their teachers' use of differentiated instructional strategies.

Few studies have examined the results of students' academic achievement of teachers who utilize DI strategies compared to those teachers who do not utilize DI strategies as regularly. This study sought to determine if End-of-Course effectiveness residuals for teachers at a single high school were significantly higher for those teachers who practiced differentiated strategies more frequently than teachers who did not practice DI strategies as regularly. The study utilized a survey created at Margate High School (a pseudonym) and teacher residual data prepared by the district's Evaluation and Research department.

T-tests were used to determine if there was a significant difference in average residual scores between teachers who frequently practiced differentiated strategies than their peers who did not employ the strategies as regularly. Additional *t*-tests determined if there were differences in the average residual scores of those who more frequently differentiated content, process and product than their peers.

School leaders must consistently evaluate instructional programs to determine their effectiveness on student academic achievement. While differentiated instruction has a strong foundation in both educational theory and brain research, the literature is mixed as to its efficacy; therefore, additional research needs to be conducted to determine the impact of differentiated instruction on student achievement.

EXPLORING THE RELATIONSHIP BETWEEN DIFFERENTIATED INSTRUCTION AND STUDENT PERFORMANCE

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EXPLORING THE RELATIONSHIP BETWEEN DIFFERENTIATED

INSTRUCTION AND STUDENT PERFORMANCE

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DEDICATION

To Blaire, Parker, Caroline, Graham and Caden Savage whom I love ever so much and who were my greatest support throughout this process. And to Tom and Mary Jane Savage who gave me the very best beginning.

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CHAPTER 1: STATEMENT OF THE PROBLEM

Introduction and Context

In 2008, Dr. Fenwick English urged Wake County Public School System (*WCPSS*) leaders to focus on differentiated instructional strategies in order to both close the achievement gap and insure academic success for all students (English, 2009). The achievement gap between Caucasian students and their non-Caucasian peers had been a consistent concern in North Carolina for over a decade and was evident in the school profiles for each school in *WCPSS*, the largest county in the state (North Carolina Department of Public Instruction Report Cards, 2007). Countywide, in 2008-09, white students in *WCPSS* had an on-time graduation rate of 89.4%, while African-American/Black students had a 63.4% rate and Hispanic/Latinos had a rate of slightly over 50% (Haynie, 2009).

To eliminate this discrepancy in student performance and to insure all students were performing at their academic capacity, English submitted that educators must concentrate on teaching teachers how to differentiate their curricula to reach all students. While the curriculum and the experiences and preparedness that a child brings to the class cannot be controlled, teachers can control the delivery of content (Downy, Steffy, Poston, & English, 2009).

English encouraged *WCPSS* school leaders to adopt differentiated instruction (DI) for all students as a goal for the 2008-09 school year. Presently, there is no quantitative data in *WCPSS* as to the effectiveness of DI in the classroom when used as a tool to increase academic achievement. Without significant research in this area, the need to differentiate instructional strategies and the impact it has on students will be largely theoretical.

Purpose Statement

The purpose of this study is to determine if there is a difference between student scores as measured by the North Carolina End-of-Course (EOC) tests in Algebra, Algebra II, Biology, Civics & Economics, English I, Physical Science and U.S. History based on the level of their teachers' use of DI.

Few studies have compared the results of teachers who identify as differentiated instructors to their peers who do not. No studies have been done in Wake County to determine how effective teachers are who both have understood the district's *Instructional Strategies that Support Differentiation* and have implemented those strategies regularly. This study seeks to determine if End-of-Course effectiveness residuals for teachers are significantly higher for those teachers who practice differentiated strategies more frequently than their peers.

This study will provide additional research on DI to help educators determine the effective of its use. As school districts consider employing these strategies, making the necessary time and development investments in them, it is imperative that these decisions are grounded in research which determines their efficacy.

Nature of the Study

The nature of this study is a quantitative comparison between two sources of data drawn from the teaching faculty of Margate High School (a pseudonym), a comprehensive 9-12 suburban school located in Raleigh, North Carolina. In August, 2008, teachers at Margate High School completed a survey which measured their frequency of use of differentiated instruction strategies as defined by *WCPSS* (see Appendix A). Their responses were averaged together and divided into quartiles. In turn, the researcher determined teachers' average responses to specific sub-topics of differentiation: differentiation of content, process, and product.

The second source of data was teacher residual scores provided by Wake County Public School Systems' Evaluation and Research Department. These scores for 2004-10 were averaged together to determine teacher residual averages.

The researcher compared differences of participants' average differentiation score to their residual averages, and determined if there were significant differences for those who viewed themselves as frequent practitioners of differentiated instruction, and those who did not. The study made similar comparisons for each sub-topic of differentiation, determining if teacher average differentiation scores on *content*, *process* and *product* showed significant differences on participants' average residuals.

This study determined if there was a significant difference between these two variables and did not examine causality. A *t*-test was run to determine if there was a significant difference in average residual scores between teachers who frequently practiced differentiated strategies than their peers who did not employ the strategies as regularly. The study also determined if there were differences in the average residual scores of those who more frequently differentiated content, process and product than their peers through additional *t*-tests.

Research Questions

1. Do teachers who employ differentiated instructional strategies have significantly higher residual scores as measured by the North Carolina EOC tests than teachers who do not practice differentiated instructional strategies as frequently?
2. Are there areas of differentiation, whether content process or product, which when employed consistently, shows a significant difference in teacher residual scores?

There are two null hypotheses for this study:

1. There is no significant difference between student achievement on the North Carolina EOC tests scores who receive instruction from those teachers who used DI strategies compared to those teachers who did not use DI strategies as frequently.
2. There are not areas of differentiation, whether content process or product, which when employed consistently, shows a significant difference in teacher residual scores as measured by the North Carolina EOC.

Definitions

This study used the following operational definitions:

Differentiation – teacher use of strategies as defined in Instructional Strategies that Support Differentiation and Margate High School Differentiation Survey.

Content differentiation - teacher use of content-designated strategies from Instructional Strategies that Support Differentiation at Margate High School (see Appendix C).

Process differentiation - teacher use of process-designated strategies from Instructional Strategies that Support Differentiation at Margate High School (see Appendix C).

Product differentiation - teacher use of product-designated strategies from Instructional Strategies that Support Differentiation at Margate High School (see Appendix C).

Strengths

There were several strengths for this study. Terms for differentiated instruction have been defined in previous research and have been codified in *WCPSS* by the Academically Gifted (AG) Department. Administrators did not need to define terms or search for resources in providing professional development in these areas if this study demonstrates significant differences between variables. Residual scores are continually prepared and updated by the *WCPSS*

Evaluation and Research Department, and school-level administrators have full access to this data

Limitations

Margate High School Differentiation Survey

Limitations include the self-identified aspects of the survey. Currently in *WCPSS*, there is no instrument administrators can use to objectively identify a teacher who uses these practices. Differentiated practices can occur over the course of several days to weeks, and cannot always be readily captured by classroom observation. For this study, researchers were dependent on teachers identifying themselves accurately. The data analysis for this study did not take additional variables into account. While a teacher who identifies himself or herself as a frequent differentiated instructor might have statistically higher residuals, this study did not determine if that is the only difference between him or her and a teacher who does not differentiate.

The instrument used to determine teachers' use of differentiated instruction was administered without prior sustained, professional development with the teaching staff. Though participants were given definitions of each strategy, they had not received demonstrations or samples of their use. Because differentiated instruction proposes a systemic change to instructional approach, indirect training has shown to be ineffective. Direct information from qualified practitioners which includes a cycle of follow-up is required for all professionals seeking to employ the strategies with fidelity (Wiggins & McTighe, 2006).

As teacher level of use of the strategies was reported, it cannot be determined whether teachers had an accurate picture of what the strategies entailed. Clear professional development prior to assessing teacher use of strategies may have provided a more accurate picture of their true implementation. Valli and Buese note that adopting differentiated instruction requires

teachers to take on additional roles and to increase intensity in their existing ones. Because structures for remediation and enrichment intensify under differentiated instruction, significant staff development is required (Valli & Buese, 2007).

Teacher perceptions were not validated through classroom observation. As Margate High School Differentiation Survey was a pre-existing data source, it was not determined a reliable instrument prior to administration. The survey was not administered to a wide enough sample to conduct a Cronbach's Alpha to determine its reliability.

This study consistently used averages to determine teacher frequency of practice. Use of a single differentiation average, rather than concentrating on individual strategies can mask key information. The same is true of the domain averages; by determining a single content average, the nuances of specific content strategies were missed.

Residual Scores

Residual scores are no longer being used by the county to measure teacher effectiveness, possibly limiting the application of this study and the ability to repeat its methodologies in different environments (Retrieved from http://blogs.newsobserver.com/wakeed/school-board-kils-the-effectiveness-index). This measurement gauged teacher effectiveness as compared to other teachers in the district. As such, for the study does not provide data as to the frequency of use of DI strategies for teachers outside of Margate to whom the sample was compared.

Teacher residual scores were averaged together. It is possible that averaging masked trends and that examining each year separately would have yielded different results. This study sought to determine if there were significant differences when comparing these two variables and did not examine causality.. The residuals were averaged over several years; however, the survey

does not indicate years when teachers utilized the strategies. A teacher may have only learned of differentiation in 2008, but their residuals were measured back to 2004.

There were a limited number of teachers who have residual measures for two years or more at Margate High School. Residual averages would be more valid if sustained over several semesters.

Significance of the Study

The core responsibility of educational leaders, whether school or district-based, is to provide research-based instructional best practices to students in their care. School leaders must consistently evaluate instructional programs and their impact on standardized tests, especially as these leaders and the schools and districts they lead are evaluated based on these evaluations.

This study is significant because there is a lack of research examining the effect of differentiated strategies on state-mandated evaluations. It broadens the research of differentiated instruction as a means to increase student performance on state-mandated benchmarks.

For differentiated instruction to be seen as a viable solution to lessening the achievement gap, it must be proven effective in producing the benchmarks defined by *No Child Left Behind.* This research expands the knowledge base related to the efficacy of these methodologies for all students. Dr. English's research-based suggestion for *WCPSS* to utilize differentiated instruction as a means to lessen the achievement gap echoes earlier recommendations of *WCPSS* Curriculum Management Audit (CMA) (Retrieved from http://www.wcpss.net/curriculum-management). This study provides local quantitative data to evaluate these directives as the first quantitative study of the differences between these differentiation strategies and measureable student performance on the North Carolina EOC tests in *WCPSS*.

CHAPTER TWO: REVIEW OF LITERATURE

In the past decade, there has been growing recognition that the manner in which teachers teach, not the safeguards used after students fail, should be the focus to reduce the achievement gap and to insure optimal learning for all students (Tomlinson, 2000a). Differentiated Instruction (DI) and its supporting theories create a framework on which instruction can be individualized to meet each learner's needs. Research is mixed as to both the practicality and efficacy of these practices and whether they make a quantifiable difference as to student performance as measured by *No Child Left Behind* constructs. The movement to use differentiated instruction in Wake County Public Schools, a district of approximately 143,000 students has two main thrusts: the findings of Dr. Fenwick English, and the county's Curriculum Management Audit (CMA) of 2007 (Retrieved from www.wcpss.net).

Differentiated Instruction as Means to Address Student Failure: Wake County, North Carolina

While *WCPSS* has implemented structures to address under-achieving students prior to academic failure (see Table 1), these strategies do not include a comprehensive *instructional* methodology. English asserts that differentiated instruction is key in light of *No Child Left Behind* (NCLB) legislation (Downey et al., 2009) which codified a system ending any option of social promotion for students in *WCPSS* who were not successful after these interventions (Retrieved from http://www2.ed.gov/nclb/overview/intro/guide/guide.pdf). Included in the legislation was language requiring LEAs to create academic improvement plans for students failing to meet the standards. School systems in Chicago and Florida note that this shift from qualitative social promotion to test-based promotion have shown limited positive results on standardized test scores (Greene & Winters, 2006). Retained students in Florida continued to

Table 1

Programs Addressing Under-Achieving Students in WCPSS

Programs	Provisions
Accelerated Learning Programs	additional months of employment allowed schools to hire staff to work with underachieving students
Special Education	programs in this structure provided reading and math support for struggling learners
Mentor Programs	programs such as *Helping Hands* sought to provide struggling students with limited parent support mentors

Note. Retrieved from http://www.wcpss.net/curriculum- instruction/docs_downloads/hs_ promotion.pdf; Retrieved from Wake County Public School Web site: http://www.wcpss.net/faqs/categories/alp.html

perform poorly on standardized tests and retention continues to increase the likelihood of drop-outs (Brown, 2007).

Holmes (2006) noted the use of frequent assessment of students and individual student plans for all students, not just special education identified, as a means to chart and adjust teaching and learning prior to year-end NCLB sanctioned benchmarks. These benchmarks, disaggregated by subgroup, require districts to develop effective programs to reach those most at-risk (SWD, ESL and children of poverty) (Herman, 2007; Picklo & Christenson, 2005). As districts move to more ongoing assessment, promotion decisions can be made on multiple administrations of multiple assessments rather than on the current basis of a single year-end assessment (Thompson, 2000a). This cycle of assessment is a hallmark of differentiated instruction (Tomlinson, 2000a).

In April, 2009, Dr. Fenwick English, Distinguished Professor of Educational Leadership at the University of North Carolina at Chapel-Hill, presented his research to *WCPSS* Principals, *WCPSS* Board of Education, and local student-advocacy groups regarding closing the achievement gap. Dr. English's comments, based on his work *50 Ways to Close the Achievement Gap*, challenged school leaders to take a shift in thinking about and addressing the achievement gap (Downey et al., 2009).

English's research indicated that teachers should concentrate on areas within their control, specifically differentiated instruction as a means to reach underperforming students (English, 2009). English's assertion that differentiated instruction can lessen the achievement gap was supported by national research. Herman (2007) noted one impact of test-based promotion is curriculum narrowing for low-performing students. Teachers of these students increasingly focus on reading and mathematics at the cost of science, social studies and the arts.

While this may lead to less test-based retention, it does little to increase student satisfaction with school and decrease the drop-out rate (Herman, 2007). Herman notes that while NCLB and test-based promotion has clearly changed what it taught; it has done little to answer whether those changes signify any real improvement to student learning (Herman, 2007).

Through the U.S. Department of Education's *Javits Program for Gifted and Talented Scientist-in-Schools*, which included teacher development in differentiated techniques, administrators were able to increase achievement level of targeted students, increase teacher knowledge of strategies, and increase the number of students identified as gifted and talented (Sisk, 2007). In a 2005 study, researchers determined that students who received differentiated intervention in math experienced significantly higher scores on post-tests than their peers who did not (Rock, Gregg, Ellis, & Gale, 2008).

English submitted that *WCPSS* had the structures in place to support differentiation of instruction. The *WCPSS Academically Gifted Plan* states its purpose "to provide an appropriately challenging educational program for students who perform, or show potential for performing, at remarkably high levels of accomplishment when compared to others of their age, experience or environment" and includes differentiation strategies as key focuses (Retrieved from http://www.wcpss.net/curriculum-instruction/ag/ag_plan07-10.pdf)

Aligned with the *National Association for Gifted Children Standards*, the authors of the *WCPSS* plan outlined several principles of differentiated curricula, including: meaning-based content, higher-order thinking, active learning, and authentic assessment. Gifted students in *WCPSS* are expected to receive "essential elements of differentiated instruction" which includes content, process, and product (Retrieved from http://www.wcpss.net/curriculum-instruction/ag/ag_plan07-10.pdf)

In May 2008, the *WCPSS* Board of Education codified this expectation through Board Policy 6230.2, insuring that "all students identified as Academically Gifted will be provided appropriate differentiated services according to the local plan adopted by the Board of Education (Retrieved from http://www.wcpss.net/policy-files/series/policies/6230-bp.html).

Closely aligned with research from Carol Tomlinson, the *WCPSS* AG team constructed a teacher resource toolkit which included eighteen terms and best practices of differentiated instruction (Retrieved from http://www.wcpss.net/curriculum-instruction/ag/ag_plan07-10.pdf)

WCPSS Curriculum Management Audit

Dr. English's presentations confirmed findings from Wake's 2007 Curriculum Management Audit initiated by then superintendent Dr. Del Burns. Phi Delta Kappa conducted this district-wide effort which culminated in a series of recommendations to the school board. The audit committee noted that the Instructional Services Division needed to better align curriculum expectations and coordination, recommending that *WCPSS* "establish a plan for centralized professional development . . . in the essential competencies necessary for effective delivery of the written curriculum including expectations for instructional best practices and monitoring" (Stripling, Bates, Bazenas, & et al., 2007, p. 367).

Board Policy 5100 Series, entitled *Curriculum Management,* followed the audit and outlined the expectation for "opportunities for research-based instructional strategies to meet the needs of each student" (Retrieved from http://www.wcpss.net/curriculum-management/downloads/*WCPSS*-curriculum-management-audit.pdf, pp. 30, 192). The board created Policy 5101.2 indicating that school-based staff were responsible for the delivery of the curriculum, noting in its preamble that "in order to provide students with equal access to the curriculum, it is necessary to establish a system-wide understanding of where decisions . . . lie"

(Retrieved from http://www.wcpss.net/policy-files/series/policies/5101-bp.html). Dr. English's work and the CMA called on *WCPSS* to utilize AG strategies of differentiation to address needs of underperforming students (Downy et al., 2009).

Domains of Differentiated Instruction

To understand how systems are to employ differentiated instruction, it is imperative that the philosophy be understood across three domains. While teachers do not have to differentiate each domain for each lesson, true differentiated instructors are conscious of the following areas in which to apply this philosophy:

Content: While curriculum is regulated by county, state, and federal guidelines, instructors can differentiate what is covered in the classroom. In order to adequately differentiate content, instructors must have strong content knowledge and be able to specifically define the essential learning outcomes and skills students must glean from the coursework. Teachers much insure equal access to this content by understanding their students' personal learning styles (Tomlinson, 2000a)

Process: Educators can differentiate how an individual student makes sense of new information. Teachers must be cognizant of how each student takes in new information and create lessons which align with each processing style. Differentiation for learners occurs over one or more dimensions, and instructors vary how deeply the student goes with information. They can vary how complex the learners' understanding should be. The instructor can introduce varying levels of novelty- challenging students to take unique or unpopular points-of-view. Lastly, an instructor can differentiate the speed at which a student covers the content (Borland, 2005; Tomlinson & McTighe, 2006).

Product: Teachers traditionally use a summative activity to measure when learning has taken place. A differentiated classroom should vary to address students' learning strengths. A student can write a paper or take a cumulative test, but he or she could also explain a process verbally, create a software program, or host a debate to demonstrate mastery of that same material (Eady, 2008; Tomlinson, 2004). DI is sometimes referred to as *responsive instruction*, wherein teachers become more comfortable with the flexibility and learning styles of each student. In order to fully meet student's needs in the DI classroom, locus of control must on occasion shift from teacher to student as students determine their activity and what product they may use to demonstrate mastery (Halpin-Brunt, 2007).

A required reading of *To Kill a Mockingbird* illustrates differentiating in the three domains of content, process and product. This teacher can differentiate the content by providing reading circles, recording chapters on tape, or partnering students to read excerpts back and forth. The educator can employ differentiated processes by providing deeper research requirements or compacting information for students who test at a high level of reading comprehension and by creating learning centers with more teacher-centered attention for lower readers.

Through product differentiation, students could show mastery of the content through the traditional written essay and a test, or they could create a soundtrack to accompany the story, create a treasure box that may have been owned by the main character or create a creative piece continues a narrative (Tomlinson, 2000a).

Inherent in differentiated instruction is modifying standard curriculum to meet the needs of the gifted learner, as gifted-education is the domain which produced DI philosophy (Kaplan, 1994; Tomlinson, 1999, 2001, 2003; Ward, 1980). This shift to inclusivity for all students

requires DI teachers to adapt their content, their processes, and expectations of final product based on a learner's readiness, his or her interest, and his or her learning profile (Tomlinson, 1999, 2003).

Levy (2008) notes that all teachers, whether or not they are conscious of the term *differentiated instruction*, differentiate instruction regularly and unconsciously to meet the needs of students. Teachers consistently use methods to reach a particular student or group of students. To fully be considered a *differentiated instructor*, however, one must know the tools and strategies of differentiation instruction and employ them in a systemic and conscious way (Grafi-Sharabi, 2009). One key systemic construct of DI involves the consistent gathering of data on students before, during, and after instruction (Chapman & King, 2005). Valli and Buese (2007), in their study of differentiated instruction, define differentiation as the ways in which teachers accelerate for above-grade-level students and remediate for those below grade-level. In her University of Virginia study, Whitaker defines differentiation as "any strategy a teacher employs to meet individual learners' needs by varying tasks according to readiness, interest, and/or learning profile and that qualitatively change the nature of the task" (Whitaker, 2008, p. 6). Other definitions reject rote memorization in favor of deeper understanding of concepts (Holmes, 2008). The literature agrees that in order to differentiate, educators must first identify skills, deficiencies, and interests in individual students.

Guiding Philosophy and Practices of Differentiated Instruction

Once educators are familiar with the *where* of differentiation, they can move to understanding the *how*.

Traditional classrooms most often feature students working on identical tasks, at the pace and style dictated by their instructor. Differentiated instruction, however, relies on a variety of

activities designed to accommodate student differences (Archambault, Westberg, Brown, Hallmark, Emmons, & Zhang, 1993). Because there is no such student as a standard-issue student, educators who ignore diversity in learning styles and rate of learning are at risk of ignoring the full range of learners which comprise their classroom (Tomlinson, 2000b).

Author and teacher Carole Tomlinson asserts that differentiated instruction is not a single use strategy to be used when a teacher has a certain goal to meet, but rather an approach to teaching that permeates all instructions (see Table 2).

Researcher Phillip Schlechty (1997) writes that differentiated instructors believes that the business of schools is "to design, create, and invent high-quality, intellectually demanding work for students: schoolwork that calls on students to think, to reason, and to use their minds well and that calls on them to engage ideas, facts, and understandings whose perpetuation is essential to the survival of the common culture and relevant to the particular culture, group and milieu from which students come and in which they are likely to function" (pp. 40-50).

With this definition of *business*, the teacher's roll in a DI classroom is to create work which challenges the student and motivates him or her to work through obstacles (see Table 3). When the student has persevered, he or she will feel satisfaction.

Methodology and Markings of a Differentiated Classroom

In order for school leaders to apply differentiated strategies effectively, it is critical for them to have a proper understanding of the common methodologies (Tomlinson, 2003). Wake County Public Schools Academically Gifted Services Department compiled a list of differentiated strategies to be utilized in gifted programs (Retrieved from http://www.wcpss.net/curriculum-instruction/ag/ag_plan07-10.pdf) which teachers were called

Table 2

Core Beliefs Shaping Differentiated Instruction

Carole Tomlinson's Approaches to Differentiated Instruction
Students who are the same age differ in their readiness to learn, their interests, their styles of learning, their experiences, and their life circumstances.
The differences in students are significant enough to make a major impact on what students need to learn, the pace at which they need to learn it, and the support they need from teachers and others to learn it well.
Students will learn best when supportive adults push them slightly beyond where they can work without assistance.
Students will learn best when they can make a connection between the curriculum and their interests and life experiences.
Students will learn best when learning opportunities are natural.
Students are more effective learners when classrooms and schools create a sense of community in which students feel significant and respected.
The central job of schools is to maximize the capacity of each student.

Note. (Tomlinson, 2000a, p. 302).

Table 3

Core Business of Schools from a Differentiated Perspective

Phillip Schlechty's Hallmarks of Authentic Work
It is intellectual activity associated with the production of a product or performance that is sufficiently attractive to the students for whom it is intended to engage them without coercion.
It is sufficiently attractive and compelling to ensure that, once students are engaged, they persist with the work until the intended product meets the required standards.
It is sufficiently challenging to ensure that students experience a sense of delight and accomplishment as they complete the task.
It results in the students learning what teachers and the students themselves intend that they should learn.
It results in the students learning things that are judged by parents, other adult members of the community, and the society at large as being of social and cultural value.

Note. (Schlechty, 1997, pp. 58-59).

on to utilize in every domain by the Curriculum Management Audit (Retrieved from http://www.wcpss.net/policy-files/series/policies/5101-bp.html).

The Environment

Differentiated instructors first establish a sense of community in the classroom prior to implementing strategies. Teachers must establish a place where students feel safe in expressing their ideas and exercising their intelligences (Tomlinson, 2003). The environment must be built upon cycles of assessment, evaluation, and re-assessment. Teachers must make assessments before starting the unit, and students must undergo assessments throughout as this is the only way teachers can alter instruction to meet the needs of the individuals in their charge (Gartin, Murdick, Imbeau, & Perner, 2002; Richards, 2005; Tomlinson 2003). In order to properly differentiate product and process for each student, instructors use formative, ongoing assessment to gauge student readiness for new, complex tasks. Authentic forms of assessment do not only include tests, but include portfolios, rubrics, observations, and rubric evaluation (Burke, 1999). Teachers must also be adept at guiding their students in the process of self-assessment (Tomlinson, 2001).

Content

Student-centered classroom. Student centeredness philosophy, derived largely from constructivist underpinnings, is a benchmark in the DI classroom in which students actively shape instruction (Gartin et al., 2002; Nunley, 2006; Sisk, 2007; Tomlinson, 2004; Wehrmann, 2000). Instructors take on similar roles as a traditional teacher such as choosing material, creating activities, and breaking up the flow of content. Differentiated instruction calls on students to be expressive in their interests and to drive rate and depth of content by proactive means (Benjamin, 2002; George, 2005; Sternberg & Zhang, 2005).

Scaffolding. While students in the differentiated classroom are working through content at differing paces and at different depths, each student is still expected to master essential learning outcomes of a given unit (VanSciver, 2005). Scaffolding is the means teachers employ to insure that each student raises his or her achievement level (Benjamin, 2002; Nunley, 2006; Rock et al., 2008; Tomlinson, 2003). Through scaffolding, teachers present concepts, and students extract connections to the content and come to conclusions. This practice, as well, is rooted in constructivist philosophy's emphasis on student experience and creation of meaning. Wake County Public Schools identifies several key strategies addressing content differentiation (see Table 4).

Process

Tiered instruction. Once initial assessment has taken place and the educator has a proper understanding of individual skills and base knowledge, the DI teacher adjusts levels of expectation. He or she varies complexity of tasks for groups as well as for individuals through tiered instruction. Teachers must insure that the core concepts of tiered assignments are the same, so that each student will walk away from the lesson with the same essential learning. Students, however, will have done so at differing depths of understanding. DI teachers typically design lessons for the average students and then create tiers above and below them to reach both struggling students and those needing enrichment (Benjamin, 2002; Edyburn, 2004; Tomlinson, 2005).

Flexibility. Teachers in the DI classroom need to be flexible in regarding student expectation variation based on the ongoing assessment cycle (Benjamin, 2002; Pettig, 2000; Rock et al., 2008; Tomlinson, 2003). Students in a DI classroom do not spend time on skills they have mastered; instead they move to more challenging work at a greater depth. Proponents of DI

Table 4

Wake County Public Schools Toolkit Addressing Content Differentiation

Content Differentiation
Curriculum compacting: a strategy that allows students who show on a pretest that they already know part of all of the materials to be studied to work on alternative activities.
Student interest: a factor to consider in offering student choice.
Varied questioning: a technique of forming questions with the goal of extending student thinking.
Varied texts and materials: a method of matching materials to the needs and abilities of different learners.
Learning contracts: formalized agreements between the teacher and a student that delineate the independent learning tasks a student will do during a unit of study.

Note. (Retrieved from http://www.wcpss.net/curriculum-instruction/ag/ag_plan07-10.pdf).

point to the loss of interest from advanced students forced to sit through traditional instruction of a skill they already have (Edwards, Carr, & Siegel, 2006). Differentiated instructors prepare multiple streams of lessons, frequently regroup and re-evaluate students, and are flexible with the time they spend on content based on student mastery. Wake County Public Schools identifies several key strategies addressing process differentiation (see Table 5).

Product

Wiggins and McTighe (2006) underscore that the focus of differentiated instruction must be enduring concepts and making connections through experiences so that students are more invested in learning, and spurred on to further study. DI instructors allow for varying products from students to demonstrate content mastery. Wake County Public Schools identifies several key strategies addressing content differentiation (see Table 6).

Educational Theories Which Support Differentiated Instruction

The methodologies prescribed previously can be more fully understood by reviewing previous educational theories which support these practices. The roots of the modern differentiation movement can be seen as far back as the writings of Confucius who urges that instructors teach "因材施教" ("to each one according to his ability"). This consideration of individual learning needs has been the hallmark of Chinese Confucian education for centuries, a seeming rarity in the traditionally uniform Chinese culture (Chen, 2007).

Constructivism

Constructivist theory is grounded in psychological belief that individuals construct meaning. Learners are active agents in the formation of knowledge, and knowledge is not something that is passed on intact. Each student is an architect of meaning, and teachers who structure lessons so that students actively take part in that construction, insure authentic

Table 5

Wake County Public Schools Toolkit Addressing Process Differentiation

Process Differentiation
Acceleration: a strategy that allows a student to study material at a faster pace.
Complexity and challenge: the use of higher-order thinking skills.
Computer-based instruction: the use of technology to individualize instruction.
Flexible grouping: a purposeful reordering of students into temporary working groups to ensure that all students work with a wide variety of classmates and in a wide range of contexts during a relatively short span of class time.
Independent study: activities in which students use their unique abilities and talents to explore areas of special interest on their own.
Intelligence preferences: modes that reflect different ways a student expresses intelligence as indicated in systems described by Howard Gardner and Robert Sternberg.
Student interest: a factor to consider in offering student choice.
Varied questioning: a technique of forming questions with the goal of extending student thinking.
Varied texts and materials: a method of matching materials to the needs and abilities of different learners.

Note. (Retrieved from http://www.wcpss.net/curriculum-instruction/ag/ag_plan07-10.pdf).

Table 6

Wake County Public Schools Toolkit Addressing Product Differentiation

Product Differentiation
Group projects and investigations: activities in which students are grouped by interest to investigate a topic related to something being studied in class.
Learning centers or stations: collections of materials and activities designed to teach, reinforce, or extend students' knowledge, understanding, and skills.
Multi-media presentations and projects: products that require the development of 21st century skills.
Open-ended activities: tasks which allow students to take … product in non-prescribed directions and depth.

Note. (Retrieved from http://www.wcpss.net/curriculum-instruction/ag/ag_plan07-10.pdf).

experiences (McTighe & Brown, 2005). Students build new knowledge and skills by adding to their background knowledge. The learner, when confronted with new information, decides if this information contradicts or aligns with what he or she already knows to be true. Through this process, they grow as a learner.

Elliot et al., as cited by Eady (2008, p. 16) outlines six tenets to constructivism; the first three address constructivist view of knowledge, while the others concentrate on how that knowledge is built (see Table 7).

In a constructivist classroom, students create meaning and explore ideas independently while teachers function as facilitative guides. Questions seek to uncover students' understanding of *why* events occur. Students in the constructivist classroom regularly explain their responses and gain confidence in expressing their ideas. Proponents submit that the result is deeper student understanding of not only new content, but stronger connections between content areas (Queen, 1999). Learners in a constructivist classroom must be active learners, and the pure constructivist approach rejects all passive learning (Marlowe & Page, 1998; Serafino & Cicchelli, 2003). As in a DI classroom, teachers in a constructivist climate must have a deep knowledge of individual learners and their needs.

Cambourne (2002) asserts that one cannot separate what is learned from the context in which it is learned. The learner provides his or her own purposes to the classroom which is critical to what the student will learn from instruction; and all knowledge and meaning are socially constructed through the processes of negotiation, evaluation, and transformation. Pure constructivists believe that all human endeavors were not "handed down, ready formed, from on high; scholars have labored mightily over the generations to construct the content of

Table 7

Tenet of Constructivism

Tenet
Objective reality implies that subjective understanding of experiences correlate with preexisting experiences.
Knowledge is subjective. Knowledge will not be constructed in the same manner by individuals.
Shared knowledge indicates that constructivism appears to function similarly in any given situation.
Knowledge is constructed through the process of adaptation of ideas and experience.
Knowledge construction is simply influenced by environment and by symbols and materials one uses or has used previously. These symbols and materials become the "essentials" that will affect perception, interpretation, and functionality within the environment.
Cognitive constructivism and "readiness to learn" are precepts of Lev Vygotsky's Zone of Proximal Development. Vygotsky's ideas encapsulate the premise that different students may both be "ready" to learn about any given concept and may acquire information from the same experience (Eady, 2008).

these fields, and no doubt internal politics has played some role. Thus, in sum, human knowledge--whether it be the bodies of public knowledge known as the various disciplines, or the cognitive structures of individual "knowers" or learners--is *constructed*" (Elliott, Kratochwill, Cook, & Travers, 2000; Phillips, 1995, p. 5). Texts are viewed as opportunities for students to develop critiquing and reasoning skills, not as innate sources of knowledge. To develop students to their maximum, constructivist teachers concentrate on meaningful classroom experiences, creating environments in which students can take risks. This approach is a shift from traditional classrooms where instruction and content are the center of learning to an environment in which the student is the center (Ormrod, 2004). In constructivist circles, the resolution of the conflict between what the learner knows and what he or she is presented with is true (Friesen, 2007). Educators must be willing to relinquish their belief that all knowledge must be dispensed through them. All students are capable of acquiring knowledge through independent study or homogeneous group work while the educators facilitate that learning by providing feedback and instruction that empowers the students to achieve academic growth (Dreeszen, 2009).

A further shift from the traditional classroom is a movement away from the teacher-directed model to one in which the teacher facilitates student inquiry and activity. Researchers assert that since knowledge is attained this way, the instructor must create an engaged classroom in which students are actively involved in discourse and reflection (Fosnot, 2005; Friesen, 2007).

One benefit of constructivism is students put more effort into material they are studying if an interest exists (Ormrod, 2004). Students operating under constructivist philosophy engage in thoughtful and real experiences and are spurred to ask questions, investigate patterns, and create problem-solving strategies (Fosnot, 2005, p. ix).

Constructivism has some current adherents. Recently the Chaddsford School District in Pennsylvania experimented with a constructivist premise. Researchers in this district demonstrated that the implementation of a constructivist approach could be successful, even when under a high-stakes, state-mandated and standardized testing world, by comparing identified learning preferences compared to students' standardized test results (Pollock, 2007). Dreeszen's (2009) study notes a comprehensive constructivist in fifth grade literature circles. These circles add a component of student interaction which is more readily viewed in a social constructivist construct.

Social Constructivism

Social Constructivist theory was developed by Lev Vygotsky, a researcher in the 1920s and 30s, who expanded on the tenets of constructivist theory by addressing the social aspects of learning. Noting the difference between the amount of learning an individual could accomplish when contrasted with the learning in a group, Vygotsky asserted that students are more capable of problem solving when working with either an adult or a peer group. Vygotsky identified this as the Zone of Proximal Development (ZPD) and asserted that true learning is done in accord with others.

Social Constructivists submit that educators should determine different levels of learning based on children's different developmental levels. Wherein some educators consider only the developmental level of a child: i.e. *in third grade, we have third grade goals and do third grade work,* of greater importance in assessing a child's mental age Determining mental age can only be accomplished through a series of individual pre and post-assessments which are at the core of differentiated instruction. A second lineage between Social Constructivism and DI is viewed in the importance of peers in the learning process. According to Tomlinson, since learners learn

differently in important ways, teachers must be ready to address them. One way to create that prepared environment is to recognize the social nature of learning and create a classroom in which peers can help move each other forward (Doubet, 2007). Decades prior, Vygotosky noted that group gives access to "more capable peer", which is as important as their access to a guiding teacher (Doubet, 2007).

A typical social constructivist classroom begins with a teacher evaluating what a student can do independently and thus establishing his or her actual development level. The teacher then intervenes in a guidance capacity through leading questions, redirection, and limited assistance. Through this process, which includes working with peers, the teacher ascertains the child's potential development level. This Zone of Proximal Development (ZPD) is fluid during a student's year in the classroom and in successive years. A student's ZPD in first grade, for example, becomes their actual development level in second grade. This process, Vygotsky asserts, is true learning when contrasted with traditional environments which often focus on having students reach levels in which they may already be proficient. While students work within their ZPD, they are exercising developmental processes that are not addressed in traditional learning (Dreeszen, 2009).

Differentiated Instruction aligns with Vygotsky's work, as demonstrated in Tomlinson's writings that "learning occurs when a learning experience pushes the learner a bit beyond his or her independence level" (Tomlinson, 1999, para 4). A differentiating educator melds instructional resources to a student's ability to master so as to stretch that learner's capacity, but not so much as to cause frustration (Chen, 2007; MacGillivray & Rueda, 2003).

Not all research supports the constructivist/social constructivist viewpoint, and these criticisms apply to differentiated instruction as well. Constructivists believe that in every theory,

there are multiple theories which contradict that theory (Chrenka, 2001). Graves, Juel, and Graves (2004) assert that knowledge, proceeding from either a teacher or from instructional content to the passive learner, *is in and of itself* instructional. To abandon traditional delivery as a strategy ignores this fact while also creating the potential for added disruption. Brooks and Martin (1993) note the core challenge of a constructivist classroom is that teachers must relinquish some control of the direction a lesson might take. This can lead to loss of classroom management, which inhibits some teachers from truly exploring constructivism (Brooks & Martin, 1993).

Detractors note also that working memory does not function in a manner to support a constructivist approach (Kirschner, Sweller, & Clark, 2006). Shulman notes that the less regimented approaches of social constructivism fail because scientific inquiry can only be employed *after* a person has established a broad base of critical knowledge. Pure constructivism demands students employ scientific inquiry immediately. Constructivist classrooms only exercise working memory which is limited in its scope and capabilities (Sweller, 2003, 2004). Critics note that new information can only be stored for a short time in working memory whose capacity is finite. Inversely, when students access long-term memory, they do so without capacity restrictions, and students can access information from their long-term memory and effectively "place" it in their working memory for short blocks of time, making the constructs of working memory irrelevant. Those who disagree with a strict constructivist approach submit that educational theory must be grounded in understanding of the limits of working memory, or that theory is largely ineffective. Constructivist teachers offer a limited approach to guiding student discovery and thus act without a true understanding of working memory and its very real constrictions. This approach provides new information through discovery, which is the type of

information which most utilizes working memory (Sweller, van Merrienboer, & Paas, 1998). To date, constructivist theorists have not supplied research as to how their philosophy functions outside of what is known about working memory.

Kirschner et al. (2006) take issue with the goals of constructivism in regards to brain research. Teachers do not want to only provide an environment in which students unearth new information; they need to provide specific coaching on how to use their brain cognitively towards a goal. The "address" of this information, to be of any use to the learner, must be in long-term memory. There are long-lasting impacts of the constructivist approach practice to overusing the limited working-memory in lieu of stimulating and storing in long-term memory. Student understanding becomes disconnected and inaccessible. The sole use of working memory does not contribute to the accumulation of knowledge in long-term memory (Kirschner et al., 2006).

Gardner and Multiple Intelligences

Constructivist philosophy provides differentiated instruction with its student-focus, cycle of assessment, and practice of pushing students to areas just outside their grasp. DI also owes much of its underpinnings to the work of Howard Gardner. In the 1990s, Gardner advanced a cognitive theory furthering measureable intelligence (Campbell, Campbell, & Dickinson, 2004). He stated that learners had varied intelligences, and that these intelligences were developmental. Gardner defined intelligence as man's ability to make something, to offer a valued service, or to generate new problems to solve (Campbell et al., 2004).

Gardner suggested in 1983 that intelligence was not a single-measureable entity, instead identifying seven intelligences: verbal-linguistic, logical-mathematical, visual-spatial, bodily-

kinesthetic, musical-rhythmic, interpersonal, and intrapersonal (*naturalistic* was added to the list in 1993) (Gardner 1983, 1993).

Tomlinson notes two specific ramifications of Multiple Intelligences (MI) in considering differentiated instruction: students think, learn and create in a variety of ways. The development of potential in students is determined by the alignment of what is learned and how students learn with particular intelligences (Tomlinson, 2005, p. 18).

Multiple Intelligences is referenced in the differentiated instruction literature as educators seek to differentiate processes and products based on student learning styles or intelligences. In a Halpin-Brunt (2007) study of a differentiated science classroom, the researcher notes how an instructor appeals to students with musical intelligence by having students sing songs focusing on simple machines, gravity, etc. Students in this study were offered choice in projects to appeal to various intelligences. DI strategists submit that educators must consider a variety of instructional strategies because intelligence is variable (Tomlinson, 2001). When a person learns in ways that are parallel with his/her preferred style, he/she will become comfortable and remember more of the lesson (Varner, 2008). Multiple Intelligence theorists note that MI goes beyond learning preference, speaking to the core of what students need to be successful (Doubet, 2007).

MI theorists believe that all students are talented (Heacox, 2002) and focus on enriching the areas in which students show intelligence in lieu of searching to remediate students in areas where they have not demonstrated intelligence (Campbell et al., 2004). A school prescribing to both MI theory and DI practice would require teachers to be cognizant of student's skills and to create lessons in which students can best sharpen, utilize, and demonstrate these strengths. This

necessarily and significantly shifts the role of the teacher from a resource of static information to a motivator, facilitator, and coach (Eady, 2008; Finley, 2008).

Additional Theories Underpinning Differentiated Instruction

In addition to the large guiding philosophies of constructivism and multiple intelligences, other methodologies have given shape to the DI movement.

Individualization of Instruction

Components of differentiated instruction are visible in the individualized child approach of the late 1950s. Kenneth Jenkins notes Dehaan and Doll's ascertation theory that teachers must individualize instruction, noting students "unique perceptions, values, concepts and needs" while "fashion(ing) learning opportunities to enhance pupil's individuality" (Retrieved from http://www.jstor.org/pss/30184070). Harold Shane, writing in 1960, cites one issue of modern education is the lack of data schools keep on individual student intelligence and achievement, contributing to teachers' inabilities to group children effectively (Retrieved from http://www.jstor.org/pss/20342430). Lindgren notes a shift in the 1950s, from the teacher "dominating the learning situation" to recognizing the learner as the "prime moving force" and urges educators use interpretation of experience specifically for each individual learner (Lindgren, 1959, p. 81).

Dixon-Hegelian Method

Researchers Dixon, Prater, Wark, and et al. (2004) point to philosopher Georg Wilhelm Friedrich Hegel's nineteenth century work to demonstrate critical thinking practices which gird current DI strategies, referring to this as the Dixon-Hegelian Method.

Hegelian thought asks "what is the accord between the mind and the world outside it? How is it that the one naturally understands the other?" (Bronowski & Mazlish, 1962, p. 481).

Hegel stresses unity between the student and knowledge, and without that *complete* unity there would be no knowledge. Learners must go through an ongoing process of reconciliation with the world in order to make sense of it. Each learner comes to a new experience with a thesis, an understanding of how the world functions. He or she then faces a conflict as new information creates an antithesis to his or her understanding of that world. Learners reconcile this conflict by absorbing this new information in a final synthesis of this "unity of opposites". This synthesis is true learning (Bronowski & Mazlish, 1962).

There are clear parallels between Hegel's process of knowledge inquisition to Bloom's higher level taxonomies of analysis, synthesis and evaluation (Bloom, Englehart, Furst, & Krathwohl, 1956). Teachers subscribing to a Hegelian process, must enhance critical thinking by creating learning environments in which these conflicts may be resolved. The Dixon-Hegelian process is informal with teachers serving as guides so that students can solve their own problems through consideration of various syntheses to reconcile new information. Issues are discussed in small-groups which are largely constructivist in nature. Synthesis creates the base for the introduction of the next thesis, and the classroom becomes an environment in which students consistently think critically as they move towards a broader view. This use of peers and critical thinking parallels both constructivism and differentiated instruction (Dixon et al., 2004).

Cognitive Psychology as Instructional Methodology

Cognitive psychology is concerned with how people think, remember, and learn (Serafino & Cicchelli, 2003). At the core of cognitive psychology is the belief that "the brain is a survival organ that must be engaged by its learning environment rather than threatened or negated by it" (McTighe & Brown, 2005, p. 236).

McTighe and Brown (2005) note an understanding of cognitive psychology is critical for implementation of differentiation in today's classroom as it aligns with the constructivist belief that we as humans construct meaning from our surroundings (see Table 8).

Transactional Theory of Reader Response

Transactional theory aligns with DI's beliefs that each reader has his or her own experiences, whether cultural, social or experiential, which they bring to each text. Students come to the classroom with a breadth of background knowledge and need for stimulation and require differentiated reading instruction. The differences students bring to a text result in readers constructing various meanings when presented with that text. Teachers are responsible for bringing the right text to the right student in order to help them to grow; and to do so requires that teachers have a both a significant command of literature and a complete understanding of each student as an individual (Rosenblatt, 2005). Without this command, a teacher will choose texts which will either bore or discourage the student; both of which damage the student's ability to acquire knowledge. The match between proper reading and prepared reader results in meaning. A reader working within his or her ability with the proper text will have a richer and more meaningful experience with instruction.

Rosenblatt continues that educators must consider the reader's purpose in reading. He delineates *efferent stances* in which the reader is looking for meaning and *aesthetic stances* which align with a reader's feelings and attitude. Whether a reader takes an aesthetic or efferent stance will shape the meaning he or she extracts from the text. The teacher, therefore, must be clear and purposeful with how they choose readings and shape student approach to them. Ultimately, neither the reader or the text is the primary component in transactional theory, it is the exchange between the two (Rosenblatt, 2005).

Table 8

Operating Principals of Cognitive Psychology

Cognitive Psychology Approach to Differentiated Instruction
Learning must be broad enough to be applicable to a diverse group and students each learn in different ways.
Educators must first reach an understanding of core ideas to be taught.
Educators should seek a deeper understanding of fewer topics in lieu of ankle-deep coverage of great many topics.
Educators must provide a continuous feedback loop.

Note. (McTighe & Brown, 2005).

Brain Research Supporting Differentiated Instruction

While aspects of brain physiology contradict constructivism and DI, current brain research is also used to support its implementation. Kablefleisch and Tomlinson (1998) note that the brain learns best when it is actively doing something rather than just absorbing. Absorption occurs through rote instruction, but when the brain is constructing knowledge and making connections between new knowledge and prior knowledge, the brain is operating at its peak performance (Halpin-Brunt, 2007).

Sprenger (1999) notes the specificity of development in the adolescent brain and how it functions best under DI; per example, providing high school students social or artistic activities in the morning stimulates the needed adrenaline to overcome sleep. As the adolescents' parietal lobes mature, their brains respond more readily to emotion and novelty. Their spatial awareness improves, making them more adept at learning activities which impact movement (Feinstein, 2004). Sprenger states, "Amy doesn't realize that the movement involved in the play helps her remember. Repeating the lines along with the movement creates another cue or trigger for the memory—much like it did in her toddler days of playing pat-a-cake and repeating the rhyme that goes with the actions" (Sprenger, 1999, p. 32). Similarly, Pennington (2010) cites movement as effective in teaching grammar to high-school students, while Wolfe (2006) asserts the connection between utilizing brain-grounded approaches such as experiential learning, rhyme, and movement to academic gains.

In consideration of the cognitive environment, educators should consider that the prefrontal cortex responds positively when given a choice (Serafino & Cicchelli, 2003). Stimulation in the amygdala demonstrates the correlation between offering choice and positive brain stimulation (Sprenger, 2005). David Sousa (2001) explains that the sensory register of the

brain filters incoming information, allowing some of it to enter working memory or rejecting some of it based on a variety of factors (prior experience, determining the information has no value, etc). If the information is found to be valuable, only then does it enter one's working memory. This puts the impetus on the educator to produce authentic learning experiences.

According to Sousa (2001), educators need to take advantage of brain phenomenon which occurs while information is in working memory; during this phase the brain chunks together multiple pieces of information as one. While learners vary in the amount of chunks they can hold in their working memory at a given time, educators may be able to increase this capability (Sousa, 2001, p. 120).

In order for those chunks to be of lasting import for the individual, true learning must take place. For this to happen, the student must transfer working memory onto meaningful frameworks. Sousa asserts this transfer is impacted by teaching methods. He notes that students remember as much as 90% of information they teach others and 75% of what they practice by doing. Yet students remember only 10% of what they read and only 5% of what they hear in a lecture (Sousa, 2001, p. 95).

Educational philosophy and brain research are keys to understanding the rationale for differentiated instruction and how its strategies apply to increasing academic performance for all students.

Differentiation Instruction as Central Methodology

Central to both the theories supporting differentiated instruction and to differentiation itself is the belief that these strategies benefit all students, not just the gifted (Downy et al., 2009; Tomlinson, 2000a). Borland argues for "no conception of giftedness" because the dichotomy of gifted education is a false one (Borland, 2005, p. 1). Creating only two categories of giftedness is

contrary to both experience and to what research supports about modalities of intelligence: “In other words, we treat giftedness as a thing, a reality, something people, especially children, either have or do not have, something with an existence of its own, independent of our conceiving or naming of it” (Borland, 2005, p. 7). Research cites that there are tangible benefits for using DI strategies with students in all classrooms (Cooper, 2007; Yatvin, 2004). Critical thinking in schools must happen regularly for children of all ages. To that end, educators emphasize the need for regular implementation of critical-thinking activities for all classrooms in America’s schools (Dixon et al., 2004; Snowman & Biehler, 2006).

Differentiation for all students is supported by both brain research and education theory and also serves to address racial tracking which exists in schools. In the United States, students in honors courses are primarily white and affluent, and low-end, special-needs students are primarily minority students (George, 2005). This tracking, results in poor performance for lower tracks who have been historically marked by low-interest reading and rote worksheets in contrast to the higher tracks who are exercising more critical thinking skills (Haury & Milbourne, 1999). There is support that this tracking also negatively impacts those in the honors tracks as well. Students in Advanced Placement classes in the United States are not performing as well as similar students in other nations because they are not receiving modified instruction in their gifted tracks. Haury and Milbourne conclude that these students are better served in mixed ability differentiated classrooms that in ability-segregated ones. The authors submit that since U.S. students do not graduate specifically prepared in math or science, educators must consider abandoning current tracking in favor of mixed-grouping with differentiated instruction as the overarching strategy to address student differences. Doing away with separate courses for

advanced students causes minimal negative impact as those students are only showed marginal gains under current predominant structure (Haury & Milbourne, 1999).

There are case studies of benefits of differentiated instruction for all levels, including benefits for special needs students in the inclusion classrooms (Gartin et al., 2002). Positive student response to the strategies is evident in Doubet's 2007 study of a small high school in New England which surveyed student perceptions of DI methodology (see Table 9).

The impact of tiered instruction is evident in a variety of settings outside of the realm of gifted education. Richard's (2005) study of tiered instruction, a foundational DI practice, found gains in assessment for all students in secondary freshmen earth science when the practice was implemented. In Montgomery's study of a specific middle school, differentiated instruction proved effective for students with varied-levels of emotionally and cognitive handicaps (Montgomery, 2006).

Studies in a various setting have produced similar findings. Stager (2007) found that tiered instruction enabled third grade students to increase their understanding of fractions, increase their competencies on common assessments, and increase their positive approach and attitude towards their studies. Similar results have been seen in English as Foreign Language programs in Taiwan (Chen, 2007). Chen examined the efficacy of tiered performance tasks through a series of interviews which revealed that participants found this strategy to be an integral component of their success. Students believed the strategies pushed them towards autonomy and increased their motivation.

Table 9

"Lakewood" High School Students' Positive Responses to Differentiation

Positive Aspects of Differentiation-Emerging Themes	Number and Percentage of Students Citing Theme
Increased Motivation from Choice and/or Freedom	32 (40%)
Increased Appreciation for Student Diversity	22 (28%)
Helps Increase Learning	20 (25%)
Opportunity to Push Myself/Feel Successful	20 (25%)
Feel "Known" by Teachers	11 (14%)
Get to Know Myself and How I Learn	9 (11%)

Note. (Doubet, 2007, p. 233).

One hindrance to full implementation of DI strategies in low-level classrooms is that these environments are often disproportionately comprised of students from low-income families. Low-income students respond better in environments with fewer distractions. Because differentiated practices have more transitions and are generally more active and sensory than traditional classrooms, they often are more distracting than traditional environments (Darling-Hammond & Bransford, 2005; Hoover & Patton, 2004; Miller, 2007). Student behaviors can also get in the way of both teacher willingness to differentiate and in the efficacy of those practices once implemented. Historically, lower-level classrooms have more incidents of student misbehavior, which decreases teacher willingness to differentiate (Miller, 2007).

Proponents of differentiated instruction submit that students will think more critically, be more engaged, and make more significant progress through the implementation of these strategies; however, there are numerous concerns and hurdles with have either slowed or halted the implementation of DI in many districts. Differentiated instruction, like many initiatives in public schools, faces common barriers such as fear of change (Drain, 2008). Additional critiques are more specifically tied to the practice itself.

Critiques of Differentiated Instruction

Curriculum Sacrifices

Because differentiated strategies can require more time, research has noted concerns with covering the breadth of the prescribed curriculum under a strict DI approach. Teachers who attempt to create more complex lessons which reach a variety of levels must make some curriculum sacrifices (Vaughan, 2010). Teachers who have built effective methods and time frames to complete the standard course of study can be hesitant to remove units on which the students, and they, will be evaluated (Carolynn & Guinn, 2007).

Differentiation Has Had Limited Successful Implementation in Gifted Education

Differentiated Instruction pulls much of its methodology from gifted education, and as such, the current shortcomings of gifted education could be replicated depending on how these philosophies are applied to wider populations. Drain (2008) notes that public education currently triages needs, and in an effort to serve underperforming students, gifted students have not consistently been served well across the board. Literature indicates that quantitative research on the effectiveness of differentiated instruction is still quite scarce as it relates to the gifted child. Reis, Gubbins, Briggs, and et al. (2004) note that educators have failed to differentiate within the AG classroom, treating gifted and talented students as a homogenous and static group rather than a collection of individuals who grow and change over time.

As gifted students are often segregated from their peers, teachers have seen no need to differentiate; they simply teach to the whole class at a higher level (Archambault et al., 1993; Reis et al., 2004). When gifted students are placed in homogeneous classrooms, current research notes they receive little if any appropriate DI strategies (Reis et al., 2004). Dreeszen (2009) asserts this model coupled with *No Child Left Behind* has resulted in a lack of differentiated strategies being employed at all for the gifted student. Critics state that educators are not prepared to replicate differentiated strategies they have been using for gifted children, because they simply have not been using them in any sustainable manner (Reis et al., 2004).

The efficacy of the AG program in *WCPSS* has been evaluated most recently by Anisa Rhea and Roger Regan from *WCPSS* Evaluation and Research and *WCPSS* Magnet Programs respectively. In a June 2006 report, Rhea and Regan quantified the effectiveness of AG Basics Program offered at Wake magnet schools. The key findings noted the program has not produced consistent higher-than-average growth composites at the county's AG Basics schools compared

to other schools in the district (Rhea & Regan, 2006). The growth composites show no significant differences between these student composites with non-AG composites. Coupled with this, EOG and EOC composites note significant needs for growth among *WCPSS*' gifted population.

Professional Development and the Problem of Definition of Terms

Because differentiated instruction and its strategies are complex, educators are not united on a single definition of terms (Burns, 2005). Finley's work with elementary educators points to the wide range of definitions practitioners bring to DI. Her survey shows pointed discrepancies between what instructors thought they knew about differentiated instruction and how they chose to define it. This lack of clarity equated to a wide-range of strategies being employed in the name of DI, mainly focusing on individual instruction, intentional grouping, and modifying lesson. Through this study, and increased professional development, student-teachers grew to understand differentiated instruction more clearly. However, in the interim much time was ill-spent with loose definition of terms (Finley, 2008).

The Association for Supervision and Curriculum Development (ASCD) reports that a lack of clarity in the definition of differentiated instruction has led to similar results and has made evaluating its effectiveness challenging. ASCD cites an educator who differentiated products for students following a class reading. Each product addressed a different learning style, paralleling Gardner's MI philosophy; however absent from the assignment was a sense of what the products were accomplishing. Because of her incomplete understanding of DI, the teacher did not provide a high-level authentic learning experience (Scherer, 2000). Eady's interviews with building-level principals revealed their gaps in understanding between both the broad concepts and the specific implementation strategies of differentiated instruction. She recommended further quantitative

study to determine if there is a direct correlation between years of tenure and level of implementation (Eady, 2008). Tomlinson notes that without the catalysts of building administrators educated in true definitions of differentiated instruction, strategies will not be implemented (Tomlinson, 2000a).

Many school leaders are currently acting independently with their own conceptions of what the differentiated instruction means. Tomlinson stresses the need for mentor teachers, administrators, and university student-teacher liaisons to unite their views around the five principals of differentiated instruction: a sense of community, the engagement of curriculum with specific learning objectives, use of appropriate level of rigor/support, on-going formative assessment and purposeful grouping (Doubet, 2007; Tomlinson, 2000a). Until those groups have a shared vocabulary, much of the professional development offered will be fragmented. Professionals overseeing the implementation of DI and the training of future differentiated practitioners must preserve fidelity of practice through unified strategy definition. Tomlinson (2000a) asserts the need for professionals to be versed in the ways in which they can differentiate (content, process and products as well as the environments).

Because differentiated instruction proposes a systemic change to instructional approach, indirect training has been ineffective. Direct information from qualified practitioners which includes a cycle of follow-up is required for all professionals seeking to employ the strategies with fidelity (Wiggins & McTighe, 2006).

An additional barrier to successful professional development is collaboration. In order for professional development to work effectively, there must be singularity of mission between schools and districts and clear definitions of what is to be done shared by all (Rowe, 2008). The

complexities of defining DI and need for teacher reflection can inhibit this singularity of mission (Nunley, 2006; Wiggins & McTighe, 2006).

A review of recent studies of the attitudes and beliefs of teachers implementing DI in their classrooms reveals impediments to its successful, long-term implementation: time and training. Valli and Buese note that adopting differentiated instruction requires teachers to take on additional roles and to increase intensity in their existing ones. Curriculum management, ongoing assessment, tiered planning, and increased data management are new roles for many teachers. Structures for remediation and enrichment intensify, and all require increased planning and evaluation time (Valli & Buese, 2007).

Doubet's qualitative study looked at three elementary schools in Pennsylvania and the degree these teacher concerns shaped differentiated instruction's implementation. Teacher interviews along with two questionnaires-one that codified teacher level of concern, and a second to determine to what extent teachers implemented DI techniques served as data sets in this study. Through this, Doubet assigned levels of DI implementation for each individual, tallied these numbers, and produced an average number of DI implementations for each school. While most surveyed teachers uses the prescribed strategies and agreed they were helpful practices, the vast majority of the teachers asserted the need for ongoing and meaningful professional development and additional time to implement (Doubet, 2007).

Teachers report that while differentiated strategies are effective at meeting the varied needs of the learner, they are so time-intensive in the planning and assessing phases that they are seldom utilized (Christian, 2005). Goodlad (1993) focused on the teacher education role of professional development in the United States in the context of school-university partnerships. He collected data through personal observation of pre-service teachers and staffing of schools in

a school university partnership program. Goodlad (1993, p. 10) reported that "teachers were expected to keep the present regularities clomping along simultaneously" while attempting to add time-intensive differentiated strategies. He concluded that to expect teachers to engage in differentiated instruction without making adjustments to administrators' previous expectations regarding their schedules and time commitments was unreasonable. Doubet (2007) asserts that collaboration is not a natural skill, and teachers need to build in more time for both up-front planning and reflection in order to implement differentiation strategies of collaboration with fidelity.

Chapman and King (2005) note that teaching is bound by habit and establishment of classroom routines in a teacher's early career. It is difficult to modify those practices once firmly entrenched. As such, the widespread changes differentiated instruction demands in every aspect of teacher work (planning, implementation, and assessment) are formidable. The varied needs of teachers- from attaining necessary management skills to understanding specific learning-outcomes make school-wide, let alone district-wide training difficult (William, 2008). The teacher who acknowledges student differences and wants to address those specifically in his or her classroom, may find the desires ignored in favor of standards-based staff development (William, 2008). Standardized testing may steer teachers from spending limited staff development opportunities away standardized, traditional teaching (Schlechty, 1997).

Sanborn (2002) notes that most schools implement professional development on a piecemeal basis without a strategic long-range plan. This does not lead to systemic growth within the system, and these workshops do not have significant impact on practice (Cochran, Hamtil, & Lake, 2008; Corcoran, 1999; Mizell, 2003). Of the changes which principals do implement, promotion of consistent change is the most overlooked (Guskey, 2002). As DI requires

consistent, ongoing change, professional development attached to it must be systemic and ongoing as well (Gordon, 2007; Retrieved from http://www.learningforward.org/standards/index.cfm). There is not a strong body of research measuring what teachers glean from professional development (Marshall, Prichard, & Gunderson, 2001).

While research points to the necessity of targeted staff development prior to the successful implementation of differentiated instruction, most systems do not have this in place prior to implementation (Burns, 2005; Graham, 2009). Educators report they have never been adequately trained in gifted education, which serves as the basis for DI, making application of this skill set without professional development impossible (Archambault et al., 1993). Many hours of training are required to implement differentiated strategies with fidelity; and DI strategies cannot be adequately taught in a single session (Burns, 2005). Richards' (2005) study points to the specific needs of ongoing professional development, demonstrating teacher hesitancy to use tiered lessons. He concluded a teacher needs to teach the curriculum two years in a row and undergo ongoing professional development under lead teachers who could control and monitor implementation.

One optimal environment for professional development around differentiated instruction is in teacher-preparatory programs at colleges and university. Finley (2008), however, states that the college-system has not adequately equipped teachers to differentiate. While students are exposed to the strategies in their coursework, there is little evidence to show that these courses lead to a conceptual model that new teachers can use in the classroom (Clift & Brady, 2005).

The professional development movement has focused on the school-based classroom teacher as facilitator. Differentiated instruction professional development requires teachers on-

site to demonstrate the strategies in a real environment (Clarke, 2006). A study by Halpin-Brunt (2007) which surveyed elementary teachers illustrates this colleague-directed support is lacking. None of these neophytes had mentor guidance on how to develop differentiated lesson plans. Eady (2008) notes the need for professional development around DI and the need for further study on the prohibitive expense of offering it in this arena.

Reconciling No Child Left Behind Standards and Practice with Differentiated Instruction

One component of the *No Child Left Behind Act* of 2001 was to increase accountability for schools and districts (Guggino, 2008). A 2004 government *Guide to Accountability and No Child Left Behind* underscores the importance of accountability and state standards in its pursuit:

> Accountability is a crucial step in addressing the achievement gaps that plague our nation. For too long, the poor achievement of our most vulnerable students has been lost in unrepresentative averages. African American, Hispanic, special education, limited English proficient, and many other students were left behind because schools were not held accountable for their individual progress. Now all students count. Under *No Child Left Behind*, every state is required to (1) set standards for grade-level achievement and (2) develop a system to measure the progress of all students and subgroups of students in meeting those state-determined grade-level standards (Retrieved from http://www2.ed.gov/nclb/overview/intro/guide/guide.pdf)

State testing standards under NCLB greatly impact curriculum and its implementation. Schlechty notes that teachers who wish to bring out the individuality of their learners through DI fall under stress based on the NCLB system (Schlechty, 1997; Waldon & McClesky, 2001). The standards imposed by NCLB can at times pull teachers away from DI practices despite the teachers' desires (Chapman & King, 2005; Drain, 2008).

The focus on achievement for student groups not performing under NCLB- who are disproportionately poor, minority and special needs- means that these groups do not have sustained practice in differentiated instruction (Guggino, 2008). Simply trying to insure that the basics are covered and remediation is provided precludes the time-intensive methods of these

strategies (Brimijohn, 2005; Graham, 2009; McTighe & Brown, 2007). Tomlinson (2000c) cites cases where concepts are removed from instruction, as teachers move to teaching isolated skills based on NCLB mandates. Differentiated instruction presupposes that authentic teaching must take place around concepts in order to impact long-term memory. Further, the demands of NCLB-focused instruction diminished the teacher time needed to motivate and engage students with tiered lessons and scaffolding (Luft, Brown, & Sutherin, 2007).

Valli and Buese's (2007) research focuses on the fundamental shift of teacher work in the wake of *NCLB* which they view as having "increased, intensified and expanded" in a system which directs them to "enact pedagogies that are often at odds with their vision of best practice" (pp. 534-535). Teachers in struggling districts in urban schools handle an array of issues like larger student populations, fewer resources, and little control over the curriculum (Calabrese, Goodwin, & Niles, 2005). When these schools face the consequences for failing to meet AYP under NCLB, principals often direct teachers back to regimented curriculum and methodology as the cure (Grineski, 2005). It may simply not be feasible to expect teachers in these schools to take on a differentiated instructional philosophy which requires a fundamental shift in their beliefs and practices and time commitments (Gleibermann, 2007; Graham, 2009).

NCLB calls for "research-based instructional programs" and therefore, theories such as differentiated instruction which do not have a significant research-based correlation with standardized test performance are marginalized (Retrieved from http://www2.ed.gov/nclb/overview/intro/guide/guide.pdf). The focus on subgroups also tracks and separates students in a manner which is contrary to DI philosophies of environment (Baglieri & Knopf, 2004; Dreeszen, 2009).

Critics of *NCLB* note that under its structure, teachers have been given the task of improving all student achievement without the ability to account for their differences. The standardized tests produced to insure adherence to *NCLB* do not measure the effectiveness of teachers, the feelings of students towards the content, and student sense of empowerment- all hallmarks of differentiated instruction. Teachers held to the tight curriculum demands of an *NCLB* –driven curriculum have little time for the cycles of assessment and student-centered planning constructs of DI (Gunning, 2008).

No Child Left Behind legislation has neither allowed for, nor given cause to, the increase in diversity in the American classroom in learning modalities, culture, home language and exceptionalities. While socio-economic and race are quantified as separate subsets, there is no verbiage as to how differences impact performance or how teachers are to reach diverse needs (Kauchak & Eggen, 2005). Proponents of differentiated strategies believe that they should be the answer to, not the casualty of NCLB requirements. *NCLB* and DI need not be mutually exclusive as the legislation has done much to shed light on the need for differentiated strategies. Prior to NCLB, teachers in special-education and ESL/EFL programs were able to implement a less rigorous curriculum, and the legislation put in place much needed standards of performance and demonstration of mastery for these student groups (McTighe & Brown, 2005).

McTighe and Brown (2005) note that the philosophy of differentiated instruction is most zeroed in on the needs of the individual, which helps performance on state-standards assessments, effectively marrying the goals of *NCLB* to differentiated instruction. Instead of altering the curriculum to meet the needs of the students, differentiated instruction provides all learners access to the same curriculum, thus improving end-of-course standardized performances for all subgroups (Bravman, 2004; Grafi-Sharabi, 2009). The conflict between standards-based

teaching and differentiated instruction will happen if standards are presented in ways that cause DI teachers to go away from what they know to be effective; in these cases of professional tension, teachers most often choose to go with administrative mandates (Chapman & King, 2005; Sondergeld & Schultz, 2008; Tomlinson, 2000a). Many researchers assert that there is a natural correlation between standards-based curriculum and DI: as the curriculum tells what to teach and differentiated instruction tells how it should best be taught (Gregory & Kuzmich, 2004; Tomlinson, 2000a, 2000b).

Teacher Resistance

Teachers can be more resistant to differentiated instruction when compared to other current initiatives as illustrated by Nicolino's 2007 survey. Nicolino investigated the factors that influence the integration of differentiated instruction compared to other strategies within the classroom. Findings indicated that teachers felt most comfortable facilitating the learning process through the use of instructional technology, and those teachers were less comfortable instituting DI protocols than other strategies (Nicolino, 2007).

Tomlinson (2005) asserted that, while differentiated instruction benefits students, it is ultimately the teachers who make instructional decisions, and they largely do so from habit and established belief systems. If the teachers do not embrace the change, the change simply will not come. In Grafi-Sharabi's (2009) study, teachers saw no need to implement the strategies as they believed that they were already using the strategies prescribed by the philosophy (their definitions of the practices revealed that this was not the case. A national survey of middle school teachers by Moon, Callahan, Tomlinson, and Miller (1995) revealed that half of all teachers felt no need to differentiate. In a Schumm and Vaugn (1995) survey, teachers who rejected differentiation noted that it was an unrealistic practice and beyond the scope of their job.

to individualize instruction at that level. Intentional grouping is one of the major components of differentiated instruction, that many teachers resist feeling that the practice is socially ineffective. One teacher notes that stratifying students puts an unnecessary spotlight on differences, when whole-group instruction is move inclusive (Vaughn, Moody, & Schumm, 1998).

Commitment of school administration. Eady's research study demonstrates that the principals interviewed did not have a working knowledge of the key concepts and strategies of differentiated instruction (Eady, 2008). The advent of NCLB has also increased the level of administrative insight into governance of what is being taught in the classroom. Many teachers see differentiation as a means for administrators to codify methodology in the classroom (Valli & Buese, 2007). Paradoxically, once the classroom doors are closed, teachers can simply choose to rely on traditional methodologies even if DI is mandated in their school (Brighton, Hertberg, Moon, & et al., 2005; Moon et al., 1995).

For the teacher trying to implement differentiated instruction, a lack of support from administration is noted as a hindrance. Christian's qualitative study looked at the implementation of DI at three elementary schools and the concerns of teachers charged with that implementation. One of the teachers' primary concerns which impacted their degree of DI implementation was their perception as to how committed their principal was to the initiative. Those with little confidence in the commitment of their principal differentiated less often. Teachers in this study expressed the need for an outside expert who could assist them in the implementation of DI, as they did not feel their building-level administrator was qualified (Chrisitan, 2005).

Administration's attitudes differentiated instruction greatly impacts implementation (Holmes, 2008; Luster, 2008; Robinson, 2004). Hertberg-Davis and Brighton's (2006) study of three middle schools revealed a wide range of DI implementation based on principal attitude.

Teachers serving under a principal who encouraged DI and supported teacher efforts made significant gains in implementation; teachers in a building run by a principal who spoke well of DI, but whose behaviors indicated it was not a priority took on those same characteristics. A third group of teachers working for a principal viewed as authoritative and who seldom attended DI professional development at the school soon came to view differentiation as a burden.

In a study of kindergartners through third graders, Robinson (2004) notes that teachers did not link differentiated research into differentiated practice. Failure of these educators to transfer these skills was the failure of the principal to establish support teams (Burns, 2005; Doubet, 2007; Drain, 2008).

Mixed body of research on differentiated instruction. Differentiated instruction is still very much in its theory stage as an effective, sustainable strategy for student success. There is not a sizable, quantifiable body of research to speak to its efficacy (Archambault et al., 1993). To date, there have been no studies in the effectiveness of Tomlinson's practices (Dearman, 2007). Other research has demonstrated failures of differentiated instruction to insure any measureable results (Danzi, Reul, & Smith, 2008). Additionally, there is a lack of research as to what exactly occurs in a differentiated classroom (Doubet, 2007; Eris, 2005).

Doubet's interviews of high school students also reveal some of the negative student reactions to differentiation instruction, which is significant as student empowerment and buy-in are among the hallmarks of the movement (Doubet, 2007, p. 247) (see Table 10).

This mixed body of research on the effectiveness of modern differentiated instruction approaches compels further research on the efficacy of differentiated instruction.

Table 10

"Lakewood High School" Students' Negative Responses to Differentiation

Negative Aspects of Differentiation-Emerging Themes	Students Citing Theme
Lack of challenge in work	53%
Methods contributed to student laziness	23%
Inequality in respectful tasks and work	20%
Strategies contributed to lower self-esteem and confidence	15%
Confusion regarding the tasks and direction	10%

CHAPTER 3: METHODOLOGY

Introduction

This quantitative research study compared the differences between the reported frequency levels of teacher differentiated instructional practices and their corresponding levels of student performance as measured by residual scores from North Carolina EOCs given at Margate High School between 2004 and 2010. Tests were given in Algebra, Algebra II, Biology, Civics & Economics, English I, Physical Science, and U.S. History. During the past five years, several studies have added to the body of research on the efficacy of differentiated instruction as a means to reach all students. Both Wake County Public School's Curriculum Management Audit (Retrieved from http://www.wcpss.net/curriculum-management/downloads/wcpss-curriculum-management-audit.pdf, pp. 30, 192) and the publication of Dr. Fenwick's findings in 2009 (Downey et al., 2009) supported the need for each teacher in the district to employ differentiated instruction techniques as a means of reducing the achievement gap.

A strong difference between the average residual EOC scores of teachers who claim to differentiate instruction frequently and the student EOC scores of those who do not report differentiating instruction frequently would provide support for differentiated instruction impacting student achievement as measured by a standardized test. This research study examined two pre-existing data sources: Margate High School's Margate High School Differentiation Survey results and Wake County Public School's teacher residual scores (2004-2010).

Research Questions

This study included all teachers who delivered instruction to students who were required to take a North Carolina EOC (Algebra, Algebra II, Biology, Civics & Economics, English I,

Physical Science, U.S. History), and who taught the same EOC course for at least two separate years between 2004 and 2010 and addressed the following questions:

1. Do instructors who employ differentiated instructional strategies have significantly higher residual scores as measured by the EOC than their peers who do not practice differentiated instructional strategies as frequently?
2. Are there areas of differentiation, whether content, process or product, which when employed consistently, show a significant difference in teacher residual scores?

Context for the Study

In 2008, Margate High School, located in Raleigh, North Carolina, had a student population of 2582 students Student population was comprised of 19.6% Academically Gifted students, 5% Limited English Proficiency and 30.8% Students with Disabilities. (Retrieved from http://dashboard.wcpss.net). On August 23, 2008, Margate High School had 142 certified teaching staff on-site, divided into eleven departments (see Table 11).

Participants in the Study

From the 152 teachers who completed the online differentiation survey on August 23, 2008, fifty-five participants were selected based on the following criteria: they had taught at least one EOC course between 2004 and 2010, and there was available residual data from *WCPSS* Evaluation and Research as to their performance.

Data Sources

This study used two sources of pre-existing data: *Margate High School Differentiation Survey* results and Margate High School teacher residual scores as prepared by Wake County Public School System's Evaluation and Research Department.

Table 11

Margate High School Instructional Staff August 2008

Department	Number of Teachers
Fine Arts	7
Career and Technical Education	21
English	18
Foreign Language	6
Healthful-Living	8
Mathematics	24
Media Specialists	3
Science	16
ESL	3
Social Studies	19
Special Education	17

Margate High School's Differentiation Survey

Development of Margate High School's Differentiation Survey. Following Dr. Fenwick English's presentation to the Superintendent's Advisory Committee in March 2008, Margate High School initiated differentiated instruction as its main instructional focus for the 2008-09 school year. A team comprised of administrators and teachers from each content area met weekly during summer 2008 to determine an implementation schedule for the philosophy and strategies of differentiated instruction. The team determined eight goals, with the primary one that each teacher would have a common definition of differentiation and its practices (J. Brown, personal communication, October 8, 2010). This instrument measured the level of understanding and implementation of the differentiated strategies presented to this school population.

The team determined to first gauge teacher knowledge and implementation of differentiated strategies. They chose several strategies from the August 2007 Wake County Public School System's Academic and Gifted department designed *Instructional Strategies that Support Differentiation* as part of their *Toolbox for Planning Rigorous Instruction* (Retrieved from http://www.wcpss.net/isd/resources/downloads/03-06-is-defn.pdf). These strategies were adapted from Carolyn Coil's *Successful Teaching in the Differentiated Classroom* and *Teaching Tools for the 21st Century*, Carol Ann Tomlinson's *The Differentiated Classroom: Responding to the Needs of All Learners* and Carol Ann Tomlinson and Caroline Cunningham Edison's *Differentiation in Practice: A Resource Guide for Differentiating Curriculum* (see Appendix B). Strategies were chosen from this initial list in order to construct a more manageable survey which covered content, process and product differentiation (see Appendix B). Margate High Schools differentiation team added verbiage to some definitions to clarify meaning and on two

occasions added terms (J. Brown, personal communication, October 8, 2010). Full rationale of changes is provided by Julie Brown, former member of Margate High School differentiation team in Appendix D.

Margate High School's differentiation team determined they wanted to measure how often teachers used each of these strategies in a given unit. The team designed an online survey tool in which teachers could self-select the frequency of use of each of these strategies. For each of the *Instructional Strategies that Support Differentiation at Margate High School*, teachers indicated they utilized the strategy "less than 1-2 times per unit", "1-2 times per unit", "3-4 times per unit", "daily" or "unsure of the application within my content". A "unit" was chosen as the measure of time as various content teachers may view number of school days differently (i.e., a science teacher may take three weeks on a given unit, while a math teacher may complete a unit in two days. By focusing on "units", instead of "days", the committee hoped to allow respondents to evaluate their choices holistically (J. Brown, personal communication, October 8, 2010). At the conclusion of the survey, teachers were able to indicate three strategies they would like more professional development around.

On August 23, 2008, a representative of High School's differentiation team presented a PowerPoint to teachers explaining the initiative to teachers; following this teachers were asked to complete the on-line survey (see Appendix A). Teachers had been divided into three smaller groups for the presentation, and were grouped by department during their surveys. Teachers were asked to be honest as to their use of the strategies as their responses would shape ongoing professional development throughout the year. Staff was provided with *Instructional Strategies that Support Differentiation at Margate High School* (see Appendix C) definitions in order to guide their responses. Teachers completed the survey independently using software provided by

the school system, measuring teacher level of understanding and implementation of the differentiated strategies presented.

Data Analysis of Margate High School Differentiation Survey. This survey (see Appendix A) was created to collect teacher response to frequency of differentiation within a unit. The survey was developed by Margate High School differentiation team using *Instructional Strategies that Support Differentiation as Part of Their Toolbox for Rigorous Instruction* (see Appendix B) as a basis which was then developed into *Instructional Strategies that Support Differentiation at Margate High School (*see Appendix C). Respondents were provided a list of differentiated instructional strategies. Participants were asked how often they utilized each strategy in a given unit. Survey items offered a fixed choice of four responses (i.e., less than 1-2 times per unit, 1-2 times per unit, 3-4 times per unit, daily, unsure of application within my content (see Table 12). Participants were asked to evaluate eighteen strategies. In addition, participants were asked to choose three of the strategies that would most help them to improve student learning. Survey results were tallied and printed by name and coded by Teacher 1, Teacher 2, etc.

Determining Average Levels of Teacher Differentiation

An average level of frequency of differentiation for the sample was determined by taking the average of each individual teacher's responses for each of the eighteen strategies.

Determining Domains of Differentiated Practice from the Margate High School Differentiation Survey

Research question two sought to determine if there were areas of differentiation, whether content, process or product, which when employed consistently, showed a significant difference in teacher residual scores. To answer these questions, research strategies from the Margate High

Table 12

Teacher Response to Instructional Strategies that Support Differentiation at Margate High School

Teacher Response	Score Assigned
Unsure of the application within my content	0
Less than 1-2 times per unit	1
1-2 times per unit	2
3-4 times per unit	3
Daily	4

School Differentiation Survey were categorized by content differentiation, process differentiation and product differentiation (see Table 13).

Determining Content Strategies from the Margate High School Differentiation Survey

Strategies were considered "content" strategies if they aligned with current literature on content differentiation. While curriculum is regulated by county, state, and federal guidelines, instructors can differentiate what is covered in the classroom. In order to adequately differentiate content, instructors specifically define the essential learning outcomes and skills students must glean from the coursework. Teachers much insure equal access to this content by understanding their students' personal learning styles (Tomlinson, 2000a). Groupings are noted in Table 5.

Determining Process Strategies from the Margate High School Differentiation Survey

Strategies were considered "process" strategies if they aligned with current literature on process differentiation. Groupings are noted in Table 6. Educators can differentiate how an individual student makes sense of new information. Teachers must be cognizant of how each student takes in new information and create lessons which align with each processing style. Differentiation for learners occurs over one or more dimensions, and instructors vary how deeply the student goes with information. They can vary how complex the learners' understanding should be. The instructor can introduce varying levels of novelty- challenging students to take unique or unpopular points-of-view. An instructor can differentiate the speed at which a student covers the content (Borland, 2005; Tomlinson & McTighe, 2006).

Once initial assessment has taken place and the educator has a proper understanding of individual skills and base knowledge, the DI teacher adjusts levels of expectation. He or she varies complexity of tasks for groups as well as for individuals through tiered instruction.

Table 13

Survey Questions Focusing Specific Domains of Differentiation

Domains
Content Differentiation
Strategy *2. Curriculum compacting* *8. Learning contracts:* *17. Varied questioning (Bloom's taxonomy* *18. Varied resources and materials*
Process Differentiation
Strategy *1. Computer-based instruction* *3. Flexible grouping* *5. Independent study* *6. Inquiry/Didactic Instruction* *9.Learning Styles/multiple intelligences* *12. Pre-assessment* *14. Scaffolding* *17. Varied questioning* *18.Varied resources and materials:*
Product Differentiation
Strategy *4. Group projects and investigations* *7. Learning centers or stations* *10. Multi-media presentations and projects: products that require the development of 21st century skills* *11. Ongoing formative assessment* *13. Product differentiation* *15. Student self-assessment* *16. Tiered activities and assignments*

Teachers must insure that the core concepts of tiered assignments are the same, so that each student will walk away from the lesson with the same essential learning. Students, however, will have done so at differing depths of understanding. DI teachers typically design lessons for the average students and then create tiers above and below them to reach both struggling students and those needing enrichment (Benjamin, 2002; Edyburn, 2004; Tomlinson, 2005). Teachers in the DI classroom need to be flexible in regarding student expectation variation based on the ongoing assessment cycle (Benjamin, 2002; Pettig, 2000; Rock et al., 2008; Tomlinson, 2003). Students in a DI classroom do not spend time on skills they have mastered; instead they move to more challenging work at a greater depth. Differentiated instructors prepare multiple streams of lessons, frequently regroup and re-evaluate students, and are flexible with the time they spend on content based on student mastery.

Determining Product Strategies from the Margate High School Differentiation Survey

Survey responses were grouped to measure participants' use of product differentiation. Groupings are noted in Table 7. Strategies were considered "product" strategies if they aligned with current literature on product differentiation. Traditionally, teachers have used summative activities to measure when learning has taken place. A differentiated classroom should vary to address students' learning strengths. A student can write a paper or take a cumulative test, but he or she could also explain a process verbally, create a software program, or host a debate to demonstrate mastery of that same material (Eady, 2008; Tomlinson, 2004). Wiggins and McTighe (2006) underscore that the focus of differentiated instruction must be enduring concepts and making connections through experiences so that students are more invested in

learning, and spurred on to further study. DI instructors allow for varying products from students to demonstrate content mastery.

Determining Average Levels of Teacher Differentiation in Specific Domains

From the survey responses, an average score for each participant under each domain was derived following the same coding scheme above.

Based on the average score for each domain, participants were assigned a quartile score for each domain (i.e., content, process, and product). Participants in the two bottom quartiles (0-1 and 1.1-2) were considered low to infrequent practitioners of differentiation strategies in the assigned domain. Those participants assigned to the top two quartiles (2.1-3 and 3.1-4) were considered consistent or frequent practitioners of the strategies in that domain. Sample tables indicates how quartiles were determined (see Table 14).

WCPSS Teacher Residual Scores

Definition of teacher residual data. The Wake County Public School System defines student residual score as "a measure of how a student performed on a test compared to other *WCPSS* students like themselves". This residual score can be provided for the North Carolina End-of-Grade (EOG) assessments as well as the NC End-of-Course (EOC) assessment. At the time of this study, EOCSs were administered to all students in Algebra, Algebra II, English I, U.S. History, Civics & Economics, Biology and Physical Science. North Carolina Department of Public Instruction design EOCS to "sample a student's knowledge of subject-related concepts as specified in the North Carolina Standard Course of Study and to provide a global estimate of the student's master of the materials in a particular content area (Retrieved from http://www.ncpublicschools.org/accountability/testing/eoc/). A residual score is a measure of

Table 14

Content Differentiation Quartiles

NAME	AVG Content Differentiation	Quartile
Teacher A	1.5	3
Teacher B	1.75	3
Teacher C	2.25	2
Teacher D	3	1
Teacher E	2.75	2
Teacher F	1.75	3
Teacher G	4	1
Teacher H	3.25	1
Teacher I	1.75	3
Teacher J	2.75	2
Teacher K	1.75	3
Teacher L	2.25	2
Teacher M	1.75	3
Teacher N	2.75	2
Teacher O	2.25	2
Teacher P	2	3
Teacher Q	2.25	2
Teacher R	1.5	3
Teacher S	1.5	3
Teacher T	2.5	2
Teacher U	1.25	4
Teacher V	0.5	4
Teacher X	1.5	3
Teacher Y	1.25	4
Teacher Z	2.25	2
Teacher AA	1.25	4
Teacher AB	2.5	2
Teacher AC	1.5	3
Teacher AD	2.5	2
Teacher AE	2	3
Teacher AF	1.25	4
Teacher AG	3	1
Teacher AH	2.25	2
Teacher AI	2.25	2
Teacher AJ	1.75	3
Teacher AK	1	4
Teacher AL	2	3

Table 14 (*continued)*

Teacher AM	3.25	1
Teacher AN	3	1
Teacher AO	1.5	3
Teacher AP	1.75	3
Teacher AQ	2.25	2
Teacher AR	2.25	2
Teacher AS	1.25	4
Teacher AT	2.25	2
Teacher AU	2.5	2
Teacher AV	1.25	4

how a teacher's students performed on an End-of-Course (EOC) test compared to how similar students performed in another teacher's class on the same EOC.

Students with disabilities or ESL/LEP students received accommodations or alternative assessments on the EOC in accord with modifications used throughout the course. EOCs are administered during the last week of courses taught on a block schedule and within the last two weeks for courses taught on traditional schedules.

For the purpose of this study, the residual scores represented performance on the state EOC test regardless of subject area. *WCPSS Evaluation and Research* determined residual scores by calculating the difference in scale score points between a student's actual score and the score predicted for that student by a statistical method called multiple regression. The regression equation took into consideration the student's pretest score, the student's special education services, the student's free or reduced-price lunch (FRL) status, and the school's FRL percentage and then calculates the score a student would be expected to achieve based upon the predictor variables and the performance of other *WCPSS* students who took the test and had the same pretest scores and academic indicators. When a residual score is near zero, it means a student scored close to the expected value for similar students across the district who took the same test. The standard error of measurement for a single student on the EOG or EOC test is given at the bottom of the student roster (Retrieved from http://www2.wcpss.net/departments/e-and-r/reports/effec-residuals10.pdf)

A teacher residual between -1 and 1 is within the average range. Teachers scoring above one have exceeded the average, and students scoring below -1 are considered below average in performance. A teacher residual average is "a measure of how the teacher's students performed on a test compared to other students like them in Wake County Public Schools". In accord with

student measurements, a teacher whose average is above "1" is in the top 25% of *WCPSS* teacher averages, and a teacher average below -1 is in the bottom 25% of averages. *WCPSS* notes that "the practices of teachers with high residual averages should be documented and shared with other teachers for school improvement (Retrieved from http://www2.wcpss.net/departments/e-and-r/reports/effec-residuals10.pdf).

Teacher residual averages are used by administrators in the system to compare student performance in one class to student performance in another, as the formula accounts for differences in student background and performance. Full explanation of determining residual is found in Appendix D. For this study, teacher residual scores from each Margate High School teacher who administered an EOC between 2004 and spring 2010 were compiled from the *WCPSS Evaluation and Research.*

Determining teacher residual averages. To determine each participant's average residual scores, the researcher compiled all residual scores for that teacher from the years 2004-2010. The researcher then determined the average residual for each participant. Scores for the sample ranged from -5.32 to 2.84 with an averages of-.4214 and Standard Deviation of 1.876.

Data Analysis

To answer the study's primary question, the researcher conducted a *t*-test between those teachers who reported high or low levels of differentiation and their average residual score to determine if there was a significant difference between the two ($p < .05$). All analyses were conducted with PASW Statistics 18, Release Version 18.0. A significant difference would support differences in student performance based on the teacher's reported levels of differentiated instruction. The researcher determined if those teachers with higher differentiated averages have higher residual averages as well. It is expected that teachers with high reported

levels of use of differentiated instructional strategies (top two quartiles) will have higher residual averages than teachers in the bottom two quartiles.

To answer the study's second question, the researcher conducted three separate *t*-tests for each type of differentiation: one between those teachers who report high or low level of content, process, and product differentiation and their average residual score to determine if there is a significant difference between the two ($p < .05$). All analyses were conducted with PASW Statistics 18, Release Version 18.0. A significant difference would support differences in student performance based on the teacher's reported levels of differentiated instruction. It is expected that teachers with high reported levels of use of differentiated instructional strategies (top two quartiles) will have higher residual averages than teachers in the bottom two quartiles.

Validity

Validity of report surveys. Field (2009) defines *validity* as "evidence that a study allows correct inferences about the question it was aimed to answer" (p. 795). The study's criterion validity evaluates how well it measures the significant differences between teacher's differentiation practices and their EOC residual scores. Each teacher's differentiation rating was reported through the survey. The University of Virginia's National Social Norms Institute reports that while the validity of report data is at times called into question, research generally supports that it provides accurate data (Retrieved from http://www.socialnorms.org/Research/SelfReports.php).

Validity of residual scores. The scale provided by the researcher to measure efficacy of these practices (residual average scores) is produced by *WCPSS* Evaluation and Research based on standardized EOC assessments which are designed to assess individual knowledge and skills of the tested content. Teacher residual scores provide a uniform evaluation of teacher

effectiveness as they compare growth of similarly-profiled students. An EOC, like all tests, is open to questions of construct validity and to what extent it truly measures the scope of knowledge and skills a student has acquired in a given course.

North Carolina Public Schools ensures validity of EOC tests through several measures. At least one half of items are written by North Carolina educators, and all questions are reviewed by teachers in the field. Questions are aligned with Standard Course of Study and item writers are trained in avoiding bias in questioning. Instructors also predict student expected grade which serves as a source of concurrent validity, although EOCs are the sole measurements of NCSCOS, there is "no obvious concurrent validity data" (Retrieved from http://www.ncpublicschools.org/docs/accountability/testing/reports/eocsciencetechmanual.pdf, Chapter 7). Residual averages compare student performance across the district (see Appendix E). As such, the researcher does not have data as to the level of differentiated instruction from those teachers outside of this study.

Reliability

Reliability of report surveys. The sample size for the Margate High School Differentiation Survey was insufficient to compute Cronbach's Alpha to provide a reliability estimate for this instrument.

Reliability of end-of-course tests. North Carolina Department of Public Instruction determines reliability coefficients to establish reliability in End-of-Course tests (see Table 15). In 2008, English 1 EOC's reliability indices indicated an average coefficient average of .91 (Retrieved from http://www.ncpublicschools.org/docs/accountability/testing/reports/english1techmanualdraft.pdf).

Table 15

NCDPI Measures of Reliability for End-of-Course Tests

Alternative-form coefficients	Administration of parallel form
Stability coefficients	Administration of same instrument on separate occasions
Internal consistency coefficients	Relationships among scores derived from individual items within a test (single administration)

Note. Retrieved from http://www.ncpublicschools.org/docs/accountability/testing/reports/english1techmanualdraft.pdf.

Average coefficients in mathematics in 2008 ranged from .844-.933 (Retrieved from www.ncpublicschools.org/docs/accountability/testing/reports/mathtechmanueldrafted2.pdf).

Average coefficients in mathematics EOCs in 2008 ranged from .905-.914 (Retrieved from www.ncpublicschools.org/docs/accountability/testing/reports/eocsciencetechmanual.pdf).

Average coefficients in science EOCs in 2008 ranged from .905-.914 (Retrieved from www.ncpublicschools.org/docs/accountability/testing/reports/eocsciencetechmanual.pdf).

North Carolina Department of Public Instruction has not yet provided average coefficients for Social Studies EOCs in 2008. However, a brief summary of the reliability statistics for the U.S. History and Civics and Economics EOC assessments shows a range of average coefficients between .926-.936 (G. Gianopulos, NCDPI, personal communication, April 4, 2011).

This study did not control for other variables which may contribute to differences in teacher residual averages (e.g., teacher experience, choice of content, etc.). One limitation in the reliability of this study was the inconsistency of EOC measurements for each participant: some participants had two measurements from 2004-2010, while others had twenty measurements in that timeframe. The researcher controlled for these variances by only including participants with measures in multiple years. This increased reliability by increasing consistency of measures. In addition, the researcher compared EOC residuals regardless of content area. A further study focused on only one EOC area would have higher reliability.

Reliability of residual scores. There were no reliability measures for teacher residual data. *WCPSS* Evaluation and Research department determined that the reliability of residual scores is a function of the reliability of the EOCS referenced. They apply those coefficients of

reliability to "any derivative of those tests" (B. McMillen *WCPSS* E&R, personal communication, April 4, 2011).

Assumptions

One assumption of this study was that participating teachers received adequate definitions and explanations of the surveyed differentiation strategies. All teachers were provided with written definitions of the strategies as well as a short oral description of each prior to taking the survey on August 23rd, 2010. The researcher depended on participants giving accurate reports as to how often they employ differentiated strategies. The researcher assumed that because the data teachers provide is not sensitive and has no bearing on their evaluations that they would provide accurate assessments of the frequency and use of these strategies. Babor and Del Boca (1992) note that two issues impacting the validity of reported data is how sensitive the requested information is and the "characteristics of the respondents" (Retrieved from http://www.socialnorms.org/Research/SelfReports.php). For this study, the researcher determined the requested information was not sensitive. The researcher assumed the characteristics of the respondents to be such that they would provide accurate information in order to shape professional development at their school. The researcher did not include a classroom observation of each participant as a secondary measure of response validity. As the survey was conducted in August, the researcher also assumed participants were able to accurately assess their level of differentiated instruction from prior years.

Limitations

Limitations include using End-of-Course tests as indicator of teacher efficacy. The tests are created by North Carolina educators and are grounded on the following measures of validity (see Table 16).

Table 16

Criteria of Validity in EOC Measurements

Validity	EOC Measurement
Curricular Validity	Content of test forms reflect goals and objective of NCSCOS
Instructional Validity	Content of test forms reflect goals and objectives *taught* in school
Item Quality	Items are clear and concise with appropriate vocabulary
Free from test/item bias	Content balanced by ethnicity, gender, geographic, SES of the state
One best answer	Distracters should appear "plausible for someone who has not achieved mastery"

Note. Retrieved from www.ncpublicschools.org/docs/accountability/testing/reports/english1techmanualdraft.dpf.

Instructors are bound by these state-mandated measurements, and can only control the content they choose to cover and the methods with which they choose to cover it. Graham (2009) determined similar limitations in her study. While the results of EOC reports do not allow for student differences, the residual scores use algorithms to account for student differences (see Appendix E).

A second concern with using the Margate High School Differentiation Survey is that differentiated instruction methodology is vast and routed in several educational theories (Multiple Intelligences, Constructivism, brain theory, etc.). Therefore, any instrument measuring teacher use of differentiated instruction is limited. However, as the strategies enumerated on this survey originated in the school system documents of how professional development on differentiated instruction would be accomplished, there was strong support in using the Margate High School Differentiation Survey document.

As this study focuses on a high school staff, potential significances for the study were more aligned to high school populations. This study utilized teacher residuals which were a methodology employed by *WCPSS* in 2008 when the study took place. This process is no longer being used by the county to measure teacher effectiveness, possibly limiting the application of this study and the ability to repeat its methodologies in different environments (Retrieved from http://blogs.newsobserver.com/wakeed/school-board-kils-the-effectiveness-index).

Confidentiality and Institutional Board Requirement Consideration

Several processes were implemented to promote confidentiality of the data and results. The researcher ensured participants' confidentiality through adherence to research protocols. Margate High School teachers who fit the study's criteria signed a consent form prior to being considered for this study. The benefit for teachers choosing to include themselves in the survey

was the sharing of their average differentiation score compared to student performance. This information could prove helpful to teachers in evaluating their current practice. No data were shared with teachers' supervisors. Residual scores and differentiation survey results were inputted using SPSS software. During the process of collecting this data, teacher information was locked and secured. At the point that information has been collected and coded correctly, pseudonyms were assigned in PASW Statistics 18, Release Version 18.0.0 and all teacher-identifying data was shredded.

Summary

The quantitative methodology format outlined above was used to collect the data for this study. The researcher determined each participant's frequency of differentiation average score as well as his or her average differentiation score for content, process and product domains. This study then compared each of those scores with corresponding teacher residual averages. By doing so, the researcher determined differences between those teachers who report as differentiating frequently and those who do not. Existence or absence of these patterns will add to the literature on the effectiveness of differentiated strategies on student achievement as measured by standardized tests. Data collection and analysis of the results will be presented in the next chapter.

CHAPTER 4: FINDINGS

Purpose of This Study

This quantitative research study compared the differences between the frequency of teacher reported practices of differentiation of instruction and their corresponding levels of student performance as measured by residual scores from the North Carolina End-of-Course (EOC) tests given at Margate High School between 2004 and 2010.

A strong difference between the average residual scores of teachers who claimed to differentiate instruction frequently and the scores of those who did not report that they were differentiating instruction would support the potential of differentiated instruction to impact student achievement as measured by a standardized test. This research study examined two pre-existing data sources: Margate High School's 2008 differentiation survey results and Wake County Public School's teacher residual scores (2004-2010). Margate High School Differentiation Survey was administered to teachers at Margate High School (a pseudonym), a comprehensive high school in the Wake County Public School System (*WCPSS*) in North Carolina. Residual scores were measures of how students performed on End-of-Course tests compared to other students like themselves.

Research Questions

1. Do teachers who employ differentiated instructional strategies have significantly higher residual scores as measured by the North Carolina EOC tests than teachers who do not practice differentiated instructional strategies as frequently?
2. Are there areas of differentiation, whether content process or product, which when employed consistently, shows a significant difference in teacher residual scores?

In order to address the research questions, it was necessary to make sense of the survey results. The survey results were discussed first and research questions were discussed next.

Margate High School Differentiation Survey

Participants. The Margate High School Differentiation Survey (Appendix A) was administered to 152 teachers in August 2008. Of those, 55 teachers had administered an EOC between the years 2004-2010. Forty-seven teachers agreed to participate in the study, yielding an 85% response rate. Signed permission letters were received and identifying information for these candidates was coded for the study (see Appendix F).

Survey. Margate High School's differentiation team determined they wanted to measure how often teachers used each of these strategies in a given unit. The team designed an online survey tool in which teachers determined the frequency of use of each strategy. Staff was provided with *Instructional Strategies That Support Differentiation at Margate High School* (see Appendix C) definitions in order to guide their responses. Teachers indicated they utilized the strategy "less than 1-2 times per unit", "1-2 times per unit", "3-4 times per unit", "daily" or "unsure of the application within my content". A "unit" was chosen as the measure of time as various content teachers may view number of school days differently (i.e., a science teacher may take three weeks on a given unit, while a math teacher may complete a unit in two days. By focusing on "units" instead of "days", the committee hoped to allow respondents to evaluate their choices holistically (J. Brown, personal communication, October 8, 2010).

Teachers completed the survey independently using software provided by the school system, measuring teacher level of understanding and implementation of the differentiated strategies presented.

Analysis of Survey Results

The analysis of survey results began with the calculation of average differentiation scores for each teacher. These calculations included an overall or total differentiation score and domain averages or scores for each group of differentiation strategies (content differentiation, process differentiation, and product differentiation).

Determining Teacher Total Differentiation Average

Teachers indicated their frequency of practice for each of Margate High School Differentiation Survey's strategies with either "less than 1-2 times per unit", "1-2 times per unit", "3-4 times per unit", "daily", or "unsure of the application within my content". Values were assigned between 0 and 4 for each response: "0" was assigned for "unsure of the application within my content", "1" for "less than 1-2 times per unit", "2" for "1-2 times per unit", "3"for "3-4 times per unit", and "4" for "daily". Each participant's responses were compiled and averaged to determine each participant's total differentiation average. Results are compiled in Table 17.

Determining Domain Averages

Teacher content differentiation average. Survey responses were grouped to measure participants' use of content differentiation. Groupings are noted in Table 7. Strategies were considered "content" strategies if they aligned with current literature on content differentiation. While curriculum is regulated by county, state, and federal guidelines, instructors can differentiate what is covered in the classroom. In order to adequately differentiate content, instructors specifically define the essential learning outcomes and skills students must glean from the coursework. Teachers much insure equal access to this content by understanding their students' personal learning styles (Tomlinson, 2000a) (see Table 17).

Table 17

Comprehensive Survey Results

Name	Residual Average	Total Differentiation AVG	Total Differentiation Quartile	Content Differentiation AVG	Content Differentiation Quartile	Process Differentiation AVG	Process Differentiation Quartile	Product Differentiation AVG	Product Differentiation Quartile
Teacher A	-0.853	2	3	1.5	3	2.29	2	1.71	3
Teacher B	-0.49	2.12	3	1.75	3	2	2	2	3
Teacher C	-0.327	2.35	2	2.25	2	1.89	3	2.43	2
Teacher D	-4.005	3.06	1	3	1	2.86	1	2.86	1
Teacher E	-0.935	2.59	1	2.75	2	2.29	2	2.29	2
Teacher F	1.023	1.71	4	1.75	3	1.71	3	1.29	4
Teacher G	0.97	3.71	1	4	1	3.29	1	3.43	1
Teacher H	-0.209	3.52	1	3.25	1	3.43	1	3.29	1
Teacher I	-2.12	1.71	4	1.75	3	1.86	3	1.29	4
Teacher J	0.713	2.29	2	2.75	2	2.29	2	1.71	3
Teacher K	-0.217	2.71	1	1.75	3	3.71	1	1.86	3
Teacher L	-1.67	2.47	2	2.25	2	2.29	2	2.43	2
Teacher M	-0.873	2.12	3	1.75	3	2.43	2	1.71	3
Teacher N	-3.33	2.24	2	2.75	2	2.43	2	1.29	4
Teacher O	-1.46	2.29	2	2.25	2	2.29	2	2	3
Teacher P	-1.3	1.59	4	2	3	1.14	4	1.43	4
Teacher Q	1.01	2.65	1	2.25	2	2.57	2	2.57	2
Teacher R	-0.13	1.53	4	1.5	3	1.43	4	1.29	4
Teacher S	0.418	1.76	3	1.5	3	1.43	4	1.86	3
Teacher T	-1.19	2.71	1	2.5	2	2.71	1	2.43	2
Teacher U	-1.32	1.65	4	1.25	4	1.71	3	1.57	4
Teacher V	-1.37	1	4	0.5	4	0.71	4	1.29	4
Teacher W	0.19	2	3	1.5	3	2.43	2	1.57	4
Teacher X	0.19	2	3	1.5	3	2.43	2	1.57	4
Teacher Y	-0.75	2	3	1.25	4	2.57	2	1.58	3

Table 17 (*continued)*

Teacher Z	0.27	2.53	2	2.25	2	2.43	2	2.43	2
Teacher AA	1.96	1.82	3	1.25	4	2.14	2	1.57	4
Teacher AB	-0.41	2.01	3	2.5	2	1.86	3	1.57	4
Teacher AC	0.24	1.94	3	1.5	3	2	2	1.86	3
Teacher AD	0.01	3.06	1	2.5	2	3	1	3	1
Teacher AE	-4.43	1.94	3	2	3	1.57	3	1.86	3
Teacher AF	-2.12	1.29	4	1.25	4	1.14	4	1.14	4
Teacher AG	-0.26	2.24	2	3	1	2	2	1.71	3
Teacher AH	0.61	2.18	2	2.25	2	2.29	2	1.71	3
Teacher AI	2.04	1.94	3	2.25	2	2.14	2	1.14	4
Teacher AJ	1.1	1.65	4	1.75	3	1.71	3	1.29	4
Teacher AK	1.02	1.47	4	1	4	1.71	3	1.29	4
Teacher AL	-1.11	2	3	2	3	1.43	4	2.14	2
Teacher AM	-1.19	2.88	1	3.25	1	2.71	1	2.43	2
Teacher AN	4	2.35	2	3	1	1.86	3	2.14	2
Teacher AO	0.42	1.94	3	1.5	3	2.29	2	1.58	3
Teacher AP	-1.33	1.82	3	1.75	3	2.14	2	1.29	4
Teacher AQ	0.75	1.88	3	2.25	2	1.58	3	1.58	3
Teacher AR	1.51	1.2	4	2.25	2	1.86	3	2	3
Teacher AS	0.46	1.29	4	1.25	4	1	4	1.29	4
Teacher AT	1.64	2.42	2	2.25	2	2.43	2	2.14	2
Teacher AU	-3.52	2.65	1	2.5	2	2.86	1	2.14	2
Teacher AV	-0.3	1.59	4	1.25	4	1.29	4	1.71	3
Average	-0.7	2.124894		2.053191		2.110638		1.876383	

Strategies which aligned with this research were considered content strategies. Participants' responses were totaled for content-domain strategies and a content differentiation average was determined for each participant. Results are compiled in Table 17.

Teacher process differentiation average. Survey responses were grouped to measure participants' use of process differentiation. Groupings are noted in Table 8. Strategies were considered "process" strategies if they aligned with current literature on process differentiation. Educators can differentiate how an individual student makes sense of new information. Teachers must be cognizant of how each student takes in new information and create lessons which align with each processing style. Differentiation for learners occurs over one or more dimensions, and instructors vary how deeply the student goes with information. They can vary how complex the learners' understanding should be. The instructor can introduce varying levels of novelty-challenging students to take unique or unpopular points-of-view. An instructor can differentiate the speed at which a student covers the content (Borland, 2005; Tomlinson & McTighe, 2006).

Strategies which aligned with this research were considered process strategies. Participants' responses were totaled for each participant's responses for process-domain strategies and a process differentiation average was determined for each participant. Results are compiled in Table 17.

Teacher product differentiation average. Survey responses were grouped to measure participants' use of product differentiation. Groupings are noted in Table 9. Strategies were considered "product" strategies if they aligned with current literature on product differentiation. Teachers traditionally have used a summative activity to measure when learning has taken place. A differentiated classroom should vary to address students' learning strengths. A student can write a paper or take a cumulative test, but he or she could also explain a process verbally, create

a software program, or host a debate to demonstrate mastery of that same material (Eady, 2008; Tomlinson, 2004).

Strategies which aligned with this research base were considered product strategies. Participants' responses were totaled for each participant's responses for product-domain strategies and a product differentiation average was determined for each participant. Results are compiled in Table 17.

Participant responses were sorted in ascending order and assigned quartile scores based on averages after their average level of differentiation was determined overall in the three domains. Quartiles were assigned for each domain. Results are compiled in Table 17.

Determining Quartile Scores

Teachers were assigned a total differentiation average based on their responses on the Margate High School Differentiation Survey (see Appendix A). Teacher total differentiation averages ranged from 1 to 3.71. Responses were arranged from smallest to largest values. The top quartile was identified as teachers scoring in the top 25% of compiled averages. These teachers are identified as *Quartile 1.* The second quartile was identified as teachers scoring in the 50-75% of compiled averages. These teachers are identified as *Quartile 2.* The third quartile was identified as teachers scoring in the 25-50% of compiled averages. These teachers were identified as *Quartile 3.* The fourth quartile was identified as teachers scoring in the lowest 25% of compiled averages. These teachers were identified as *Quartile 4.* Results are compiled in Table 17.

Determining Domain Quartiles

Content quartiles. Teacher content differentiation averages ranged from .5 to 4. The top quartile was identified as teachers scoring the top 25% of compiled averages. These teachers

were identified as *Quartile 1.* The second quartile was identified as teachers scoring in the 50-75% of compiled averages. These teachers were identified as *Quartile 2.* The third quartile was identified as teachers scoring in the 25-50% of compiled averages. These teachers were identified as *Quartile 3.* The fourth quartile was identified as teachers scoring in the lowest 25% of compiled averages. These teachers were identified as *Quartile 4.* Results are compiled in Table 17.

Process quartiles. Teacher process differentiation averages ranged from .71 to 3.71. The top quartile was identified as teachers scoring the top 25% of compiled averages. These teachers were identified as *Quartile 1.* The second quartile was identified as teachers scoring in the 50-75% of compiled averages. These teachers were identified as *Quartile 2.* The third quartile was identified as teachers scoring in the 25-50% of compiled averages. These teachers were identified as *Quartile 3.* The fourth quartile was identified as teachers scoring in the lowest 25% of compiled averages. These teachers were identified as *Quartile 4.* Results are compiled in Table 17.

Product quartiles. Teacher product differentiation averages ranged from 1.14 to 3.43. The top quartile was identified as teachers scoring the top 25% of compiled averages. These teachers were identified as *Quartile 1.* The second quartile was identified as teachers scoring in the 50-75% of compiled averages. These teachers were identified as *Quartile 2.* The third quartile was identified as teachers scoring in the 25-50% of compiled averages. These teachers were identified as *Quartile 3.* The fourth quartile was identified as teachers scoring in the lowest 25% of compiled averages. These teachers were identified as *Quartile 4.* Results are compiled in Table 17.

Quartile Range Comparisons

Table 18 compares the ranges of quartiles for total differentiation and each domain, demonstrating several areas of interest. One trend was that the quartile one range for content differentiation was higher than in other areas, signifying that teachers as a whole reported higher levels of differentiation in this domain. In turn, the content quartile 4 range was the lowest.

Designating Quartiles as High or Low for Data Analysis

Quartiles 1 and 2 were both coded as "high" in data analysis and quartiles 3 and 4 were both coded as "low". The study sought to determine if teachers who identify themselves as frequent practitioners of differentiated instruction had significantly higher residual scores than those who rated themselves as low to infrequent practitioners of these strategies, and as such responses were grouped in two categories. For the purposes of this study, participants coded as "high" scored in the top two quartiles of averages, while those coded as "low" scored in the bottom two quartiles of averages (see Appendix G)

After determining participants' quartile values for their total level of differentiation and their quartile value for each domain of differentiation, teacher residual averages were determined.

Wake County Public School System's Evaluation and Research Department provided residual scores for participants in the study. A residual score is a measure of how a teacher's students performed on an End-of-Course (EOC) test compared to how similar students performed in another teacher's class on the same EOC. Available residual score; scores ranged from -8.37 to 6.88. The minimum number of student residual sets available per teacher was two with a maximum available of thirty. Class sizes ranged between eighteen and thirty-six students whose scores comprised the final residual measure. The mean number of residual scores per

Table 18

Quartile Ranges for Each Domain

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Total Differentiation Range	3.71-2.59	2.53-2.18	2.12-1.76	1.71-1
Product Range	3.43-2.86	2.57-2.14	2-1.58	1.57-1.14
Process Range	3.71-2.71	2.57-2	1.89-1.57	1.43-.71
Content Range	4.0-3.0	2.75-2.25	2-1.5	1.25-.5

participant was 12.7 (see Appendix H). Participants' residual scores were average together. Results are compiled in Table 17.

Prior to determining if significant differences existed between residual scores and differentiation averages, there were several areas worth noting. The application of *WCPSS* standard in sorting averages resulted in emerging patterns of teacher response. When a residual score was near zero, it meant that a student scored close to the expected value for similar students across the district who took the same test (Retrieved from http://www2.wcpss.net/departments/e-and-r/reports/effec-residuals10.pdf). A teacher whose average residual scores was above "1" was in the top 25% of Wake County Public School System (*WCPSS*) teacher averages, and a teacher average below -1 is in the bottom 25% of averages. *WCPSS* notes that "the practices of teachers with high residual averages should be documented and shared with other teachers for school improvement" (Retrieved from http://www2.wcpss.net/departments/e-and-r/reports/effec-residuals10.pdf). In Tables 19-21, teachers' residual scores were disaggregated by above average, average and below average according to these *WCPSS* structures.

Teachers with above average residual scores had lower total differentiation, content, and product differentiation than their peers who had lower residuals (see Tables 22). This finding warrants further study as it raised the question of whether some aspect of differentiation strategies (time intensiveness, student-centeredness, etc.) can impede achievement as measured by a standardized test. The teachers identified as having the highest residual scores taught a variety of subjects (mathematics, social studies, science) and taught at all levels, indicating that their comparative success does not have a clear alignment in either content or level.

Table 19

Teachers with Residual Averages Above 1 (Above Average)

NAME	Residual Average	Total Differentiation	Content Differentiation	Process Differentiation	Product Differentiation
Teacher AN	4	2.35	3	1.86	2.14
Teacher AI	2.04	1.94	2.25	2.14	1.14
Teacher AA	1.96	1.82	1.25	2.14	1.57
Teacher AT	1.64	2.42	2.25	2.43	2.14
Teacher AR	1.51	1.2	2.25	1.86	2
Teacher AJ	1.1	1.65	1.75	1.71	1.29
Teacher F	1.023	1.71	1.75	1.71	1.29
Teacher AK	1.02	1.47	1	1.71	1.29
Teacher Q	1.01	2.65	2.25	2.57	2.57
Average	1.91288	2.15125	2.21875	2.26625	1.92875

Table 20

Teachers with Residuals Averages Between -1 and 1 (Average)

NAME	Residual Average	Total Differentiation	Content Differentiation	Process Differentiation	Product Differentiation
Teacher G	0.97	3.71	4	3.29	3.43
Teacher AQ	0.75	1.88	2.25	1.58	1.58
Teacher J	0.713	2.29	2.75	2.29	1.71
Teacher AH	0.61	2.18	2.25	2.29	1.71
Teacher AS	0.46	1.29	1.25	1	1.29
Teacher AO	0.42	1.94	1.5	2.29	1.58
Teacher S	0.418	1.76	1.5	1.43	1.86
Teacher Z	0.27	2.53	2.25	2.43	2.43
Teacher AC	0.24	1.94	1.5	2	1.86
Teacher X	0.19	2	1.5	2.43	1.57
Teacher AD	0.01	3.06	2.5	3	3
Teacher R	-0.13	1.53	1.5	1.43	1.29
Teacher H	-0.209	3.52	3.25	3.43	3.29
Teacher K	-0.217	2.71	1.75	3.71	1.86
Teacher AG	-0.26	2.24	3	2	1.71
Teacher AV	-0.3	1.59	1.25	1.29	1.71
Teacher C	-0.327	2.35	2.25	1.89	2.43
Teacher AB	-0.41	2.01	2.5	1.86	1.57
Teacher B	-0.49	2.12	1.75	2	2
Teacher Y	-0.75	2	1.25	2.57	1.58
Teacher A	-0.853	2	1.5	2.29	1.71
Teacher M	-0.873	2.12	1.75	2.43	1.71
Teacher E	-0.935	2.59	2.75	2.29	2.29
Average Score	-0.03058	2.233043	2.076087	2.226957	1.963913

Table 21

Teachers with Residuals Averages Lower than -1 (Below Average)

Name	Residual Average	Total Differentiation	Content Differentiation	Process Differentiation	Product Differentiation
Teacher AL	-1.11	2	2	1.43	2.14
Teacher T	-1.19	2.71	2.5	2.71	2.43
Teacher AM	-1.19	2.88	3.25	2.71	2.43
Teacher P	-1.3	1.59	2	1.14	1.43
Teacher U	-1.32	1.65	1.25	1.71	1.57
Teacher AP	-1.33	1.82	1.75	2.14	1.29
Teacher V	-1.37	1	0.5	0.71	1.29
Teacher O	-1.46	2.29	2.25	2.29	2
Teacher L	-1.67	2.47	2.25	2.29	2.43
Teacher I	-2.12	1.71	1.75	1.86	1.29
Teacher AF	-2.12	1.29	1.25	1.14	1.14
Teacher N	-3.33	2.24	2.75	2.43	1.29
Teacher AU	-3.52	2.65	2.5	2.86	2.14
Teacher D	-4.005	3.06	3	2.86	2.86
Teacher AE	-4.43	1.94	2	1.57	1.86
Average	-2.097667	2.086667	2.066667	1.99	1.839333

Table 22

Comparison of Differentiation Averages Based on Teacher Residual Averages

	Residual Avg.	Total Diff. Avg.	Content Avg.	Process Avg.	Product Avg.
Teachers with above average residuals	1.7	1.912- Quartile 3	1.972- Quartile 3	2.01- Quartile 2	1.71- Quartile 3
Teachers average residuals	-0.03	2.23- Quartile 2	2.08- Quartile 3	2.23- Quartile 2	1.96- Quartile 3
Teachers with below average residuals	-2.1	2.09- Quartile 3	2.07- Quartile 3	1.99- Quartile 3	1.84- Quartile 3

As noted in Table 22, teachers with average residuals had higher averages in all domains of differentiation than their peers who had below average differentiation scores.

This study did not standardize the quartile range. Ranges could have been standardized as such: quartile 1 (4-3), quartile 2 (2-2.99), quartile 3 (1-1.99), quartile 4 (0-.99). Such divisions would have resulted in Table 23.

This organization of data response points to the possibility non-standardized quartile ranges may have masked some trends. It is interesting to note that when quartile ranges were standardized, teachers with below average residuals had the *highest* quartiles of total differentiation and content differentiation. This suggests that some aspect of differentiation (time intensiveness, student-centered aspects, etc.) can have a negative impact on student performance as measured by a standardized test.

The data suggests that since teachers with above average residuals do not have higher differentiation averages in any domain, examining the use of differentiated strategies by this group may not yield significant findings. In fact, those teachers who score above average, on the whole differentiate *less* often than their peers (see Table 22).

Table 24 indicates that teachers whose students had above average success on the EOCs implemented only curriculum compacting, inquiry/didactic instruction, and learning styles and multiple intelligences more frequently than teachers who scores placed them in the average range. These differences were not statistically significant, but suggest that differentiated instruction may not be a key approach in impacting above average performance.

Table 23

Comparison of Differentiation Averages Based on Teacher Residual Averages with Standardized Quartile Ratings

	Residual Avg.	Total Diff. Avg.	Content Avg.	Process Avg.	Product Avg.
Teachers with above average residuals	1.7	Quartile 3	Quartile 3	Quartile 2	Quartile 3
Teachers average residuals	-0.03	Quartile 3	Quartile 2	Quartile 2	Quartile 3
Teachers with below average residuals	-2.1	*Quartile 2*	*Quartile 2*	Quartile 3	Quartile 3

Table 24

Average Levels of Implementation of Strategies for Teacher Groups

Strategy	Average level of implementation for teachers with below average residuals	Average level of implementation for teachers with average residuals	Average level of implementation for teachers with above average residuals
Computer-Based instruction	1.83	2.2	1.2
Curriculum compacting	1.4	1.2	1.3
Flexible grouping/cooperative learning	2.5	2.47	2.3
Group projects and investigations	1.5	1.95	1.4
Independent Study	2.5	2	1.7
Inquiry/didactic instruction	1.5	2.24	2.7
Learning centers/station	1.4	1.86	1.3
Learning contracts	1.05	1.14	0.8
Learning styles/multiple intelligences	2.67	2.52	2.9
Multimedia presentations and projects	2	2.95	1.9

Table 24 (*continued)*

On-going formative assessments	2.83	2.81	2.7
Pre-assessments	1.5	2	1.2
Product differentiation	1.3	1.67	1
Scaffolding	2.2	2.76	1.7
Student self-assessment	1.8	1.76	1.5
Tiered activities and assignments	1.8	2.1	1
Varied questions (Bloom's taxonomy)	3.1	3.52	3.3
Varied resources and materials (Resources	2.4	2.61	2.5

However, the fact that teachers within the average residual range had higher differentiation averages than those below average, suggests that differentiation instruction may make a difference in helping teachers move students from below average standardized test performance to proficiency. Administration wishing to impact these students may benefit from providing focused professional development in differentiation to teachers scoring below average residuals.

Further study of the specific practices teachers utilized either "daily" or "3 to 4" times per unit, indicated that teachers with above average residual scores, differentiate in the process domain at a higher percentage than their peers (see Table 25). Utilization of Bloom's taxonomy and varied questioning was the most commonly used practice in this domain. Eighty-percent of teachers in this domain used Bloom's taxonomy and varied questions either "daily or "3 to 4" times per unit. This indicates an area for further research as to how these teachers are utilizing process strategies.

No single group differentiated each strategy at the highest level; for some practices those with below average residual scores had the highest percentage of implementation (see Table 26).

While not statistically significant, this data suggests key strategies teachers may focus on in order to raise their residuals. It also points to the possibility that an over-emphasis on student independent study and self-assessment may negatively impact performance on standardized tests.

Comparing the average level of implementation of specific strategies between those with average residuals and those with low residuals averages reveals additional trends (see Table 27).

The level of implementation of several strategies was higher for teachers with average residuals scores as compared to those with lower than average residual scores (see Table 28).

Table 25

Numbers and Percentages of Practices Used by Each Teacher Group in Each Domain of Differentiated Instruction

	Content	Process	Product	Total
Number of practices in category	4	10	4	18
Number/Percent of practices used either "3 to 4 times a unit" or "daily" by teachers with “above” residuals	8/ 20%	46/ 46%	7/ 18%	53/ 31%
Number/Percent of practices used either "3 to 4 times a unit" or "daily" by teachers with “average” residuals	116/ 32%	31/ 37%	88/ 42%	15/ 18%
Number/Percent of practices used at either "3 to 4 times a unit" or "daily" by teachers with “below average” residuals	19/ 26%	46/ 25%	13/ 18%	81/ 26%

Table 26

Top Percentages of Implementation of Strategies by Average Residual Scores

Above Average Residuals	Average Residuals	Below Average Residuals
Curriculum Compacting	Computer-based instructions	Independent study
Flexible grouping/cooperative learning	Group projects and investigation	Learning styles/multiple intelligences
Multi-media presentations and projects	Inquiry/didactic instruction	Student self-assessment
On-going formative assessment	Learning centers or stations	
	Learning contracts	
	Product differentiation	
	Pre-assessments	
	Scaffolding	
	Tiered activities and assignments	
	Varied questioning (Bloom's taxonomy	
	Varied resources and materials	

Table 27

Comparison of Differentiated Strategies Between Average and Below Average Teacher Residual Scores

Strategy	Domain of Differentiated	Below Average Residuals Level of Implementation	Average Residuals Level of Implementation
Computer-Based instruction	Process	1.83	2.2
Curriculum compacting	Process	1.4	1.2
Flexible grouping/cooperative learning	Process	2.5	2.47
Group projects and investigations	Product	1.5	1.95
Independent Study	Process	2.5	2
Inquiry/didactic instruction	Process	1.5	2.24
Learning centers/stations	Content	1.4	1.86
Learning contracts	Content	1.05	1.14
Learning styles/multiple intelligences	Process	2.67	2.52
Multimedia presentations and projects	Product	2	2.95
On-going formative assessments	Process	2.83	2.81
Pre-assessments	Process	1.5	2
Product differentiation	Product	1.3	1.67
Scaffolding	Process	2.2	2.76
Student self-assessment	Product	1.8	1.76
Tiered activities and assignments	Content	1.8	2.1
Varied questions (Bloom's taxonomy)	Content/Process	3.1	3.52
Varied resources and materials	Content	2.5	2.61

Table 28

Strategies Which Were Implemented More Frequently for Average Residuals as Compared to Below Average Residuals

Strategy	Domain	Below average residuals	Average residuals
Learning centers/station	Content	1.4	1.86
Learning contracts	Content	1.05	1.14
Tiered activities and assignments	Content	1.8	2.1
Varied questions (Bloom's taxonomy)	Content/Process	3.1	3.52
Computer-Based instruction	Process	1.83	2.2
Inquiry/didactic instruction	Process	1.5	2.24
Pre-assessments	Process	1.5	2
Scaffolding	Process	2.2	2.76
Multimedia presentations and projects	Product	2	2.95
Product differentiation	Product	1.3	1.67
Varied resources and materials	Content	2.5	2.61

It is noteworthy that teachers who fell within the average residuals scores differentiated more frequently in 61% of the strategies on the Margate survey. Those strategies were distributed among all three domains. This indicates there may be some relationship between the frequency of specific strategies and a students' proficiency on the EOC, and that concentrating on building teacher capacity to differentiate in these areas will increase student performance.

Teachers whose residuals were below average, scored lower in *all* content domains of differentiation than their peers with average residual scores. This may be because there were few content-domain strategies in the survey, but may also suggest that one key way to move teachers forward from low residuals is to have them concentrate on content differentiation.

Sorting strategies by their average level of implementation suggests some areas which district leaders could concentrate as entry-level professional development to impact student residual scores (see Tables 29 and 30).

Teachers with average residual scores, on average practiced 64% of the strategies 1-2 times per unit, while those with below average residual scores, on average practiced only 41% of the strategies 1-2 times per unit. This suggests the frequency of practice of differentiated practice may contribute to proficiency. Multi-media projects, emphasis on inquiry, didactic instruction are among the most frequently practiced strategies of average practitioners, and ranked much lower by those with low scores, suggesting these could be key areas leaders could focus on developing in under-performing teachers. In turn, teachers with below average residuals concentrating more on independent summary than their more successful peers, suggesting this not to be a key strategy in beginning professional development around differentiated instruction. It is imperative to note, however, that the number of strategies and groupings of the strategies may mask which specific strategies are most effective.

Table 29

Differentiation Strategies Sorted by Average Level of Implementation (Average Residuals)

Strategy	Domain of Differentiated Instruction	Average Level of Implementation
Varied questions (Bloom's taxonomy)	Content/Process	3.52
Multimedia presentations and projects	Product	2.95
On-going formative assessments	Process	2.81
Scaffolding	Process	2.76
Varied resources and materials	Content	2.61
Learning styles/multiple intelligences	Process	2.52
Flexible grouping/cooperative learning	Process	2.47
Inquiry/didactic instruction	Process	2.24
Computer-Based instruction	Process	2.2
Tiered activities and assignments	Content	2.1
Independent Study	Process	2
Pre-assessments	Process	2
Group projects and investigations	Product	1.95
Learning centers/station	Content	1.86
Student self-assessment	Product	1.76
Product differentiation	Product	1.67
Curriculum compacting	Process	1.2
Learning contracts	Content	1.14

Table 30

Differentiation Strategies Sorted by Average Level of Implementation (Below Average Residuals)

Strategy	Domain of Differentiated	Average level of implementation
Varied questions (Bloom's taxonomy)	Content/Process	3.1
On-going formative assessments	Process	2.83
Learning styles/multiple intelligences	Process	2.67
Independent Study	Process	2.5
Flexible grouping/cooperative learning	Process	2.5
Varied resources and materials	Content	2.5
Scaffolding	Process	2.2
Multimedia presentations and projects	Product	2
Computer-Based instruction	Process	1.83
Tiered activities and assignments	Content	1.8
Student self-assessment	Product	1.8
Pre-assessments	Process	1.5
Inquiry/didactic instruction	Process	1.5
Group projects and investigations	Product	1.5
Learning centers/station	Content	1.4
Curriculum compacting	Process	1.4
Product differentiation	Product	1.3
Learning contracts	Content	1.05

Tables 31-33 were created to explore the relationship between domain scores. Each chart indicates the top ten scoring averages for each domain.

Table 31 does not indicate any clear correlations between a teacher's high content differentiation average and their averages in other domains, suggesting that performance in this domain does not indicate a teacher differentiates elsewhere as the same level.

Table 32 does not indicate any clear correlations between a teacher's high process differentiation average and their averages in other domains, suggesting that performance in this domain does not indicate a teacher differentiates elsewhere as the same level.

While Table 33 does not indicate any clear correlations between a teacher's high product differentiation average and their averages in other domains, alignments seem to be more consistent than in both content and process domains. There appears to be more consistency to suggest that performance in this domain may indicate a teacher differentiates elsewhere as the same level. These statistics suggest that administrators wanting to promote differentiated instruction in all domains, should concentrate on training teachers in how to differentiate products as these skill sets appear more likely to translate into differentiating in other domains.

Tables 34-36 compares level of domain differentiation with residual scores. Each chart indicates the top ten scoring averages for each domain and the teacher's corresponding residual scores.

Table 34 indicates no clear relationship between high content differentiation scores and residual performance. Several teachers with high content differentiation averages had residual averages below the county expectation.

Table 31

Comparison of Top Content Averages Compared to Other Domains

Content Differentiation	Process Differentiation	Product Differentiation
4	3.29	3.43
3.25	3.43	3.29
3.25	2.71	2.43
3	2.86	2.86
3	2	1.71
3	1.86	2.14
2.75	2.43	1.29
2.75	2.29	2.29
2.75	2.29	1.71
2.5	3	3

Table 32

Comparison of Top Process Averages Compared to Other Domains

Process Differentiation	Product Differentiation	Content Differentiation
3.71	1.86	1.75
3.43	3.29	3.25
3.29	3.43	4
3	3	2.5
2.86	2.86	3
2.86	2.14	2.5
2.71	2.43	3.25
2.71	2.43	2.5
2.57	2.57	2.25
2.57	1.58	1.25

Table 33

Comparison of Top Product Averages Compared to Other Domains

Product Differentiation	Content Differentiation	Process Differentiation
3.43	4	3.29
3.29	3.25	3.43
3	2.5	3
2.86	3	2.86
2.57	2.25	2.57
2.43	3.25	2.71
2.43	2.5	2.71
2.43	2.25	2.43
2.43	2.25	2.29
2.43	2.25	1.89

Table 34

Comparison of Top Content Averages with Corresponding Residual Scores

Content Differentiation	Residual Average
4	0.97
3.25	-0.209
3.25	-1.19
3	-4.005
3	-0.26
3	4
2.75	-0.935
2.75	0.713
2.75	-3.33
2.5	-1.19

Table 35

Comparison of Top Process Averages with Corresponding Residual Scores

Process Average	Residual Average
3.71	-0.217
3.43	-0.209
3.29	0.97
3	0.01
2.86	-4.005
2.86	-3.52
2.71	-1.19
2.71	-1.19
2.57	1.01
2.57	-0.75

Table 36

Comparison of Top Product Averages with Corresponding Residual Scores

Product Average	Residual Average
3.43	0.97
3.29	-0.209
3	0.01
2.86	-4.005
2.57	1.01
2.43	-0.327
2.43	-1.67
2.43	-1.19
2.43	0.27
2.43	-1.19

Table 35 indicates no clear relationship between high process differentiation scores and residual performance. Several teachers with high process differentiation averages had residual averages below the county expectation.

Table 36 indicates no clear relationship between high process differentiation scores and residual performance. Several teachers with high product differentiation averages had residual averages below the county expectation.

While not statistically significant, this data points to an interesting trend worth further investigation. Tables 34-36 determined the top ten averages for each differentiation domain. Corresponding residuals scores were lower than average for 40% of these teachers. While some teachers are top scorers in more than one domain, this suggests further study into the possible negative impact of differentiated instruction on student performance on standardized tests.

Research Question 1

To answer the study's primary question, an independent samples *t*-test was run between those teachers who reported high or low levels of differentiation on the Margate High School Differentiation Survey and their average residual score to determine if there was a significant difference between the two ($p < .05$). All analyses were conducted with PASW Statistics 18, Release Version 18.0. Teacher scores on the survey were arranged in ascending order and divided into quartiles. The independent samples *t*-test was run to determine if those teachers whose scores placed them in the top two quartiles had significantly higher residual averages than those whose scores placed them in the lower two quartiles. Further study determined whether scores in the top two quartiles of differentiation practice had higher residual averages than those in the bottom two quartiles (see Table 37).

Table 37

Independent t-Test Samples for Residual Scores for Total Differentiation Value

	Levene's Test for Equality of		*t*-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	11.225	.002	-.177	45	.861	-.08461	.47915	-1.04966	.88044
Equal variances not assumed			-.159	24.604	.875	-.08461	.53083	-1.17877	1.00955

Independent t-Test Comparison for Residual Scores and Total Differentiation Value

	Differentiation Value	N	Mean	Std. Deviation	Std. Error Mean
Residual Average	1	20	-.4035	2.21673	.49568
	2	27	-.3189	.98711	.18997

To answer the study's second question, the Margate High School Differentiation Survey responses were divided into three domains: content, process, and product differentiation. Strategies in the content domain addressed changes to the content teachers presented to students.

Strategies in the process domain addressed changes to the methodology of instruction, while strategies in the product domain were ones that teachers used to allow for differentiation of assessments of student mastery.

Once divided into these domains, participants' average scores were sorted in ascending order and quartiles for each domain were determined. Three separate independent samples t-tests were run: a *t*-test between content quartiles and residual averages, a *t*-test between process quartiles and residual averages, and a *t*-test between product quartiles and residual averages. The significance level was set at .05 for all analyses. All analyses were conducted with PASW Statistics 18, Release Version 18.0. Further study determined whether scores in the top two quartiles of differentiation practice had higher residual averages than those in the bottom two quartiles a significant difference would have supported differences in student performance based on the teacher's reported levels of differentiated instruction. This significant difference within a specific domain would have need to demonstrate that teachers with high levels of use of differentiated instructional strategies in key domains (top two quartiles) had higher residual averages than teachers whose residual averages placed them in the bottom two quartiles.

T-test: Differences Between Teacher Residuals and Total Differentiation Value

To examine Research Question 1, an independent-samples *t*-test was conducted to compare teacher residual scores and their differentiation value scores. A value 1 indicates *high differentiation value*, and a value of 2 indicates *low differentiation value*. A Levene's test for equality of variances demonstrated significance (p= .002); therefore, the researcher reported the

alternative t-value for equal variance not assumed as provided by SPSS. There was no significant difference in scores for those with high (M= -.3189, SD= .98711) or low (M= -.4035, SD= 2.1673) levels of reported differentiation of instruction (t(24.604)= -.159, p<. 05)). The results are also presented in Table 37.

Results for Research Question 1

Research Question 1 focused on the differences between teachers' use of differentiated strategies and their average residual scores. This research study determined there was not a significant difference between those teachers who differentiated instruction often and those teachers who did not differentiate instruction as frequently

Research Question 2

To determine Research Question 2, three independent-samples *t*-tests were conducted to compare teacher residual scores and their domain quartile value scores. A value 1 indicated *high differentiation value*, and a value of 2 indicates *low differentiation value*

***T*-test: Differences Between Teacher Residuals and Content Quartile Values**

A Levene's test for equality of variances demonstrated significance (p= .002); therefore, the researcher reported the alternative t-value for equal variance not assumed as provided by SPSS. There was no significant difference in scores for those with high (M= -.1848, SD=2.13090) or low (M= -.5179, SD= .87427) levels of reported differentiation of instruction (t(28.950)=.696, p<. 05). The results are also presented in Table 38.

Table 38

Independent t-Test Samples for Residual Scores for Content Differentiation Value

	Levene's Test for Equality of		*t*-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	12.492	.001	.707	45	.483	.33313	.47146	-.61644	1.28271
Equal variances not assumed			.696	28.950	.492	.33313	.47882	-.64624	1.31251

Independent t-Test Comparison for Residual Scores and Content Differentiation Value

	Differentiation Value	N	Mean	Std. Deviation	Std. Error Mean
Residual Average	1	23	-.1848	2.13090	.44432
	2	24	-.5179	.87427	.17846

T-test- Differences Between Teacher Residuals and Process Quartile Values

There was no significant difference in scores for those with high (M= -.4146, SD= 1.89580) or low (M= -.2668, SD= 1.09273) levels of reported differentiation of instruction (t(45)= -.306, p=.118)). The results are also presented in Table 39.

T-test- Differences Between Teacher Residuals and Product Quartile Values

A Levene's test for equality of variances demonstrated significance (p= .006); therefore, the researcher reported the alternative t-value for equal variance not assumed as provided by SPSS. There was no significant difference in scores for those with high (M= -.5027, SD= 2.32652) or low (M= -.2856, SD= 1.7118) levels of reported differentiation of instruction (t(17.431)= -.342, p<. 05)). The results are also presented in Table 40.

Research Question 2 Results

There was not a significant difference between teachers who differentiated content, process, or product and their peers who did so less frequently. Therefore, Research Question 2, which focused on determining which domain yielded the highest significant differences in residual averages, does not warrant further analysis. Organization of strategies into domains may have obscured these findings.

Table 39

Independent t-Test Samples for Residual Scores for Process Differentiation Value

	Levene's Test for Equality of		*t*-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	2.536	.118	-.306	45	.761	-.14780	.48240	-1.11940	.82380
Equal variances not assumed			-.338	44.066	.737	-.14780	.43727	-1.02902	.73342

Independent t-Test Comparison for Residual Scores and Process Differentiation Value

	Differentiation Value	N	Mean	Std. Deviation	Std. Error Mean
Residual Average	1	28	-.4146	1.89580	.35827
	2	19	-.2668	1.09273	.25069

Table 40

Independent t-Test Samples for Residual Scores for Product Differentiation Value

	Levene's Test for Equality		*t*-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	8.248	.006	-.428	45	.671	-.21704	.50736	-1.23891	.80482
Equal variances not assumed			-.342	17.413	.737	-.21704	.63538	-1.55516	1.12108

Independent t-Test Comparison for Residual Scores and Product Differentiation Value

	Differentiation Value	N	Mean	Std. Deviation	Std. Error Mean
Residual Average	1	15	-.5027	2.32652	.60070
	2	32	-.2856	1.17118	.20704

CHAPTER 5: CONCLUSION

Overview

This study explored the differences between differentiated instruction (DI) and student performance as measured by the End-of-Course (EOC) test. The study was completed using data at Margate High School (a pseudonym), a school within the Wake County Public School System (*WCPSS*) in North Carolina. No other studies had been done in *WCPSS* to determine how regular use of the district's *Instructional Strategies That Support Differentiation* (see Appendix B) was related to student learning. *No Child Left Behind* legislation resulted in mandated exit standards in North Carolina, and instructional effectiveness must be evaluated, in part, against these mandates. The purpose of this study was to add to the research on the differences between differentiated instructional strategies and student performance on standardized tests. As school districts consider employing differentiated strategies, it is imperative that these decisions be grounded in research as to their efficacy.

Summary of Related Research

Research demonstrates mixed success of differentiated instruction as a strategy to reach all learners. There are case studies of the benefits of differentiated instruction for all levels, including benefits for special needs students in the inclusion classrooms (Gartin et al., 2002). Positive student response to the strategies is evident in Doubet's 2007 study of a small high school in New England which surveyed student perceptions of DI methodology.

Richard's (2005) study of tiered instruction, a foundational DI practice, found gains in assessment for all students in secondary freshmen earth science when the practice was implemented. In Montgomery's (2006) study of a specific middle school, differentiated instruction proved effective for students with varied-levels of emotional and cognitive handicaps.

Stager (2007) found that tiered instruction enabled third grade students to increase their understanding of fractions, increase their competencies on common assessments, and increase their positive approach and attitude towards their studies. Similar results have been seen in English as Foreign Language programs in Taiwan (Chen, 2007). Chen examined the efficacy of tiered performance tasks through a series of interviews which revealed that participants found this strategy to be an integral component of their success. Students believed the strategies pushed them towards autonomy and increased their motivation.

In addition to studies supporting the use of differentiated instruction, there is a body of research noting the insufficiency of data to support its use. Research is mixed as to both the practicality and efficacy of these practices and whether they make a quantifiable difference as to student performance as measured by *No Child Left Behind* constructs.

Differentiated Instruction pulls much of its methodology from gifted education, and as such, the current shortcomings of gifted education could be replicated depending on how these philosophies are applied to wider populations. Literature indicates that quantitative research on the effectiveness of differentiated instruction is still quite scarce as it relates to the gifted child (Drain, 2008).

A lack of understanding about differentiated instruction has inhibited some leaders in implementing the strategies with fidelity. Eady's interviews with building-level principals revealed their gaps in understanding between both the broad concepts and the specific implementation strategies of differentiated instruction. She recommended further quantitative study to determine if there is a direct correlation between years of tenure and level of implementation (Eady, 2008).

Research indicates that some holes in implementation of differentiated instruction may be the result of school leaders operating with independent definitions of DI. Tomlinson stresses the need for mentor teachers, administrators, and university student-teacher liaisons to unite their views around the five principles of differentiated instruction: a sense of community, the engagement of curriculum with specific learning objectives, use of appropriate level of rigor/support, on-going formative assessment, and purposeful grouping (Doubet, 2007; Tomlinson, 2000a). Administration's attitudes toward differentiated instruction greatly impacts implementation (Holmes, 2008; Luster, 2008; Robinson, 2004). Hertberg-Davis and Brighton's (2006) study of three middle schools revealed a wide range of DI implementation based on principal attitude.

The mandates of *No Child Left Behind* have at times served as an impediment to DI implementation. The focus on achievement for student groups not performing under NCLB (who are disproportionately poor, minority and special needs) means that these groups do not have sustained practice in differentiated instruction (Guggino, 2008). Simply trying to insure that the basics are covered and remediation is provided precludes the time-intensive methods of these strategies (Brimijohn, 2005; Graham, 2009; McTighe & Brown, 2007). Tomlinson (2000c) cites cases where concepts are removed from instruction, as teachers move to teaching isolated skills based on NCLB mandates. Differentiated instruction presupposes that authentic teaching must take place around concepts in order to impact long-term memory. Further, the demands of NCLB-focused instruction diminished the teacher time needed to motivate and engage students with tiered lessons and scaffolding (Luft et al., 2007).

Teachers can be more resistant to differentiated instruction when compared to other current initiatives as illustrated by Nicolino's 2007 survey. Nicolino investigated the factors that

influence the integration of differentiated instruction compared to other strategies within the classroom. Findings indicated that teachers felt most comfortable facilitating the learning process through the use of instructional technology, and those teachers were less comfortable instituting *DI* protocols than other strategies (Nicolino, 2007).

There is a mixed body of research on the effectiveness of differentiated instruction, and to date there have not been studies on the effectiveness of Tomlinson's practices (Dearman, 2007). Doubet (2007) notes the lack of research as to what specifically occurs in a differentiated classroom.

Theoretical Framework

Differentiated Instruction (DI) and its supporting theories create a frame on to which instruction can be individualized to meet each learner's needs. To understand how systems are to employ differentiated instruction, it is imperative that the philosophy be understood across three domains. While teachers do not have to differentiate each domain for each lesson, true differentiated instructors are conscious of the following areas in which to apply this philosophy: *content, process,* and *product.* Differentiated instruction, however, relies on the consistent use of a variety of activities designed to accommodate student differences (Archambault et al., 1993).

Inherent in differentiated instruction is the modification of the standard curriculum to meet the needs of the gifted learner, as gifted-education is the domain which produced DI philosophy (Kaplan, 1994; Tomlinson, 1999, 2001, 2003; Ward, 1980). As the valued of each student is recognized, teachers are expected to adapt their instruction to the needs of specific individuals. This shift to inclusivity for all students requires DI teachers to adapt their content, their processes, and expectations of final product based on a learner's readiness, his or her interest, and his or her learning profile (Tomlinson, 1999, 2003). Differentiated instructional

strategies require teachers to consistently gather data on students before, during, and after instruction (Chapman & King, 2005).

Differentiated instruction is rooted in both educational theories and brain research; constructivist theory is central in guiding DI philosophy. Constructivist theory is grounded in the psychological belief that individuals construct meaning. Learners are active agents in the formation of knowledge, and knowledge is not something that is passed on intact. Each student is an architect of meaning, and teachers who structure lessons so that students actively take part in that construction ensure authentic experiences (McTighe & Brown, 2005).

Student-centeredness philosophy, derived largely from constructivist underpinnings, is a benchmark in the DI classroom in which students actively shape instruction (Gartin et al., 2002; Nunley, 2006; Sisk, 2007; Tomlinson, 2004; Wehrmann, 2000). Instructors take on similar roles as traditional teachers such as choosing material, creating activities, and breaking up the flow of content. Differentiated instruction calls on students to be expressive in their interests and to drive rate and depth of content by proactive means (Benjamin, 2002; George, 2005; Sternberg & Zhang, 2005).

Differentiated instruction derives many of its strategies from Gardner's use of Multiple Intelligences. Gardner suggested in 1983 that intelligence was not a single-measureable entity, instead identifying seven intelligences: verbal-linguistic, logical-mathematical, visual-spatial, bodily-kinesthetic, musical-rhythmic, interpersonal, and intrapersonal (*naturalistic* was added to the list in 1993) (Gardner 1983, 1993). Tomlinson notes two specific ramifications of Multiple Intelligences (MI) in considering differentiated instruction: students think, learn, and create in a variety of ways. The development of potential in students is determined by the alignment of what is learned and how students learn with particular intelligences (Tomlinson, 2005).

Transactional theory aligns with DI's beliefs that each reader has his or her own experiences, whether cultural, social or experiential, which they bring to each text. Students come to the classroom with a breadth of background knowledge and need for stimulation and require differentiated reading instruction. The differences students bring to a text result in readers constructing various meanings when presented with that text. Sprenger (1999) notes the specificity of development in the adolescent brain and how it functions best under DI; per example, providing high school students social or artistic activities in the morning stimulates the needed adrenaline to overcome sleep. As the adolescents' parietal lobes mature, their brains respond more readily to emotion and novelty. Their spatial awareness improves, making them more adept at learning activities which impact movement (Feinstein, 2004).

Nature of the Study

This study compared two sources of data drawn from the teaching faculty of Margate High School, a comprehensive 9-12 suburban school located in Raleigh, North Carolina. In August 2008, teachers at Margate High School completed a survey regarding the frequency of use of differentiated instructional strategies as defined by the school system (see Appendix A). Their responses were averaged together and divided into quartiles. For each quartile, average responses were determined for specific sub-topics of differentiation: differentiation of content, process, and product as well as for a total differentiation average. Teachers were designated either *high* or *low* practitioners of the strategies based on their responses.

The second source of data was teacher residual scores provided by Wake County Public School Systems' Evaluation and Research Department. The Wake County Public School System defines student residual score as measures of how a student performed on an EOG/EOC compared to other *WCPSS* students like themselves. This residual score can be provided for the

North Carolina End-of-Grade (EOG) assessments as well as the NC End-of-Course (EOC) assessment. EOCSs are administered to all students in Algebra I, Algebra I, English I, U.S. History, Civics & Economics, Biology, and Physical Science. North Carolina Department of Public Instruction design EOCs to "sample a student's knowledge of subject-related concepts as specified in the North Carolina Standard Course of Study and to provide a global estimate of the student mastery of the materials in a particular content area (Retrieved from http://www.ncpublicschools.org/accountability/testing/eoc/). In accord with student measurements, a teacher whose average is above "1" is in the top 25% of *WCPSS* teacher averages, and a teacher average below -1 is in the bottom 25% of averages. *WCPSS* notes that "the practices of teachers with high residual averages should be documented and shared with other teachers for school improvement (Retrieved from http://www2.wcpss.net/departments/e-and-r/reports/effec-residuals10.pdf). Teacher residual scores for this study were averaged together to determine a single teacher residual average.

Research Questions

This study sought to answer two research questions.

1. Do teachers who employ differentiated instructional strategies have significantly higher residual scores as measured by the North Carolina EOC tests than teachers who do not practice differentiated instructional strategies as frequently?
2. Are there areas of differentiation, whether content process or product, which when employed consistently, shows a significant difference in teacher residual scores?

Context for the Study

Margate High School is a 2,582-student school located in Raleigh, North Carolina. Student population is comprised of 19.6% Academically Gifted students, 5% Limited English

Proficiency, and 30.8% Students with Disabilities. Of the 2,582 students currently on rolls, 49% are white (Retrieved from http://dashboard.wcpss.net). On August 23, 2008, Margate High School had 142 certified teaching staff on-site, divided into eleven departments (see Table 11).

Participants in the Study

From the 152 teachers who completed the online differentiation survey on August 23, 2008, fifty-five participants were selected based on the following criteria: they had taught at least one EOC course between 2006 and 2009, and there was available residual data from *WCPSS* Evaluation and Research as to their performance.

Data Sources

Margate High School's Differentiation Survey (see Appendix A) was created to collect teacher response to frequency of differentiation within a unit. The survey was developed by Margate High School differentiation team using *Instructional Strategies that Support Differentiation as Part of Their Toolbox for Rigorous Instruction* (see Appendix B) as a basis which was then developed into *Instructional Strategies that Support Differentiation at Margate High School* (see Appendix C). Respondents were provided a list of differentiated instructional strategies. Participants were asked how often they utilized each strategy in a given unit. Survey items offered a fixed choice of four responses (i.e., less than 1-2 times per unit, 1-2 times per unit, 3-4 times per unit, daily, unsure of application within my content (see Table 12). Researcher determined averages for teacher responses in the survey, as well as dividing responses into content, process and product domains.

A residual score is a measure of how a teacher's students performed on an End-of-Course (EOC) test compared to how similar students performed in another teacher's class on the same EOC . Teacher residual averages are used by administrators in the system to compare student

performance in one class to student performance in another, as the formula accounts for differences in student background and performance. Full explanation of determining residuals is found in Appendix D. For this study, teacher residual scores from each Margate High School teacher who administered an EOC between 2004 and fall 2010 were compiled from the *WCPSS* Evaluation and Research Department data.

Analysis of Data

The first step in the analysis of data was to explore survey responses using descriptive statistics. This process yielded patterns in the implementation of differentiated instruction. Teachers with above average residual scores had lower total differentiation, content, and product differentiation than their peers who had lower residuals. When quartiles ranges were standardized with the data, teachers with below average residuals had the highest quartiles of total and content differentiation. Teachers with above average residuals differentiated less often than their peers on the whole, suggesting that differentiated instruction may not have been key in impacting above average student performance.

Of note was that teachers within the average residual range did have higher differentiation averages than those below average, suggesting that DI strategies may be helpful in moving students from below average standardized test performance to proficiency. Data, while not statistically significant, point to practice of product differentiation as the best indicator of teacher differentiation in other domains. One interesting trend was noted when delineating top ten residual averages for each differentiation domain. Often these teachers had lower than average practice of differentiated strategies suggesting further study into the possible negative impact of these strategies on student performance on standardized tests.

Research Question 1

To answer the first research question, an independent samples *t*-test measured the difference between those teachers who reported high or low levels of differentiation on the Margate High School Differentiation Survey and their average residual score to determine if there was a significant difference between the two ($p < .05$). All analyses were conducted with PASW Statistics 18, Release Version 18.0. Teacher scores on the survey were arranged in ascending order and divided into quartiles. The independent samples *t*-test examined if those teachers whose scores placed them in the top two quartiles had significantly higher residual averages than those whose scores placed them in the lower two quartiles. Researcher examined if scores in the top two quartiles of differentiation practice had higher residual averages than those in the bottom two quartiles. A significant difference would have supported differences in student performance based on the teacher's reported levels of differentiated instruction.

A Levene's test for equality of variances demonstrated significance ($p = .002$), therefore the researcher reported the alternative t-value for equal variance not assumed as provided by SPSS. There was no significant difference in scores for those with high ($M = -.3189$, $SD = .98711$) or low ($M = -.4035$, $SD = 2.1673$) levels of reported differentiation of instruction ($t(24.604) = -.159$, $p < .05$)).

This research study determined there was not a significant difference between those who differentiated often and those who did not.

Research Question 2

To answer the second research question, teacher survey responses were divided into three domains: content, process, and product differentiation. Strategies in the content domain addressed changes to the content teachers presented to students. Strategies in the process domain

addressed changes to the methodology of instruction, while strategies in the product domain were ones that teachers used to allow for differentiation of assessments of student mastery.

Participant scores were tallied for each domain and assigned an average score for each. These were sorted in ascending order to determined quartiles for each domain. Three separate independent samples *t*-tests were run: a *t*-test between content quartiles and residual averages; a *t*-test between process quartiles and residual averages; and a *t*-test between product quartiles and residual averages. The significance level was set at .05 for all analyses. All analyses were conducted with PASW Statistics 18, Release Version 18.0. A significant difference would have supported differences in student performance based on the teacher's reported levels of differentiated instruction. This significant difference within a specific domain would have needed to demonstrate that teachers with high levels of use of differentiated instructional strategies in key domains (top two quartiles) have higher residual averages than teachers who residual averages places them in the bottom two quartiles.

Next, three independent-samples *t*-tests were conducted to compare teacher residual scores and their domain quartile value scores. The first of these *t*-tests focused on teacher use of content differentiation. A Levene's test for equality of variances demonstrated significance (p= .002); therefore the researcher reported the alternative t-value for equal variance not assumed as provided by SPSS. There was no significant difference in scores for those with high (M= -.1848, SD= 2.13090) or low (M= -.5179, SD= .87427) levels of reported differentiation of instruction (t(28.950)=.696, p<. 05).

A second *t*-test was run using data from teacher process differentiation. There was no significant difference in scores for those with high (M= -.4146, SD= 1.89580) or low (M= -.2668, SD= 1.09273) levels of reported differentiation of instruction (t(45)= -.306, p=.118).

The third of these *t*-tests focused on teacher use of product differentiation. A Levene's test for equality of variances demonstrated significance (p= .006); therefore the researcher reported the alternative t-value for equal variance not assumed as provided by SPSS. There was no significant difference in scores for those with high (M= -.5027, SD= 2.32652) or low (M= -.2856, SD= 1.7118) levels of reported differentiation of instruction (t(17.431)= -.342, p<. 05).

Conclusions

The study yielded clear answers to the research questions posted, which add to the body of research on differentiated instruction.

Research Question 1

Research Question 1 asked, "Do teachers who employ differentiated instructional strategies have significantly higher residual scores as measured by the North Carolina EOC tests than teachers who do not practice differentiated instructional strategies as frequently?" The *t*-test demonstrated no significant difference between those who differentiated often and those who did not.

Research Question 2

Research Question 2 asked, Are there areas of differentiation, whether content process or product, which when employed consistently, shows a significant difference in teacher residual scores?

There was not a significant difference between teachers who differentiated content, process or product and their peers who did so less frequently. Therefore, Research Question 2, which focused on determining which domain when practiced frequently yields the highest significant differences in residual averages, did not warrant further analysis.

In summary, the study determined no significant differences in any of the four *t*-tests run to determine differences between teacher use of differentiation and their corresponding residual scores.

Limitations

This section addresses the limitations of the study, specifically related to the two pre-existing data sources.

Margate High School Differentiation Survey

Limitations include the self-identified aspects of the survey. Currently in *WCPSS*, there is no instrument administrators can use to objectively identify a teacher who uses these practices. Differentiated practices can occur over the course of several days to weeks, and cannot always be readily captured by classroom observation. For this study, researchers were dependent on teachers identifying themselves accurately. The data analysis for this study did not take additional variables into account. While a teacher who identifies him or herself as a frequent differentiated instructor might have statistically higher residuals, this study did not determine if that was the only difference between him or her and a teacher who does not differentiate.

The instrument used to determine teachers' use of differentiated instruction was administered without prior sustained, professional development with the teaching staff. Though participants were given definitions of each strategy, they had not received demonstrations or samples of their use. Because differentiated instruction proposes a systemic change to instructional approach, indirect training has shown to be ineffective. Direct information from qualified practitioners which includes a cycle of follow-up is required for all professionals seeking to employ the strategies with fidelity (Wiggins & McTighe, 2006).

As teacher level of use of the strategies was reported, it cannot be determined whether teachers had an accurate picture of what the strategies entailed. Clear professional development prior to assessing teacher use of strategies may have provided a more accurate picture of their true implementation. Valli and Buese note that adopting differentiated instruction requires teachers to take on additional roles and to increase intensity in their existing ones. Because structures for remediation and enrichment intensify under differentiated instruction, significant staff development is required (Valli & Buese, 2007).

Teacher perceptions were not validated through classroom observation. As Margate High School Differentiation Survey was a pre-existing data source, it was not determined a reliable instrument prior to administration. The survey was not administered to a wide enough sample to conduct a Cronbach's Alpha to determine its reliability.

This study consistently used averages to make determine teacher frequency of practice. Use of a single differentiation average, rather than concentrating on individual strategies can mask key information. The same is true of the domain averages; by determining a single content average, the nuances of specific content strategies were missed.

Residual Scores

Residual scores are no longer being used by the county to measure teacher effectiveness, possibly limiting the application of this study and the ability to repeat its methodologies in different environments (Retrieved from http://blogs.newsobserver.com/wakeed/school-board-kils-the-effectiveness-index). This measurement gauged teacher effectiveness as compared to other teachers in the district. As such, the study does not provide data as to the frequency of use of DI strategies for teachers outside of Margate to whom the sample was compared.

Teacher residual scores were averaged together. It is possible that averaging masked trends and that examining each year separately would have yielded different results. This study sought to determine if there was a difference between these two variables and did not examine causality between the variables. The residuals were averaged over several years; however, the survey does not indicate years when teachers utilized the strategies. A teacher may have only learned of differentiation in 2008, but their residuals were measured back to 2004.

Implications and Recommendations

There were no significant differences in standardized test scores between those teachers who exercised differentiation strategies and those who did not. These finding have implications for instructional practice as well as bring forth recommendations for further study.

Implications for Instructional Practice

Dr. Fenwick English challenged Wake County school leaders to take a shift in thinking about the achievement gap by concentrating on differentiated instruction as a means to reach underperforming students (Downey et al., 2009). While this study does not examine the impact of differentiation on literacy, student engagement and other factors which impact underperforming students, it does suggest that further research is needed to determine whether differentiation can make a serious impact on the standardized tests required for student promotion.

Differentiation as NCLB "research-based instructional program". This research study adds to the body of literature as to the efficacy of differentiated instruction on *No Child Left Behind* mandates. NCLB calls for "research-based instructional programs" and therefore, theories such as differentiated instruction which do not have a significant research-based

correlation with standardized test performance can be marginalized (Retrieved from http://www2.ed.gov/nclb/overview/intro/guide/guide.pdf).

The educational theories of differentiated instruction appear at times to be in conflict with the standardization of assessments prescribed by *NCLB*. For example, *NCLB* focuses on subgroups, tracking students in a manner which is contrary to DI philosophies of inclusive environment (Baglieri & Knopf, 2004; Dreeszen, 2009). Schlechty notes that teachers who wish to bring out the individuality of their learners through DI fall under stress based on the NCLB system (Schlechty, 1997; Waldon & McClesky, 2001). The standards imposed by NCLB can at times pull teachers away from DI practices despite the teachers' desires (Chapman & King, 2005; Drain, 2008). This study, which does not find a significant link between DI and NCLB performance, further weakens the connection between the two, and does not lend support for teacher time devoted to the pursuit of the strategies in order to reach *NCLB* mandates.

The results of this study contradict the adherents of differentiated instruction who note that DI is most zeroed in on the needs of the individual, which helps performance on state-standards assessments, effectively marrying the goals of *NCLB* to differentiated instruction (Bravman, 2004; Grafi-Sharabi, 2009; McTighe & Brown, 2005). The literature reveals that the cycle of assessment and planning inherent in DI is time-consuming for the teacher; this study does not confirm time spent on these strategies has significant outcomes on standardized tests.

Focus on domains. Data from this study does not demonstrate that content, process or product differentiation makes a significant difference in higher student performance as measured by the EOC. While these methodologies may have impact in other measures of student achievement, the data suggests additional studies are needed to determine whether any of the domains have significant impact on mandated assessments.

Implications for School and District Leaders

Differentiated instruction focus in North Carolina. Margate High School is a high school in the Wake County Public School System. At the time of this study, each school in that county was required to adopt differentiated strategies. As of 2011, all North Carolina schools were evaluating teachers in part on their ability to "know how students think and learn. Teachers understand the influences that affect individual student learning development, culture, language proficiency, etc.) and *differentiate* their instruction accordingly (Retrieved from http://www.ncpublicschools.org/docs/profdev/training/teacher/teacher-eval.pdf). It is clear that there is a statewide movement towards differentiated instruction as a key strategy to impact student performance. However, there is not a substantial body of research in North Carolina to support that differentiation makes a difference in student performance as measured by a standardized assessment. Prior to implementing strategies on a local and statewide scale, it is imperative that school and district leaders found those choices on quantifiable research. School and district leaders should continue to mine the quantifiable research on differentiation instruction and use those findings to shape the level of its implementation at the district and state level.

Need for sustained staff development. Before continuing to mandate and evaluate teachers on their ability to differentiate, district leaders should take two steps. They need to provide ongoing, substantial staff development on differentiation's proper use and ensure that its strategies are implemented with fidelity. After sustained training and implementation, leaders should then initiate specific studies on the strategies' efficacy using their own standardized measurements. Once this cycle is complete, school leaders can better assess the long-range use of differentiated instruction in their LEAs.

Entry points for DI training. LEAs wishing to implement differentiated instruction with their staff can find support as to entry points based on this study. There is a higher correlation between high practices of product differentiation and consistent practice in the other domains, suggesting that concentrating on these practices will more readily move staff into adopting strategies from other domains. Teachers with below-average residuals practiced each content-related practice less frequently than their peers, suggesting that one key way to move teachers forward from low residuals is to have them concentrate on content differentiation. Multi-media projects, emphasis on inquiry, and didactic instruction are among the most frequently practices strategies of those with average scores; these practices are less frequently practiced by those with lower residuals. This suggests these may be key strategies on which to concentrate to improve students with below average growth on the EOCs.

Implications for Future Research

Focus on process differentiation. While this study found no statistically significant differences among student North Carolina EOC test scores, there are aspects of the findings which merit further investigation. Teachers with residual score averages above the *WCPSS* benchmarks had comparatively low total differentiation, content differentiation, and product differentiation than those of their peers with lower residual scores. However, those teachers at the top level, differentiated process strategies more frequently than their peers. Further studies on process strategies could be beneficial in determining if teachers' frequency of utilization of these strategies significantly impacted student performance.

Subsequent case studies. A 2007 study finds the demands of NCLB-focused instruction diminished the teacher time needed to motivate and engage students with tiered lessons and scaffolding (Luft et al., 2007). Much deeper quantitative research is required to answer this

question. One suggestion is the creation of an instrument to measure specifically how each teacher implements the strategies, with a focus on time. A qualitative study focusing on strategies used by teachers with highest residual scores would determine which strategies are most effective. A case study of a specific group of teachers with high residuals would be helpful in this regard. A separate qualitative study that generally explores the differences between teacher residuals, student characteristics and teaching strategies could add to the body of research on this topic. A study of high-level students over time in this environment could further pinpoint efficacy of differentiation strategies to this population. It would be interesting to determine if these students performed significantly better with a teacher who differentiates frequently than when they had one who did not.

Possibility of inverse relationship between DI and student performance. Above-average-residual teachers, on average, only led their peers in four instructional practices. One questions whether there are aspects of differentiation which could negatively impact student scores as measured by a standardized test. A hypothesis is that because differentiation is time intensive (back with research), those who employ strategies often must make curricular cuts elsewhere. Many teachers with highest differentiation domain averages had below average residual scores. Residual scores were lower than average for 40% of the teachers who differentiated the most frequently. This bears further study into the possibility of inverse relationships of differentiated practices and student proficiency and growth.

Comparing teachers with average performance residuals to those with low residuals. In addition to emerging trends with those teachers in the above-average range, there are several areas worth noting in the comparison between average and below-average residuals. Teachers who had average residuals reported higher averages in all domains of differentiation as

well as total differentiation average than those in the below-average range. The average teachers in this study differentiated more frequently in over half of the strategies. Additional research between these two groups may give insight as to if/how differentiation practices can students' below average growth. Isolating specific strategies would also provide deeper insight as to efficacy of each. This study did not determine the general level of students within a class; the residual averages measure classes as a whole. Further studies could explore the level of students within the courses to further explore these trends.

This study notes that those with average residual scores, on the whole, practiced the strategies more frequently than their lower performing peers. While this suggests that this frequency may contribute to proficiency, this study did not specifically quantify time. For example, a math teacher who differentiates one to two times per unit, may do so forty-five minutes each time. A social studies teacher may differentiate three to four times per unit, but only during a ten minute activity. Further studies should quantify time more specifically so that measures between teachers can be uniform.

For some practices, those with below-average residual scores had the *highest* percentage of implementation- *independent study, learning styles/multiple intelligences, students' self-assessment.* These strategies are all individual-focused, relying on the student's learning profile and, to some extent, their self-discipline. Clearly, exercise of these strategies did not on average result in growth. Further study into the impact of these specific strategies on *No Child Left Behind* constructs could provide further quantitative support for this

Decreasing limitations of the study. This study had several limitations that can be decreased or eliminated in subsequent research. This study points to the need for more research on the relationship between differentiated instruction and standardized test performance. The

instrument used to determine teachers' use of differentiated instruction (see Appendix A) should be administered after sustained professional development with the teaching staff. In turn, report data would be strengthened by creating a classroom rubric to evaluate the fidelity of the strategies. This would confirm or contradict teachers' perceptions and provide a second level of validity to the survey. Quartiles were not standardized among the four areas of differentiation which could have resulted in trends being masked.

The Margate survey asked teachers to evaluate their use of several strategies; a subsequent study focusing on a smaller group of strategies would help to further isolate strategies which when used frequently and with fidelity may impact standardized test scores. Teachers in this study were compared across disciplines as well as across grades nine through twelve. A more reliable study should be performed in a specific content and grade (i.e. English 9) which would reduce variables which may have impacted results. This study should be replicated at the elementary level. These classrooms have not already been separated by student ability and are more aligned to ideal environments espoused by DI literature.

This study should be replicated with a measure of teacher efficacy as compared to those within their building. The residual scores used in this study compared teachers to all teachers in the county. By focusing on a single staff, researchers will eliminate some unknown variables as well as strengthen the comparisons of their survey group. Further study is needed on the efficacy of differentiated instruction in raising student performance as measured by a standardized assessment. To do so, one must measure changes in student performance following use of differentiated strategies. This will require a cycle of pre and post-assessment.

Summary

The purpose of this study was to determine if there was a difference between student scores as measured by the North Carolina End-of-Course (EOC) tests based on the level of their teachers' use of differentiated strategies.

Few studies have compared the results of teachers who identify themselves as differentiated instructors to their peers who do not. No studies had been done in Wake County to determine how effective teachers are who both have understood the district's *Instructional Strategies that Support Differentiation* and have implemented those strategies regularly. This study sought to determine if End-of-Course effectiveness residuals for teachers at a single high school are significantly higher for those teachers who are frequent practitioners of differentiated strategies than those of their peers who do not employ the strategies as frequently.

The study considered two pre-existing data sources from teachers at Margate High School- a teacher differentiation survey and teacher residual scores from 2004-2010. T-tests run to determine the differences between teacher reported differentiation average and their residual averages demonstrated no significant difference between those who differentiated frequently and those who did not. Additional *t*-tests found no significant differences in the specific domains of content, process or product differentiation.

School leaders must consistently evaluate instructional programs. Professional development, materials, and investment in teachers is costly, and LEAs must put due diligence into evaluating programs prior to requiring staff to adhere to them. While differentiated instruction has a strong foundation in both educational theory and brain research, the literature is mixed as to its efficacy and needs to be fully evaluated based on the standardized tests that determine student promotion and retention. While educators can support the movements

heralding of student potential and ability to learn, more is needed to adopt this strategy as a "research-based instructional program" mandated by *No Child Left Behind.*

REFERENCES

Archambault, F. A., Jr., Westberg, K. L., Brown, S. W., Hallmark, B. W., Emmons, C. L., & Zhang, W. (1993). Regular classroom practices with gifted students: Results of a national survey of classroom teachers (Research Monograph 93102). Storrs, CT: The National Research Center on the Gifted and Talented, University of Connecticut

Babor, T. F. & Del Boca, F. K. (1992). Just the facts: Enhancing measurements of alcohol consumption using report methods. In R. Litten & J. Allen (Eds.), *Measuring alcohol consumption: Psychosocial and biochemical methods.* (pp.3-19). Totawa, NJ: Humana Press. Retrieved from http://www.socialnorms.org/Research/SelfReports.php

Baglieri, S., & Knopf, J. H. (2004). Normalizing difference in inclusive teaching. *Journal of Learning Disabilities, 37*(6), 525-529. Retrieved from ProQuest Nursing & Allied Health Source. (Document ID: 739422331)

Benjamin, A. (2002). *Differentiated instruction: A guide for middle and high school teachers*. Larchmont, UK: Eye on Education.

Bloom, B. S., Englehart, M. D., Furst, E., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives. Handbook I: Cognitive domain*. New York: McKay.

Borland, J. H. (2005). The case for no conception of giftedness. In R. J. Sternberg and J. E. Davidson's (Ed.), *Conceptions of giftedness* (2nd ed.). Yale University PACE Center, Cambridge University Press.

Bravmann, S. (2004). Two, four, six, eight, Let's all differentiate differential education: Yesterday, today, and tomorrow. Available from New Horizons for Learning Web site; http://www.newhorizons.org/strategies/differentiated/bravmann.htm

Brighton, C. M., Hertberg, H. L., Moon, T. R., Tomlinson, C. A., & Callahan, C. M. (2005). *The feasibility of high-end learning in a diverse middle school* (RM05210). Storrs, CT: The National Research Center on the Gifted and Talented, University of Connecticut.

Brimijoin, K. (2005). Differentiation and high-stakes testing: An oxymoron? *Theory Into Practice*, *44*, 254-261.

Bronowski, J., & Mazlish, B. (1962). *The western intellectual tradition: From Leonardo to Hegel.* New York: Harper & Row.

Brooks, J. G., & Martin, G. B. (1993). *In search of understanding: The case for constructivist classrooms.* Alexandria, VA: Association for Supervision and Curriculum Development.

Brown, C. P. (2007). Examining the streams of a retention policy to understand the politics of high-stakes reform. *Educational Policy Analysis Archives, 15*(9). (ERIC Document Reproduction Service No. 407710).

Burke, K. (1999). *The mindful school: How to assess authentic learning*. Arlington Heights, IL: Skylight Training and Publishing, Inc.

Burns, J. P. (2005). An analysis of the implementation of Differentiated Instruction in a middle school and high school and the effects of implementation on curriculum content and student achievement. Ed.D. dissertation, Seton Hall University, United States -- New Jersey. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3190178)

Calabrese, R. L., Goodvin, S., & Niles, R. (2005). Identifying the attitudes and traits of teachers with an at-risk student population in a multi-cultural urban high school. *The International Journal of Educational Management, 19*(4/5), 437-450. Retrieved September 30, 2010, from ProQuest database.

Cambourne, B. (2002). Holistic, integrated approaches to reading and language arts instruction: The constructivist framework of an instructional theory. In S. J. Samuels, A. E. Farstrup (Ed.), *What research has to say about reading instruction* (2nd ed.), pp. 25-47. Newark Del: International Reading Association.

Campbell, C., Campbell, B., & Dickinson, D. (2004). *Teaching and learning through multiple intelligences* (3rd ed.). Boston: Pearson.

Carolynn, J., & Guinn, A. (2007). Differentiation: Lessons from master teachers. *Educational Leadership, 64*, 44-47.

Chapman, C., & King, R. (2005). *Differentiated assessment strategies.* Thousand Oaks, CA: Corwin Press.

Chen, Y. (2007). Exploring the assessment aspect of differentiated instruction: College EFL learners' perspectives on tiered performance tasks. Ph.D. dissertation, University of New Orleans, United States -- Louisiana. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3292290)

Chrenka, L. (2001, May). Misconstructing constructivism. *Phi Delta Kappan, 82*(9), 694-695.

Christian, M. L. (2005). *The implementation of differentiated instruction in three elementary schools*: A case study. (Doctoral dissertation, Wilmington College, Wilmington, DE). Retrieved from ProQuest Digital Dissertations database. (Publication No. AAT 3202228)

Clarke, H. (2006). *Development of teacher training in differentiated instruction to Improve reading achievement* (Doctoral dissertation, Capella University, Minneapolis, MN). Retrieved from ProQuest Digital Dissertation database. (Publication No. AAT 3216019)

Clift, R. T., & Brady, P. (2005). Research on methods courses and field experiences. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education: A report of the AERA panel on research and teacher education* (pp. 309-424). Washington, DC: American Educational Research Association.

Cochran, S., Hamtil, H., & Lake, C. (2008). Professional preparedness, scientifically based interventions and differentiated instruction. EdD dissertation, Saint Louis University, United States -- Missouri. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3351847)

Cooper, D. (2007). *Talk about assessment: Strategies and tools to improve learning.* Toronto: Thomson Nelson.

Corcoran, T. (1999). Making the most of professional development. *Curriculum Review, 96*(4), 232-239.

Danzi, J., Reul, K., & Smith, R. (2008, April). *Improving student motivation in mixed ability classrooms using differentiated instruction.* Saint Xavier University & Pearson Achievement Solutions, Inc. Field-Based Master's Program. Chicago, Illinois.

Darling-Hammond, L., & Bransford, J. (Ed.) (2005). Preparing teachers for a changing world: what teacher should learn and be able to do. Jossey-Bass: San Francisco, CA

Dearman, C. C. (2007, August). Reflectively studying student work together: Collaborate to differentiate instruction for all student. EDD dissertation. The University of Southern Mississippi.

Dixon, F., Prater, H., Wark, M., Williams, T., Hanchon, T., & Shobe, C. (2004). Teaching to their thinking: A strategy to meet the critical-thinking needs of gifted students. *Journal for the Education of the Gifted, 28*(4), 56-76.

Doubet, K. (2007). Teacher fidelity and student response to a model of differentiation as implemented in one high school. Ph.D. dissertation, University of Virginia, United States -- Virginia. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3283287).

Downey, C. J., Steffy, B. E., Poston, W. K., & English, F. W. (2009). *50 ways to close the achievement gap* (3rd ed.). Thousand Oaks, CA: Corwin Press.

Drain, J. (2008). Teachers' attitudes and practices toward differentiating for gifted learners in K--5 general education classrooms. Ph.D. dissertation, The College of William and Mary, United States -- Virginia. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3308106)

Dreeszen, J. (2009). The impact of differentiation on the critical thinking of gifted readers and the evolving perspective of the fifth grade classroom teacher. Ph.D. dissertation, Kansas State University, United States -- Kansas. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3389827)

Eady, K. (2008). Differentiated instruction: An implementation review. Ph.D. dissertation, Capella University, United States -- Minnesota. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3320642)

Edyburn, D. (2004). Technology supports for Differentiated Instruction. *Journal of Special Education Technology, 19*(2), 60-62. Retrieved from ProQuest Nursing & Allied Health Source. (Document ID: 678445271)

Edwards, C., Carr, S., & Siegel, W. (2006). Influences of experiences and training on effective teaching practices to meet the needs of diverse learners in schools. *Education, 126*(3), 580-592.

Elliott, S. N., Kratochwill, T. R., Cook, J. L., & Travers, J. F. (2000). *Educational psychology: Effective teaching, effective learning*. Boston: McGraw-Hill.

English, F. (2009, April). Wake County Public Schools raising achievement closing the gap. *50 ways to close to achievement gap* (PowerPoint slides). Retrieved from http://www2.wcpss.net/departments/isd/

Eris, B. (2005). Differentiation of curriculum in heterogeneous settings with diverse learners: Teachers' conceptualizations and practices. Ed.D. dissertation, Columbia University Teachers College, United States -- New York. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3160606)

Feinstein, S. (2004). *Secrets of the teenage brain*. San Diego, CA: The Brain Store.

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). Sage Publications LTs.

Finley, P. (2008). A transfer model for differentiated instruction from the university to elementary classrooms. Ed.D. dissertation, Walden University, United States -- Minnesota. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3297565)

Fosnot, C. T. (2005, Fall). *Constructivism revisited: Implications and reflections. The Constructivist, 16*(1). City College of New York

Friesen, L. (2007). How teachers make sense of differentiated instruction and technology integration through participation in a community of practice. M.Ed. dissertation, The University of Regina (Canada), Canada. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT MR42430)

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences.* New York: Basic Books.

Gardner, H. (1993). *Frames of mind: A theory of multiple intelligences.* New York, NY: Basic.

Gartin, B. C, Murdick, N. L., Imbeau, M., & Perner, D. F. (2002). *How to use differentiated instruction with students with development disabilities in the general education classroom.* Arlington, VA: Council of Exceptional Children.

George, P. (2005). A rationale for differentiating instruction in the regular classroom. *Theory into Practice, 44*(3), 185-193.

Gleibermann, E. (2007). Teaching even 100 hours a week leaves children behind. *Phi Delta Kappan, 88*(6), 455-459. Retrieved from EBSCOhost database.

Goodlad, J. (1993). School-university partnerships. *Educational Policy, 7,* 24-39.

Gordon, A. (2007). Preparing teachers to use an instructional management system to differentiate instruction. EdD dissertation, University of Delaware, United States -- Delaware. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3291726)

Grafi-Sharabi, G. (2009). A phenomenological study of teacher perceptions of implementing the differentiated instruction approach. Ed.D. dissertation, University of Phoenix, United States -- Arizona. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3393495)

Graham, K. (2009). Mandated differentiated instruction effectiveness examined. EdD dissertation, Walden University, United States -- Minnesota. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3366972)

Graves, M. F., Juel, C., & Graves, B. B. (2004). *Teaching reading in the 21st century*.

Green, J. P., & Winters, M. A. (2006). Getting farther ahead by staying behind: a second-year evaluation of Florida's policy to end social promotion. (ERIC Document Reproduction Service No. 407710)

Grineski, S. (2005). Misidentified problems and mistaken solutions: A response to the teaching at risk: A call to action report. *The Teacher Educator, 41*(2), 110-126. Retrieved September 26, 2010, from ProQuest database.

Gregory, G., & Kuzmich, L. (2004). *Data driven differentiation in the standards-based classroom*. Thousand Oaks, CA: Corwin Press, Inc.

Guggino, P. (2008). NBCTs on NCLB: A survey of National Board Certified Teachers on the impact of the No Child Left Behind legislation. Ph.D. dissertation, University of California, Riverside, United States -- California. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3332614)

Gunning, T. G. (2008). *Creating literacy instruction for all students* (6th ed.). Boston: Allyn & Bacon.

Guskey, T. (2002). Professional development and teacher change. *Teachers and Teaching, 8*(3/4), 381-391.

Halpin-Brunt, S. (2007). Differentiated instructional practices: A case study of science teachers in a suburban middle school setting. EdD dissertation, Teachers College, Columbia University, United States -- New York. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3269072)

Haury, D. L., & Milbourne, L. A. (1999). Should students be tracked in math or science? *Eric Clearing House for Science and Mathematics and Environmental Education, ED433217*.

Haynie, G. (2009). High school graduation rates, Wake County Public School System (*WCPSS*): 2008-09. Retrieved from http://www.wcpss.net/evaluation-research/reports/2009/0931hs-graduation09.pdf

Heacox, D. (2002). *Differentiating instruction in the regular classroom*. Free Spirit Publishing: Minneapolis, MN.

Herman, J. L. (2007). Accountability and assessment: Is public interest in k-12 education being served? *CRESST Report*. Retrieved July 2, 2009, from EBSCO database

Hertberg-Davis, H. L., & Brighton, C. M. (2006). Support and sabotage: Principals' influence on middle school teachers' responses to differentiation. *The Journal of Secondary Gifted Education, 17*(2), 90-102.

Holmes, C. T. (2006). Low test scores + high retention rates= more dropouts. *Kappa Delta Pi Record Winter.* (ERIC Document Reproduction Service No. 407710)

Holmes, L. (2008). Teachers' perceptions of a differentiated instruction professional development program. PhD dissertation, The University of Alabama, United States -- Alabama. 2008 Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3377528)

Hoover, J. J., & Patton, J. R. (2004). Differentiating standards based education for students with diverse needs. *Remedial and Special Education, 25*(20), 74-78.

Kablefleisch, M., & Tomlinson, C. (1998, November). Teach me, teach my brain: A call for differentiated classrooms. *Educational Leadership- How the Brain Learns, 56*(3).

Kaplan, S. (1994). *Differentiating core curriculum and instruction to provide advanced learning opportunities.* Sacramento, CA: California Association for the Gifted.

Kauchak, D., & Eggen, P. (2005). *Introduction to teaching: Becoming a professional* (2nd ed.). Upper Saddle River: Pearson Prentice Hall.

Kirschner, P., Sweller, J., & Clark, R. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovers, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75-86.

Levy, H. (2008). Meeting the needs of all students through differentiated instruction: Helping every child reach and exceed standards. *The Clearing House, 81*(4), 161-164. Retrieved April 21, 2010, from Ethnic NewsWatch (ENW). (Document ID: 1453633641).

Lindgren, H. C. (1959). The teacher helps the learner interpret his experiences in yearbook. *Association for Supervision and Curriculum Development*, *17*(2), pp. 83-104

Luft, P., Brown, C. M., & Sutherin, L. J. (2007). Are you and your students bored with the benchmarks? Sinking under the standards? Then transform your teaching through transition! *Teaching Exceptional Children, 39*(6), 39-47. Retrieved from EBSCOhost database.

Luster, R. (2008). A quantitative study investigating the effects of whole-class and differentiated instruction on student achievement. Ed.D. dissertation, Walden University, United States -- Minnesota. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3320691)

MacGillivray, L., & Rueda, R. (2003). Listening to inner city teachers of English language learners: Differentiating literacy instruction. Washington DC: Office of Educational Research and Improvement, U.S. Department of Education. (ERIC Document Reproduction Service No. ED479984)

Marlowe, B., & Page, M. (1998). *Creating and sustaining the constructivistic classroom*. Thousand Oaks, CA: Corwin Press.

Marshall, J., Prichard, R., & Gunderson, B. (2001). Professional development: What works and what doesn't. *Principal Leadership (High School Edition), 1*(6), 64-68.

McTighe, J., & Brown, J. L. (2005). Differentiated instruction and educational standards: Is détente Possible? *Theory into Practice, 44*(3), 234-244. Retrieved from ProQuest database.

McTighe, J., & Brown, J. L. (2007). Differentiated instruction and educational standards: Is détente possible? *Theory Into Practice, 44*(3), 234-244.

Miller, M. (2007). Differentiated reading instruction and classroom management structures that promote reading development. PhD dissertation, University of Florida, United States -- Florida. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3271181)

Mizell, H. (2003). Facilitator: 10, refreshments: 8, evaluation: 0. *Journal of Staff Development, 24*(4), 10-13.

Montgomery, M. (2006). A practical application of differentiated instruction: A middle school teacher's quest to make it relevant. MA dissertation, Chapman University, United States -- California. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT EP30547)

Moon, T. R., Callahan, C. M., Tomlinson, C. A., & Miller, E. M. (1995). *Middle school classrooms: Teachers' reported practices and student perceptions.* Washington, DC: The National Research Center for the Gifted and Talented.

Nicolino, P. (2007). Teacher perceptions of learning styles assessment, differentiated instruction, instructional technology and their willingness to adopt individualized instructional technology. EdD, Dowling College, 192 pages; AAT 3272895.

North Carolina Department of Public Instruction Report Cards. (2007). Retrieved from: http://www.ncreportcards.org/src/search.jsp?pYear=2008-2009&pList=1&pListVal=920%3AWake+County+Schools++++++++++&GO2=GO

Nunley, K. F. (2006). *Differentiating the high school classroom: Solution strategies for 18 common obstacles.* Thousand Oaks, CA: Corwin.

Ormrod, J. E. (2004). *Human learning* (4th ed.). Upper Saddle River, NJ: Pearson.

Pennington, E. (2010). Brain-based learning theory: The incorporation of movement to increase the learning of grammar by high school students. EdD dissertation, Liberty University, United States -- Virginia. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3389881)

Pettig, K. (2000). On the road to differentiated. *Educational Leadership*, *58*(1), 14-18.

Phillips, D. C. (1995). The good, the bad, and the ugly: The many faces of constructivism. *Educational Researcher, 24*(7), 5-12.

Picklo, D. M., & Christenson, S. (2005). Alternatives to retention and social promotion: the availability of instructional options. *Remedial and Special Education, 26*(5). Retrieved from EBSCO database.

Pollock, H. C. (2007). *The implementation of multiple intelligences activities through differentiated instruction in English and mathematics classrooms in one Pennsylvania middle school.* Wilmington College, DE.

Queen, J. (1999). *Curriculum practice in the elementary and middle school.* Upper Saddle River, NJ: Prentice-Hall.

Reis, S. M., Gubbins, E. J., Briggs, C., Schreiber, F. J., Richards, S., Jacobs, J., Eckert, R. D., & Renzulli, J. S. (2004). Reading instruction for talented readers: Case Studies document few opportunities for continuous progress. *Gifted Child Quarterly*, *48*, 315-338.

Rhea, A., & Regan, R. (2006, June). *Academically gifted (ag) basics program*. Retrieved from Wake County Public School System Web site: http://www.wcpss.net/evaluation-research/reports/2006/0602ag_basics.pdf

Richards, M. R. E. (2005). The effects of tiered lessons on learning gain in a secondary freshmen earth science course, as measured by assessment performance. EdD dissertation, University of Northern Colorado, United States -- Colorado. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3183575)

Robinson, E. M. (2004). Teacher decision-making in utilizing differentiated instruction. (Doctoral dissertation, Marywood University, 2004). *Dissertation Abstracts International, 65, 2496.*

Rock, G., Gregg, M., Ellis, E., & Gale, R. (2008). *REACH: a framework for differentiating classroom instruction.* Retrieved from http://www.highbeam.com/doc/1G1-174595103.html

Rosenblatt, L. M. (2005). *Making meaning with texts: Selected essays.* Portsmouth, NH: Heinemann.

Rowe, C. (2008). Principal leadership practices facilitating the implementation of differentiated instruction. EdD dissertation, Southern Connecticut State University, United States -- Connecticut. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3288079).

Sanborn, J. (2002). Targeted training: Using data to avoid random acts of professional development. *School Administrator, 59,* 16-20.

Scherer, M. (2000, September). Standardized instruction-effects may vary. *Educational Leadership, 58*(1), 5-5.

Schlechty, P. (1997). *Inventing better schools: An action plan for educational reform.* San Francisco: Jossey-Bass.

Schumm, J., & Vaughn, S. (1995). Getting ready for inclusion: Is the stage set? *Learning Disabilities Research & Practice, 10,* 169-179.

Serafino, K., & Cicchelli, T. (2003). Cognitive theories, prior knowledge, and anchored instruction on mathematical problem solving and transfer. *Education and Urban Society, 36*(1), 79–93.

Sisk, D. (2007). Differentiation for effective instruction in science. Gifted Education International 2007*, 23,* pp. 32-45.

Snowman, J., & Biehler, R. (2006). Psychology applied to teaching: Text with teaching in action guide. *Houghton Mifflin College Division,* 11.

Sondergeld, T. A., & Schultz, R. A. (2008). Science, standards, and differentiation: It really can be fun. *Gifted Child Today, 31*(1), 34-40.

Sousa, D. (2001). *How the brain learns*. Thousand Oaks, California: Corwin Press.

Sprenger, M. (1999). *Learning and memory: The brain in action*. Alexandria, VA: Association for Supervision and Curriculum Development

Sprenger, M. (2005, April). The adolescent learner: Inside Amy's brain. *Educational Leadership, 62*(7), 28-32.

Stager, A. (2007). Differentiated instruction in mathematics. M.A. dissertation, Caldwell College, United States -- New Jersey. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 1443733

Stripling, R., Bates, B., Bazenas, J., Birmingham, J., Dorris, C., Edwards, M., & Zinn, L. (2007). *A curriculum management audit of the Wake County Public School System. Raleigh, NC.* Retrieved from Wake County Public School System Web site: http://www.wcpss.net/curriculum-management/downloads/*WCPSS*-curriculum-management-audit.pdf

Sternberg, R., & Zhang, L. (2005). Styles of thinking as a basis of differentiated instruction. *Theory Into Practice*, *44*(3), 245-253.

Sweller, J. (2003). Evolution of human cognitive architecture. In B. Ross (Ed.), *The Psychology of Learning and Motivation, 43*, 215–266. San Diego, CA: Academic.

Sweller, J. (2004). Instructional design consequences of an analogy between evolution by natural selection and human cognitive architecture. *Instructional Science, 32*, 9–31.

Sweller, J., van Merrienboer, J. J. G., & Paas, F. (1998). Cognitive architecture and instructional design. *Educational Psychology Review, 10*, 251–296.

Thompson, C. L. (2000). Retention and social promotion: research and implications for policy. ERIC digest number 161. (ERIC Document Reproduction Service No. 407710)

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

Tomlinson, C. (2000a). Differentiation of Instruction in the Elementary Grades. *ERIC Clearinghouse on Elementary and Early Childhood Education.* EDO-PS-00-7.

Tomlinson, C. (2000b). Sharing responsibility for differentiated instruction. *Roeper Review, 26(4)* 188-190.

Tomlinson, C. (2000c). Reconcilable differences? Standards-based teaching and differentiation. *Educational Leadership*, *58*, 6-11.

Tomlinson, C. (2001). *How to differentiate instruction in mixed-ability classrooms* (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C. (2003). *Fulfilling the promise of the differentiated classroom: Strategies and tools for responsive teaching.* Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C.A. (2004). Differentiation in diverse settings. *School Administrator*, *61*(7), 28-35.

Tomlinson, C. (2005). *The differentiated classroom: Responding to the needs of all learners.* Upper Saddle River, NJ: Pearson Education, Inc.

Tomlinson, C., & McTighe, J. (2006). *Differentiated instruction & understanding by design.* Alexandria, VA: Association for Supervision and Curriculum Development.

Valli, V., & Buese, D. (2007). The changing roles of teachers in an era of high-stakes accountability. *American Educational Research Journal, 44*(3), 519-558. Retrieved from ABI/INFORM Global. (Document ID: 1334727311).

VanSciver, J. (2005). Motherhood, apple pie, and differentiated instruction. *Phi Delta Kappan, 86*(7), 534-535.

Varner, E. (2008). Learning preferences vs physiological responses. *Ohio Journal of Science, 108*(1), 33.

Vaughn, S. (2010, October). *Broken promises: Reading instruction in the resource room*. Exceptional Children. FindArticles.com. http://findarticles.com/p/articles/mi_hb3130/is_n2_v64/ai_n28701764/

Vaughn, S., Moody, S.W., & Schumm, J. S. (1998). Broken promises: Reading instruction in there source room. *Exceptional Children*, *64*, 211-225.

Vygotsky, L. (1978). Interaction between learning and development (pp. 79-91). In Mind in Society. (Trans. M. Cole). Cambridge, MA: Harvard University Press.

Waldon, N., & McClesky, J. (2001). Helping schools include all learners. *Intervention in School and Clinic, 36*(3), 175-181.

Ward, V. (1980). *Differential education for the gifted.* Ventura, CA: National/State Leadership Training Institute for the Gifted and Talented.

Wehrmann, K. S. (2000). Baby steps: A beginner's guide. *Educational Leadership, 58*(1), 20-23.

Whitaker, S. (2008). One national board certified teacher's post-certification journey with differentiated reading instruction in middle school language arts. PhD dissertation, University of Virginia, United States -- Virginia. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3353850)

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

William, D. (2008). Changing classroom practice. *Educational Leadership, 65*(4), 36-42.

Wolfe, P. (2006). Brain-compatible learning: Fad or foundation?." *School Administrator, 63*(11), 10. ERIC. EBSCO. Web. 1 June 2010.

Yatvin, J. (2004). *A room with a differentiated view: How to serve ALL children as individual learners*. Portsmouth, NH: Heinemann.

APPENDIX A: MARGATE HIGH SCHOOL DIFFERENTIATION SURVEY

What methods do you use to differentiate? How often do you differentiate?

	Less than 1-2 times per unit	1-2 times per unit	3-4 times per unit	Daily	Unsure of application within my content
Computer-based instruction					
Curriculum compacting					
Flexible grouping/cooperative learning					
Group projects and investigations					
Independent study					
Inquiry/didactic instruction					
Learning centers or stations					
Learning contracts					
Learning styles/multiple intelligences					
Multi-media presentations and projects					
On-going formative assessments					
Pre-assessments					
Product differentiation					
Scaffolding					
Students self-assessment					
Tiered activities and assignments					
Varied questioning (Bloom's Taxonomy)					
Varied resources and materials					
Choose the 3 strategies that would help					
you most improve student learning:					
Computer-based instruction					
Curriculum compacting					
Flexible grouping/cooperative learning					
Group projects and investigations					
Independent study					
Inquiry/didactic instruction					
Learning centers or stations					
Learning contracts					
Learning styles/multiple intelligences					
Multi-media presentations and projects					
On-going formative assessments					
Pre-assessments					
Product differentiation					
Scaffolding					
Students self-assessment					
Tiered activities and assignments					
Varied questioning (Bloom's Taxonomy)					
Varied resources and materials					

APPENDIX B: INSTRUCTIONAL STRATEGIES THAT SUPPORT DIFFERENTIATION AS PART OF THEIR TOOLBOX FOR PLANNING RIGOROUS INSTRUCTION

Instructional Strategies that Support Differentiation

♦ **Acceleration**: a strategy that allows a student to study material at a faster pace

♦ **Complexity and challenge**: the use of higher-order thinking skills

♦ **Computer-based instruction**: the use of technology to individualize instruction

♦ **Curriculum compacting**: a strategy that allows students who show on a pretest that they already know part or all of the material to be studied to work on alternate activities

♦ **Flexible grouping-**: a purposeful reordering of students into temporary working groups to ensure that all students work with a wide variety of classmates and in a wide range of contexts during a relatively short span of classroom time

♦ **Group projects and investigations**: activities in which students are grouped by interest to investigate a topic related to something being studied in class

♦ **Independent study**: activities in which students use their unique abilities and talents to explore areas of special interest on their own

♦ **Intelligence preferences-**: modes that reflect different ways a student expresses intelligence as indicated in systems described by Howard Gardner and Robert Sternberg

♦ **Learning centers or stations**: collections of materials and activities designed to teach, reinforce, or extend students' knowledge, understanding, and skills

♦ **Learning contracts**: formalized agreements between the teacher and a student that delineate the independent learning tasks a student will do during a unit of study

♦ **Learning style-** the way student learning is affected by personal and environmental Factors

♦ **Mentorships**: utilization of community and business resources, abilities, and talents to support students in exploration of areas of special interest

♦ **Multi-media presentations and projects**: products that require the development of 21st century skills

♦ **On-going formative assessments**: varied and frequent opportunities for students to demonstrate and teachers to evaluate progress towards a goal

♦ **Open-ended activities**: tasks which allow students to take content, process, and product in non-prescribed directions and depth

♦ **Scaffolding**: any support system that enables students to succeed with tasks they find genuinely challenging

♦ **Student interest**: a factor to consider in offering student choice

♦ **Student self-assessment**: a strategy that, in combination with teacher assessment, enriches the picture of student performance

♦ **Student choice**: a strategy that strengthens performance by increasing student Ownership

♦ **Tiered activities and assignments**: assignments in which all students work toward the same standards or objectives but at different levels of readiness or ability

♦ **Varied questioning**: a technique of forming questions with the goal of extending student thinking

♦ **Varied texts and materials**: a method of matching materials to the needs and abilities of differing learners

Many definitions were adapted from the following resources:

Carolyn Coil, *Successful Teaching in the Differentiated Classroom* and *Teaching Tools for the 21st Century*
Carol Ann Tomlinson, *The Differentiated Classroom: Responding to the Needs of All Learners*
Carol Ann Tomlinson and Caroline Cunningham Eidson, *Differentiation in Practice: A Resource Guide for Differentiating Curriculum*

APPENDIX C: INSTRUCTIONAL STRATEGIES THAT SUPPORT

DIFFERENTIATION AT MARGATE HIGH SCHOOL

- **Computer-based instruction:** the use of technology by teachers and/or students to *individualize* instruction.
- **Curriculum compacting:** a strategy that allows a student to study material at a faster pace so that they can work on alternative enrichment activities.
- **Flexible grouping / cooperative learning:** a *purposeful* reordering of students into temporary working groups to ensure that all students work with a wide variety of classmates and in a wide range of contexts during a relatively short span of classroom time.
- **Group projects and investigations:** activities in which students are grouped by interest to investigate a topic related to something being studied in class.
- **Independent study:** activities in which students use their unique abilities and talents to explore areas of special interest on their own.
- **Inquiry / didactic instruction:** learning through student-led discovery.
- **Learning centers or stations:** collections of materials and activities designed to teach, reinforce, or extend students' knowledge, understanding, and skills.
- **Learning contracts:** formalized agreements between the teacher and a student that delineate the independent learning tasks a student will do during a unit of study.
- **Learning styles / multiple intelligences:** modes that reflect different ways a student expresses intelligence as indicated in systems described by Howard Gardner and Robert Sternberg.
  Ex.: visual, auditory, tactile, etc.
- **Multi-media presentations and projects:** products that require the development of 21st century skills.
- **On-going formative assessments:** varied and frequent opportunities for students to demonstrate and teachers to evaluate progress towards a goal.
- **Pre-assessments:** using formal or informal methods for determining the prior knowledge of students.
- **Product differentiation:** tasks which allow students to demonstrate knowledge by creating a product of their choosing.
- **Scaffolding:** a support system that enables students to succeed with tasks they find genuinely challenging. Ex.: graphic organizers, study guides, re-teaching, extended teaching, reading buddies, etc.
- **Student self-assessment:** a strategy that, in combination with teacher assessment, enriches the picture of student performance.
- **Tiered activities and assignments:** students are grouped for instruction based on their prior background knowledge. Students begin at their current level of understanding. All students then work toward mastering the same standards or objectives.
- **Varied questioning (Bloom's taxonomy):** a technique of forming questions with the goal of extending student thinking.
- **Varied resources and materials:** a method of matching materials to the needs and abilities of differing learners.

Content-learning centers or stations, learning contracts, tiered activities or assignments, varied resources and material
Process- computer-based instruction, curriculum compacting, flexible grouping/cooperative learning, independent study, inquiry/didactic instruction, learning styles/multiple intelligences, ongoing formative assessments, pre-assessments, scaffolding, varied questions (Bloom's taxonomy)
Product- group projects and investigations, multi-media presentations and projects, product differentiation, student self-assessment

APPENDIX D: RATIONALE FOR CHANGES MADE TO *WCPSS* AG PROGRAM 2009 TOOLBOX IN CREATION OF INSTRUCTIONAL STRATEGIES THAT SUPPORT DIFFERENTIATION AT MARGATE HIGH SCHOOL - SOURCE, JULIE BROWN

Instructional Strategies that Support Differentiation

Deleted **Acceleration**-*This is essentially the same thing as "curriculum compacting".*

Deleted **Complexity and challenge**- *This is Bloom's Taxonomy (we used Bloom Taxonomy because teachers would understand the concept better with less explanation…. Since they were doing their survey by themselves, they didn't have anyone to explain the different tools so it was best to use terminology they were already comfortable with.).*

Added to definition-**Flexible grouping (cooperative learning**)-*Cooperative learning is the actually teaching strategy. Flexible grouping is the method by which you make cooperative learning more effective.*

Added **Inquiry/Didactic instruction-***These are specific to Science / English. They are buzz words in the subject areas and have been used to differentiate instruction to meet the needs of higher level students. I had never heard of "didactic" used in this way before. I think it also includes the Socratic teaching style (which is learning by guided questioning).*

Deleted **Intelligence preferences-** *Learning styles & multiple intelligences covered this*

Added to definition-**Learning style-(multiple intelligence)-** *Learning styles & multiple intelligences to fit nicely together and typically these are implemented in similar ways.*

Deleted **Mentorships**- *This just doesn't happen very often most people just don't have the time to coordinate community mentors*

Added **Pre-assessment-***Pre-Assessments allow teachers to determine how differentiation needs to be done. A lot of times teachers do a pre-assessment (i.e. take the first step in differentiation) and don't go any further (i.e. adjust their future teaching). It is useful to include separately because it is often the first step in differentiated.*

Added **Product differentiation-** *specific example of differentiation and while it was included as part of "open-ended activities", we thought it would get lost. Separating it seemed the best idea.*

Deleted -**Open-ended activities**-*Too broad – this pretty much includes all of differentiation in one term.*

Deleted **Student interest**- *Didn't seem like a full-fledged tool… more like a part of product differentiation and independent study.*

Deleted **Student choice**- *Didn't seem like a full-fledged tool… more like a part of product differentiation and independent study.*

Added to definition-**Varied questioning (Bloom's)-** *a technique of forming questions with the goal of extending student thinking Bloom's taxonomy was a better explanation.*

Added to definition**- Varied texts and materials (Resources)-***Everything is not in text form these days – videos, animations, etc.*

APPENDIX E: UNDERSTANDING 2006-07 *WCPSS* EFFECTIVENESS INDEX INFORMATION

Contact: Brad McMillen, Glenda Haynie, or Kevin Gilleland, E&R

EXERCISE CAUTION IN THE USE OF EFFECTIVENESS INFORMATION

Single test scores give a snapshot in time and have measurement error. Use averages of 15 or more students whenever possible, and look at performance over time. Use effectiveness information for school improvement and not evaluation.

Averaging residual scores for groups of students greatly reduces the impact of standard error of measurement and is a more powerful way to analyze results. Looking at average residual scores for groups of students can indicate whether a group of students in a school showed achievement comparable to, below, or above the achievement shown by similar students served in other schools across our district. Since residuals compare

Q.1 What is a student residual score?

A. A student residual is a measure of how a student performed on a test compared to other *WCPSS* students like themselves.

A student residual is the difference in scale score points between a student's actual score and the score predicted for that student by a statistical method called multiple regression. The regression equation takes into consideration the student's pretest score, the student's special education services, the student's free or reduced-price lunch (FRL) status, and the school's FRL percentage and then calculates the score a student would be expected to achieve based upon the predictor variables and the performance of other *WCPSS* students who took the test and had the same pretest scores and academic indicators.

When a residual score is near zero, it means a student scored close to the expected value for similar students across the district who took the same test. The standard error of measurement

for a single student on the EOG or EOC test is given at the bottom of the student roster. Individual residuals one standard deviation above (coded in green) or one standard deviation below (coded in red) may be worthy of closer examination. Reviewing individual residuals can help teachers identify patterns of student success or failure that may be related to the instructional methods used with those students.

Q.2 What is a teacher residual average?

A. A teacher residual average is a measure of how the teacher's students performed on a test compared to other students like them in Wake County Public Schools.

A teacher residual average is the average of all the students' residuals for a particular test and roster of the teacher. The class average for an EOG or EOC test is given at the bottom of the roster. The teacher residual average can be compared to other teacher averages by using the tables on the next page. A teacher average above the top quartile is in the top 25% of *WCPSS* teacher averages, and a teacher average below the lower value is in the bottom 25% of averages. The practices of teachers with high residual averages should be documented and shared with other teachers for school improvement.

Q.3 What is a school effectiveness index?

A. A school effectiveness index is a measure of how the school's students performed on a test compared to other students like them in Wake County Public Schools.

A school effectiveness index is the z-score value of the average of all the student residuals for a particular test given in the school. A z-score is a statistical measure of how far (in standard deviations) the average for a group of students is from the statistical average for our school system. A z-score of zero is the average of all *WCPSS* student residuals on a given test, and the standard deviation of scores for all schools is one. Therefore, a school that receives an index of

0.010 on 5th grade mathematics is close to zero, which means the 5th grade students in that school performed about equal to other students with similar profiles.

If the index is above +1.0, the school's residual average is among the top schools in the system serving that grade level. If the index is below –1.0, the school's residual average is among the bottom school averages. Thus, subjects and grades in which a school showed a z-score of less than –1.0 might be targets for school improvement efforts. A z-score above +1.0 might mean that a grade-level team is implementing practices that should be documented and shared with other schools or other grade levels.

EOG & EOC Teacher Average Residual Cut Points for 2006-07 Test Results

The tables below give teachers a guide to the average value of student residuals above which or below which 25% of all teacher averages fall. For example, a Grade 4 reading teacher whose average student residual value is +1.23 is among the top 25% of student residual averages for all Grade 4 reading teachers in Wake County Public Schools. A Grade 7 math teacher whose average student residual value is -1.35 is among the bottom 25% of student residual averages for all Grade 7 math teachers in Wake County Public Schools.

Student residual rosters are given to principals for all EOC and EOG courses, by teacher and section. Averages are printed at the bottom of each roster. The values below were calculated for teachers across *all* sections. A teacher may have a high student residual average but still have one class that had a low average and vice versa. Remember that averages are positively or negatively influenced by very large or very small residuals. Teachers should have at least 15 students in a class to use the values below as a meaningful point of comparison to their own results.

EOC Subject	Bottom Quartile	Top Quartile
8th grade Algebra 1	Coming soon	Coming soon
High School Algebra 1	< -1.4	> 1.6
Geometry	< -1.7	> 1.8
Algebra 2	< -2.3	> 1.5
English 1	< -0.7	> 0.7
Biology	< -1.4	> 1.0
Chemistry	NA	NA
Physics	NA	NA
Physical Science	NA	NA
Civics and Economics	< -1.4	> 1.1
U. S. History	< -1.5	> 1.4

EOG Subject	Bottom Quartile	Top Quartile
Grade 3 Reading	< -1.2	> 1.1
Grade 4 Reading	< -0.9	> 0.9
Grade 5 Reading	< -0.9	> 0.8
Grade 6 Reading	< -0.6	> 0.6
Grade 7 Reading	< -0.4	> 0.6
Grade 8 Reading	< -0.4	> 0.5
Grade 3 Math	<-1.8	> 1.7
Grade 4 Math	< -1.2	> 1.3
Grade 5 Math	< - 1.4	> 1.5
Grade 6 Math	< -1.2	> 1.1
Grade 7 Math	< -0.8	> 1.2
Grade 8 Math	< -1.0	> 0.9

Remember that these values do rank order students, schools, and teachers. However, being on the bottom does not equate with bad; it only indicates that someone is doing better (in a district which already performs at a high level compared to the state).

APPENDIX F: PARTICIPANT PERMISSION LETTER

Agreement to Participate

Mark Savage
(919) 556-7898
savagem08@ecu.edu

January 7, 2011

Dear Respondent:

My name is Mark Savage and I am currently a doctoral candidate in the Department of Educational Leadership in the College of Education at East Carolina University. I am conducting a dissertation study on the use of differentiated instruction. For this study, I will look at the relationship between student performance and teacher reported use of differentiation on the staff survey administered at Wakefield High School in 2008 (attached).

I would like to invite you to participate in this study by signing the attached consent form. If you consent, I will use your individual survey responses as well as any available student residual information from Wake County Public School Systems' Evaluation and Research Department. This data will be coded to provide anonymity.

No names or identifying information will be used in my reporting of the results, or in any publication about the research. The school itself will be given a pseudonym prior to publication of findings. All teacher-identifying information will be coded and identifying markers will be destroyed to protect the identity of program participants. No identifying information will be shared with your supervisor, evaluator, or any other employee of Wake County Public Schools.

I will analyze the results of the surveys as a group, and I will not analyze results of individual participants. Prior to publication, this work will be shared only with the chair of my dissertation committee, my doctoral chair and the study's methodologist.

Once data are compiled, I will use comparative statistics to determine if there is a significant relationship between reported differentiation and student residual scores. Currently, there is a lack of research examining the effect of differentiated strategies on standardized test results. This study seeks to broaden the research on differentiated instruction as a means to increase student performance on state-mandated benchmark tests.

If you choose to participate, I will provide you with a copy of all findings at your request. If at any time, you become uncomfortable with participation in the study for any reason, you may opt out by contacting me at

savagem@ecu.edu or at (919) 556-7898. At that time, any collected data will be shredded and removed from the study.

This study has been approved by East Carolina University and Wake County Public Schools. You may also contact David Holdzkom at dholdzkom@wcpss.net with any concerns about the use of this study in the school system. I will leave boxes at your campus for you to place your consent form. Thank you for your consideration.

Sincerely,

Mark Savage, Administrator

Research study: *Exploring the relationship between differentiated instruction and student performance.*

Participant's Name: _____

____ I will participate in this research study, and give permission for researcher to use results from my August 2008 differentiation survey and any available residual data.

____ I will not participate in the research study.

____ I have some questions, please contact me at _____

APPENDIX G: PARTICIPANTS QUARTILE SCORES

	Total Different.		Product Diff.		Process Diff.		Content Diff.	
Participant	**Quartile**	**Value**	**Quartile**	**Value**	**Quartile**	**Value**	**Quartile**	**Value**
Teacher A	3	2	3	2	2	1	3	2
Teacher B	3	2	3	2	2	1	3	2
Teacher C	2	1	2	1	3	2	2	1
Teacher D	1	1	1	1	1	1	1	1
Teacher E	1	1	2	1	2	1	2	1
Teacher F	4	2	4	2	3	2	3	2
Teacher G	1	1	1	1	1	1	1	1
Teacher H	1	1	1	1	1	1	1	1
Teacher I	4	2	4	2	3	2	3	2
Teacher J	2	1	3	2	2	1	2	1
Teacher K	1	1	3	2	1	1	3	2
Teacher L	2	1	2	1	2	1	2	1
Teacher M	3	2	3	2	2	1	3	2
Teacher N	2	1	4	2	2	1	2	1
Teacher O	2	1	3	2	2	1	2	1
Teacher P	4	2	4	2	4	2	3	2
Teacher Q	1	1	2	1	2	1	2	1
Teacher R	4	2	4	2	4	2	3	2
Teacher S	3	2	3	2	4	2	3	2
Teacher T	1	1	2	1	1	1	2	1
Teacher U	4	2	4	2	3	2	4	2
Teacher V	4	2	4	2	4	2	4	2
Teacher X	3	2	4	2	2	1	3	2
Teacher Y	3	2	3	2	2	1	4	2
Teacher Z	2	1	2	1	2	1	2	1
Teacher AA	3	2	4	2	2	1	4	2
Teacher AB	3	2	4	2	3	2	2	1
Teacher AC	3	2	3	2	2	1	3	2
Teacher AD	1	1	1	1	1	1	2	1
Teacher AE	3	2	3	2	3	2	3	2
Teacher AF	4	2	4	2	4	2	4	2
Teacher AG	2	1	3	2	2	1	1	1

Teacher AH	2	1	3	2	2	1	2	1
Teacher AI	3	2	4	2	2	1	2	1
Teacher AJ	4	2	4	2	3	2	3	2
Teacher AK	4	2	4	2	3	2	4	2
Teacher AL	3	2	2	1	4	2	3	2
Teacher AM	1	1	2	1	1	1	1	1
Teacher AN	2	1	2	1	3	2	1	1
Teacher AO	3	2	3	2	2	1	3	2
Teacher AP	3	2	4	2	2	1	3	2
Teacher AQ	3	2	3	2	3	2	2	1
Teacher AR	4	2	3	2	3	2	2	1
Teacher AS	4	2	4	2	4	2	4	2
Teacher AT	2	1	2	1	2	1	2	1
Teacher AU	1	1	2	1	1	1	2	1
Teacher AV	4	2	3	2	4	2	4	2

APPENDIX H: PARTICIPANT RESIDUAL SCORES 2004-201

Participant							Residual Scores 2004-2010									
Teacher A	-1.03	-1.78	0.25													
Teacher B	0.83	-1.81														
Teacher C	-0.78	-2.78	0.14	-0.2	-0.98	-1.69	1.02	1.42	-0.61	-0.86	-1.89	2.83	0.13			
Teacher D	-4.82	-1.74	-4.59	-4.87												
Teacher E	-1.04	-0.88	2.84	0.71	-1.71	-0.45	-2.75	1.46	-0.12	-3.34	-2.32	-3.18	-1.37			
Teacher F	-4.62	0.46	-3.59	5.76	4.36	6.88	0.8	4.25	-1.95	3.25	4.91	-6.67	-0.49	2.04	1.19	-0.12
Teacher G	0.2	1.91	-0.08	0.69	1.91	0.98	1.71	-0.04	0.4	1.74	1.5	0.11	1.58			
Teacher H	-1.9	-2.14	-1.73	1.44	0.2	-0.99	0.82	1.09	-0.01	0.7	-1.28	-0.47	-0.48	-2.06	1.38	2.08
Teacher I	1.85	-1.67	-1.88	-5.56	-5.36	-3.76	-0.31	-0.28								

Teacher J	2.89	-1.65	0.9																														
Teacher K	1.21	-0.6	-0.14	0.4	-2.04	0.42	-3.74	1.6	0.54	1.71	-0.71	-0.93	-0.54																				
Teacher L	-0.59	-3.82	-3.96	-2.26	-1.91	-0.51	0.65	-3.07	-2.87	1.1	0.36	-2.75	-1.96																				
Teacher M	0.46	0	0.92	-2.85	-6.21	-2.05	-0.96	1.09	1.74																								
Teacher N	-3.36	-0.01	-4.83	-3.52	-3.78	-3.67	-4.13																										
Teacher O	-0.77	-0.82	-2.79																														
Teacher P	-1.84	-0.23	-3.66	-3.85	-2.9	-2.92	-2.3	-0.96	1.08	-0.05	-0.75	0	3.02	-2.88																			
Teacher Q	1.98	1.7	-1.92	2.26																													
Teacher R	-1.68	-1.6	-2.06	-0.08	2.55	2.41	2.19	2.62	0.47	0.33	-0.86	0.72																					
Teacher S	0.18	-1.79	1.67	-1.35	-1.07	-0.85	-0.08	0.36	0.14	-0.85	-0.59	-0.05	-3.74	0.22	-3.83	-0.63	-1.2	-3.25	0.89	-1.19	2.86	-2.63	-0.65										
Teacher T	-1.88	0.68	-2.76																														

Teacher U	0.58	-1.08	-2.32	-2.55	0.98	0.62	1.08	-0.62	0.58	-4.56	-5.74	1.95	-3.12	2.56	-1.77	-1.83	-2.14	-2.74	-2.56	-4.18	1.12	-2.25	-4.86	-3.19	-2.91	-2.08	0.83	-0.42	0.75	
Teacher V	1.3	0.28	0.78	-1.57																										
Teacher X	-2.78	-3.75	-0.79	-3.22	0.27	-1.15	0.45	-1.08	2.18	0.54	-0.26	-0.39	-1.41	0.96																
Teacher Y	-2.14	-1.59	-2.01	-1.59	1.09	1.03	2.82	3.11	-0.34	2.11	0.49																			
Teacher Z	-0.35	2.04	2.31	2.83	2.7	4.15	3.09	0.7	1.93	0.17																				
Teacher AA	-2.77	-0.99	-1.25	-0.64	-0.03	0.33	0.63	0.01	0.81	0.5	1.05	-2.39	-2.23	-0.3	1.59	0.99	-0.52	-0.4	-2.66	0.13										
Teacher AB	1.81	2.82	2.47	4.42	-3.78	1.39	-0.45	-2.43	0.79	2.68	3.19	-2.48	-4.93	2.86	-2.52	-0.93	0.93	-1.18	-1.5	2.39	1.26	-0.7	-0.52							
Teacher AC	-0.36	-1.53	1.87	-1.14	2.32	-1.13																								
Teacher AD	-8.37	-1.11	-3.81																											
Teacher AE	0.18	-1.91	-2.28	-1.65	-2.17	-0.19	-3.37	-2.66	-3.22	-2.56	-2.72	-2.5	-3.39																	
Teacher AF	0.35	-1.46	1.06	1.2	0	-0.84	-0.12	-1.71	-0.62	0	0.64	-1.22	-1.48	-0.7	0.44	0.37														

Teacher AG	-1.5	2.83	-0.87	2.18	0.92	0.76	2.29	2.14	2.36	0.03	0.65	2.73	0.54	1.49	-1.86	0.82	0.86	0.83	-1.75	-2.53	-0.38	0	1.42						
Teacher AH	0.17	2.59	-1.85	-0.1	2.23	2.6	2.94	1.11	3.35	1.15	2.4	2.59	3.05	1.63	3.45	3.37	3.48	2.53											
Teacher AI	0.77	1.86	-0.18	2.76	2.41	-0.27	3.77	1.9	1.32	1.69	-2.22	2.58	1.36	-0.93	1.16	2.16	2.2	-0.31	-1.54	1.16	1.71	2.69	1.1	-0.45	1.42	1.11	1.61	0.52	0.54	
Teacher AJ	1.78	1.56	0.09	2.13	1.02	0.85	1.45	2.32	1.69	0.32	1.66	0.4	1.56	2.08	0.13	-1.3	0.92												
Teacher AK	0.24	0.87	-2.98	-1.77	-1.19	-1.83																							
Teacher AL	-2.99	-1.37	-0.13	-3.43	0.12	-5.22	3.61	1.7	-0.92	-2.52	-1.13	-0.28	-1.72	-1.24	-2.3														
Teacher AM	4.67	4.09	3.42	4.96	2.86																								
Teacher AN	0.46	-1.6	1.47	2.62	-0.68	-0.61	2.48	-2	2.91	1.39	1.44	2.6	-1	-1.39	1.36	-0.16	-2.19												
Teacher AO	3.73	-1.69	-0.63	-1.22	0.63	-0.96	0.28	-1.96	-2.79	-5.03	-0.69	-3.23	-3.75																
Teacher AP	2.12	0.91	0.67	-1.31	-0.9	0.25	0.46	2	-1.36	0.02	-0.11	-0.37	1.6	-1.31	-0.6	-1.19	0.88	-3.31	0.48	-3.18	-0.22	-0.52	0.11	1.86	-1.06	0.26	-1.27	2.16	0.43	-1.39

Teacher AQ	0.87	0.65	1.93	-2.52	0.34	2.47	1.75	1.09	2.15	2.69	1.33	1.01	1.7	-0.74	-1.65	-1.1														
Teacher AR	2.22	1.87	2.21	1.34	1.23	0.74	0.75	-0.8	-0.19	0.11	1.13	1.67	1.39	1.23	1.57	0.98	1.18	-0.32	0.37	3.52	1.04	2.89	1.11	3.53	2.29	3.66	3.59	2.44	1.05	
Teacher AS	1.44	3.65	2	1.2	-0.46	-2.43	-4.74	4.65	1.71	-3.12	-4.14	2.63	-1.85	1.62	1.62	2.43	1.74	0.34												
Teacher AT	-0.26	0.62	-2.95	1.35	2.37	3.64	2.58	3.53	-2.49	2.15	3.63	5.49																		
Teacher AU	-1.64	-3.86	-2.42	-3.95	-5.74	-3.51																								
Teacher AV	-1.53	0.03	0.47	-1.43	0.37	0.16	-2.04	-3.68	1.39	4.01	-1.03																			

APPENDIX I: INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
1L-09 Brody Medical Sciences Building• 600 Moye Boulevard • Greenville, NC 27834
Office 252-744-2914 • Fax 252-744-2284 • www.ecu.edu/irb

TO: Mark Savage, 6608 Austin Creek Dr., Wake Forest, NC 27587

FROM: UMCIRB

DATE: February 2, 201.

RE: Expedited Category Research Study

TITLE: "Exploring the Relationship between Differentiated Instruction and Student Performance"

UMCIRB #11-054

This research study has undergone review and approval using expedited review on 1/30/11. This research study is eligible for review under an expedited category number 7. The Chairperson (or designee) deemed this **unfunded** study **no more than minimal risk** requiring a continuing review in **12 months.** Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The investigator must adhere to all reporting requirements for this study.

The above referenced research study has been given approval for the period of **1/30/11** to **1/29/12.** The approval includes the following items:

- Internal Processing Form (dated 1/ 0/11)
- Informed consent (revised, received 1/30/11)
- Differentiation survey

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

The UMCIRB applies 45 CFR 46, Subparts A-D, to all research reviewed by the UMCIRB regardless of the funding source. 21 CFR 50 and 21 CFR 56 are applied to all research studies under the Food and Drug Administration regulation. The UMCIRB follows applicable International Conference on Harmonisation Good Clinical Practice guidelines.