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Mandated differentiated instruction effectiveness examined

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This is to certify that the doctoral study by

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ABSTRACT

Mandated Implementation of Differentiated Instruction Effectiveness Examined

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Doctoral Study Submitted in Partial Fulfillment
for the Requirements for the Degree of
Doctor of Education, Teacher Leadership

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ABSTRACT

Educational institutions are implementing curriculum mandates without data to support the benefits of the mandates to students. The purpose of this concurrent, mixed-method study, which utilizes quasi-experimental and case study approaches, was to address the effectiveness of mandated differentiated instruction in a suburban high school. This study investigated the significant differences in achievement before and after the implementation of differentiation as well as differences in achievement between a school that mandated the use of differentiation and one that did not. The study also investigated strategies used to implement differentiation and student and teacher attitudes toward it. For ninth grade literature and biology students, *t*-test analyses revealed significant differences between end-of-course test passing rates before and after implementing differentiation. However, the data showed no significant difference between the passing rates of the two different schools. A change midstream in the daily schedule from 4, 90-minute classes to 7, 50-minute period courses presented a confounding variable that could have affected passing rates. Teachers and students participated in surveys to evaluate attitudes toward differentiation. Surveys among teachers suggested a trend toward a preference for differentiation. Both teachers and students felt that differentiation was beneficial for students. According to students, differentiation was evidence of teacher professionalism and passion which influenced a student's desire to learn. Differentiation provides an avenue for educating all students through students' interests and strengths. Ideally, this avenue will lead to improved student learning and achievement resulting in a more educated society.

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CHAPTER 1: INTRODUCTION TO STUDY

Introduction

Student achievement is a source of contention in education. Therefore, "On Jan. 8, 2002, President Bush signed the *No Child Left Behind Act of 2001* (P.L. 107-110) into law...Accountability is a crucial step in addressing the achievement gaps that plague our nation" (A Guide to Education, 2004). This emphasis on accountability and federal funding has forced districts, individual schools, and classroom teachers to analyze how curriculum, instruction, and learning relate to achievement. The standardized achievement scores of all ethnic and ability groups are linked to making Adequate Yearly Progress (AYP), the criteria by which schools' performances are judged due to No Child Left Behind (NCLB). Therefore, diverse strategies must be employed to ensure that all students learn and achieve. Because federal funding is connected to AYP, ensuring achievement has spurred research focusing on the best educational practices. Thus, the research-based practices and standards-based curriculum movements were born (Benson, 2003; O'Shea, 2005).

One of the most crucial realities resulting from these movements is that students learn differently and therefore, must be taught differently (National Research Council, 2000). In the eighties Gardner (2004) developed the theory of multiple intelligences (MI), suggesting that all students have learning strengths and weaknesses that can be used during instruction. While this was not a new idea to classroom teachers, converting theory to practice in a class of 30 students was daunting.

The decade of the 1990s is considered the decade of the brain because of the technological explosion of anatomical and physiological mapping devices that allowed researchers to record brain activity while a subject performed specific tasks (Bruer, 1999; Willis, 2007). This new knowledge lead to a movement in education called brain-based learning (BBL). While much of the data was converted into a brain-friendly curriculum, practical application that benefited all students still proved elusive. Research educators and cognitive psychologists warn that much of the brain research performed in the 1990s was performed on subjects who had neurological problems and misrepresented to educators. Still, a greater understanding of brain function and memory has been a major benefit to educators in designing an engaging, brain-friendly curriculum (Wolfe, 2001, 2006; Sprenger, 2003; Sousa, 2001). So, the question remains regarding how educators can integrate theory and practice while meeting the diverse needs of learners.

Differentiated instruction is one of the current approaches being used in an attempt to meet the diverse needs of students. Although the United States has a history utilizing the factory model for educating students, the idea that students learn best when they construct their own knowledge is a founding principle for many of the constructivist curricular strategies presently used in America's classrooms (Sousa, 2001; Tomlinson, 2001, 2003). However, according to Tomlinson (1999), "Differentiated instruction is not a strategy. It is a total way of thinking about learners, teaching, and learning" (p.6). The idea behind differentiated instruction is that all students have different interests and abilities. Therefore, students learn differently and consequently construct knowledge differently (Tomlinson & McTighe, 2006; Sprenger, 2003; Tomlinson, 2001). It is these

differences that differentiation seeks to use to the student's advantage. According to Tomlinson (1999)

> Cultivating schools that effectively, vigorously and consistently address that full range of learning needs in the context of heterogeneity is the goal of differentiation. It is ambitious in its scope, likely not fully possible, confounding in its complexity – and yet no more worthwhile goal may exist for school leaders who believe in public education that provides equity of access and growth in individual excellence for all learners. (p. 6)

Differentiated instruction's core belief is that all students can learn in a comfortable, safe learning environment if they are engaged and an active participant in the learning process (Tomlinson & McTighe, 2006; Tomlinson, 2001). In order for learning to occur several conditions must be met. These conditions include a focus on content that is applicable and meaningful, a positive learning environment where students feel safe and supported, and instructional strategies that ignite students' desire to learn (Tomlinson & McTighe, 2006; Benson, 2003; Sousa, 2001).

In order for a differentiated curriculum to truly help students learn and succeed, differentiation must be based on sound theoretical principles. One strategy of differentiation is through the use of learning styles or modalities. Gardner's (2004) MI Theory postulates that learners have different strengths and learn best when material is presented through techniques targeting these modalities. Another premise upon which to differentiate is by using BBL. BBL addresses many issues from nutrition to using music and color to improve memory, as well as, to designing lessons that target specific regions of the brain. One BBL example is using emotion in the learning process (Sousa, 2002).

According to Wolfe (2006), “Emotion is the primary catalyst in the learning process” (p. 4). Researchers agree that memory is not stored in one specific region of the brain but spread out based on the functions of the different lobes and that experience literally shapes the brain (Wolfe, 2006). Differentiation using MI and BBL should improve learning and student achievement. But, how do classroom teachers choose what strategies to use for differentiation? How do they know when to differentiate? More importantly, how can teachers train students to use differentiation methods when studying independently? Answers to some of these questions can be found in education literature. A more detailed literature review follows in chapter 2 where the use of MI, BBL and scientific inquiry is connected with a differentiated curriculum.

Problem Statement

Scherer (2008) reports that, almost one in three high school students will not graduate from high school. Another study found that approximately one-half of the students in the nations' 50 largest cities will graduate from high school (Scherer, 2008, p. 7). While many of the education initiatives have focused on middle and elementary few have focused on the high school. Thus, too many students are dropping out or graduating with skills that are inadequate for college or the work place. Because of this dropout problem, the United States’ international competitiveness is diminishing (Scherer, 2008; Wise, 2008; Cech, 2008). More responsibility and blame is being placed on classroom teachers for students’ lack of achievement. When President Bush signed the *No Child Left Behind Act of 2001* (P.L. 107-110) into law, accountability shifted from students to

teachers and to the schools. Because student achievement is tied to federal mandates and funding, strategies to improve achievement by improving learning are the focus of intense research and debate. Because of perceived gaps in what students are taught and what they learn, educational institutions are implementing curriculum mandates without the necessary data to prove it benefits students.

One school system adopted Schlecty's (2002) WOW (Working on the Work) approach in order to provide quality instruction for students. Yet the system continued to struggle in making enough gains for achieving (AYP), especially within the subgroups of special populations and English language learners. The administration for the high school at the center of the investigation chose to mandate the use of differentiation as a way to implement the components of Schlecty's WOW approach to teaching with the idea that using the best of WOW and differentiation should improve student learning (interview with Susan Atkins, assistant principal). This investigation focused on how differentiation of the curriculum was used by teachers and students to improve learning and what evidence was present to prove that differentiated instruction has an effect on student learning and achievement.

In an effort to improve student achievement and meet the state and federal requirements for AYP, one suburban area high school mandated the implementation of differentiated instruction. However, the effectiveness of differentiating instruction has not been examined in a high school setting. Therefore, data that suggests that differentiation improves or impedes students' academic progress is absent from the literature.

Nature of Study

At all levels of education in the U.S., strategies are being implemented to improve student achievement in the classroom and on standardized tests. Teacher accountability has been intricately tied to student achievement. One suburban area school system has not been successful in meeting AYP standards. While individual schools in this system have consistently been successful in meeting AYP, the system as a whole has not shown significant gains in different subgroups, such as English language and special populations. In an effort to improve the quality of instruction the system adopted Phillip Schlecty's (2002) WOW approach. WOW stands for working on the work, a premise that if students are provided with quality instruction they are more likely to become engaged and take ownership in their learning. In an effort to implement Schlecty's (2002) WOW Designed Qualities, described later, the administration at the school under investigation chose to mandate that teachers differentiate their curriculum. Because differentiation means different things to different educators, the extent, methods, and effectiveness of differentiation must be investigated.

Tomlinson and McTighe (2006) suggest that differentiated instruction creates an environment that allows students to reach their optimal potential. The problem is that there is very little data to suggest that student achievement is increased when instruction is differentiated. Since students have learning strengths and weaknesses, these should be exploited to maximize learning (Gardner, 2004). But the implications of current brain research cannot be ignored when planning an effective instruction and curriculum. Because of the growing trend toward differentiation in America's schools its efficacy

must be examined (Tomlinson, 1999). Educational researchers must also explore not only achievement data, but how and when classroom teachers choose to differentiate their curriculum. If students learn best in a physically and psychologically safe environment that is engaging and challenging, do students feel that a differentiated curriculum provides that? The purpose of this study is to add to the current body of knowledge on differentiation by seeking answers to these questions in order to better meet the diverse needs of American students. By investigating differentiation, this study hopes to discover if student achievement and learning are maximized in order to ensure that American students are competitive in today's educational and world market.

Differentiated instruction also faces specific challenges in certain subjects. One example is the debate in science education between direct instruction versus an inquiry based approach. While differentiation and inquiry align with the dominant constructivist approach, what evidence is there to suggest that students learn best through these methods? Another goal of this study is to provide such evidence and explore how current research theories such as inquiry, MI, BBL, and differentiated instruction can mesh to create a successful learning environment where student learning is truly maximized in all areas not just on standardized tests (Tomlinson & McTighe, 2006; Sprenger, 2003; Wolfe, 2001). Because differentiation has a varied theoretical background, this concurrent mixed-method study will focus a theoretical lens on how MI, BBL, and other strategies are incorporated in a differentiated curriculum. Taking advantage of a high school program that has implemented differentiated instruction, the researcher explored how teachers decide when, how, and what strategies were used when planning a

differentiated curriculum. A case study method was utilized for the qualitative component. Teachers were surveyed and interviewed in an effort to gain insight strategies used to plan differentiated lessons. These decisions, choices, and methods of implementation were included in this investigation to further understand how teachers are utilizing this instructional tool. Student surveys and a focus group interview were used to investigate what type of instruction students prefer. The study used statistical analysis to determine whether there is a significant difference in the initial passing rates of standardized tests the 2 years before and the 3 years after the implementation of differentiation. Quantitative analysis will also be used to determine if there is a difference in standardized scores of the students from a school where differentiated instruction is mandated and where it is not. The independent variable was the type of instruction (mandated differentiation versus non-mandated); the dependent variable was the Georgia End-of- Course Test (EOCT) passing rates for the core subject areas of math, science, and literature. Many questions drive this study. A detailed description of the research process and surveys used will follow in chapter 3.

Research Questions and Hypotheses

1. Is there a difference between the initial passing rates on standardized tests in a suburban area high school before the use of differentiated instruction was mandated and after?

H_0 1- Null Hypothesis: There is no significant difference in the initial passing rates on the EOCT prior to the mandate of differentiation and the initial passing rates on the EOCT following the mandate of differentiation.

H_A 1- Alternative Hypothesis: There is a significant difference in the initial passing rates on the EOCT prior to the mandate of differentiation and the initial passing rates on the EOCT following the mandate of differentiation.

The variables for Hypothesis 1 in the quantitative portion of the study is the mandating of differentiation as a teaching approach (independent) and the EOCT initial passing rates (dependent). The dependent variable for Hypothesis 1 is EOCT initial passing rates prior to and after the implementation of differentiated instruction. A comparison of Initial passing rates is the mechanism used for collecting the quantitative data.

2. Is there a difference between the initial passing rates on standardized test between a school where differentiation is mandated and where it is not?

H_0 2-Null Hypothesis: There is no statistically significant difference between the initial passing rates among high school students on the Georgia End-of-Course Tests for students who attend a school where differentiation is mandated and those who attend a school where differentiation is not mandated.

H_A 2-Alternative Hypothesis: There is a statistically significant difference between the initial passing rates among high school students on the Georgia End-of-Course Tests for students who attend a school where differentiation is mandated and those who attend a school where differentiation is not mandated.

This investigation compares EOCT passing rates between two schools, one that mandates differentiation be used and the other does not. The independent variable for Hypothesis 2 is the instructional approach and the dependent variable is the resulting initial passing rates on the EOCT.

3. What strategies, methods, successes, and failures are educators facing when differentiating instruction?

Interviews and a survey created by the researcher was used to collect data to answer this research question.

4. What are the students' perceptions regarding differentiated instruction and how does it affect their educational process?

Interviews and a Likert-type survey created by the researcher was used to collect data to answer this question.

For question one, a two-tailed t test was performed comparing the EOCT passing rates 2 years prior to the mandate of differentiated instruction with each of the 3 years after the mandate. Data was collected from the Governor's Office of Student Achievement in order to compare the initial passing rates on the EOCT for math, science, and language arts. For Research Question 2, the same two-tailed t test was performed on initial passing rates on each of the EOCT tests between a school that mandates differentiation and another that does not. This data was used to evaluate Hypotheses 1 and 2 above. Research Questions 3 and 4 were investigated using interviews and surveys. The survey was developed by the researcher and validated by Rick Wormeli and Carol Tomlinson, leading researchers in the field of education. The researcher interviewed teachers individually to gather additional data on how teachers approach differentiation. Data to answer Question 4 was collected through a focus group interview with students and through a survey developed by the researcher that investigated students' attitudes toward differentiation. The data collected through the surveys and interviews was

compared to the statistical analysis of the test scores to see if the attitudes toward differentiation and passing rates mirror each other.

Purpose of Study

The purpose of this concurrent, mixed-method study was to address the effectiveness of mandated differentiated instruction in a suburban area high school. In an effort to move beyond traditional classroom practices educators are embracing research that suggests students have multiple modes through which they learn. Gardner's (1991) explanation of learning established a framework that educators use to provide students with different learning opportunities. Gardner's work illuminated the idea that schools are attempting to educate students in ways that are diametrically opposed to the way that they learn. To further this case Gardner (2004) described his theory of multiple intelligences which describes the multiple modes through which one can learn culminating in learning strengths for students. Along with multiple intelligences, brain-based learning addresses the physiological aspects of learning (Sprenger, 2003). However, putting all these concepts and theories into a workable product for teachers is difficult, hence, the development of differentiated instruction as an approach to teaching (Sprenger, 2003; Tomlinson, 2002; Tomlinson, 2003, Dockertman, 2002). Differentiation within the classroom learning environment is one-way that schools are attempting to address the various needs of learners to improve student learning.

The qualitative component of this study investigated why and when teachers choose to differentiate instruction and its perceived effectiveness. Both teachers' and students' opinions toward differentiation was examined through surveys and interviews.

The goal was to discover trends and characteristics that facilitate differentiation. A comparison using the pretest and posttest model was made between EOCT initial passing rates prior to the implementation of differentiation and after. The purpose of this segment of the research was to investigate significant differences based on *t-test* analysis. The EOCT initial passing rates provided concrete data that was analyzed to determine effectiveness in light of the focus and judgments associated with standardized tests made by local, state, and federal governing bodies. However, educators teach students that are complex, emotional, and different. For these reasons, a mixed-method approach was used to explore all the different dimensions of implementing a new teaching approach.

In this concurrent, mixed-method study quantitative data was collected from standardized test scores which are reported collectively as initial passing rates on the Georgia EOCT. A comparison was made between the EOCT initial passing rates of students prior to and after the mandated implementation of differentiated instruction in a suburban area high school. Survey data was collected from high school teachers in a school that has implemented differentiation. These teachers teach at a suburban area high school and are chosen because they teach at the school that is the focus of this investigation. The researcher accessed these teachers via email. Likert-type and open ended surveys were used. Another population under investigation is high school students who have participated in both traditional and differentiated instruction and have taken at least one EOCT. The researcher had access to tenth and eleventh grade students. The researcher is an active participant in the research study because she is a high school

science teacher at one of the high schools. She will also be conducting the interviews, designing, and implementing the surveys.

Theoretical Framework

Gardner (2004, 1991) is one of the most influential psychologists impacting the field of education with his MI theory. By suggesting that students have learning strengths and weaknesses, the focus of the education shifted from the process to the student. Recognizing the individuality of students created a need for teachers to examine what they do in the classroom and why they do it. Understanding that learning is a singular, personal process for the student led to a need to understand how this process works for each student. Although there are individual learning strengths and weaknesses, emotion, and physiology also play a role in learning.

The 1990s were called the decade of the brain (Sprenger, 2003). Advances in technology, cognitive science, and educational psychology resulted in a multitude of brain friendly strategies that eventually became known as BBL. Researchers, such as Sousa (2001) and Jensen (2000) suggested strategies that included the use of music, color, graphic organizers, experiential leaning activities, providing proper nutrition and hydration, and more. These strategies and methods were designed to engage students and maximize the learning process. The National Research Council's Committee on the science of learning (2000) published their own study. The goal of this study was to integrate the best of neuroscience, psychology, and sociology to get to the fundamental components of life long learning. Learning in any context is affected by brain-function, developmental readiness, and social norms (culture).

The impact for educators is how do teachers utilize all of these dimensions of learning to help students succeed and create an environment for learning. One possible approach to creating successful learning environment is differentiated instruction or differentiation. Wormeli (2006) defined differentiation as, “a collection of best practices strategically employed to maximize students’ learning at every turn” (p. 3). Tomlinson (2001), the primary pioneer of differentiation, describes a differentiated classroom as one that, “provides different avenues to acquiring content, to processing or making sense of ideas, and to developing products so that each student can learn effectively” (p. 1). Differentiation takes the best of all educational practices and incorporates them into their classroom based on the needs of the learners. Some educators / researchers such as Sprenger (2003) focus on infusing learning styles and brain-based learning to differentiate instruction. Regardless of the strategies chosen the response to students’ needs is a cornerstone of differentiation.

The school that was at the center of this investigation is part of a system that has adopted Schlecty’s (2002) WOW model which strives to provide quality, student centered lessons that engage students in the learning process. In order to implement the Schlecty standards, the administration felt that differentiation would be the best instructional approach due to its focus on standards, student centered quality lessons, and positive learning environment. A more detailed description of BBL, MI theory, and differentiation will follow in chapter 3.

Definitions

Brain-based learning, according to Bruer (1999), is an approach to learning that favors the constructivist model of education; learning that is active and engaging; learning that has meaning to students. Willis, (2007) also suggests that BBL is instructional methods targeting specific regions of the brain, which researchers can use to maximize learning because it is uses "evidence-based neuron-imaging and brain-mapping students to determine the most effective ways to teach" (p. 1).

Georgia End-of-Course Test is a standardized test given to all students in Georgia in the classes that are considered core classes making them a requirement for graduation. A greater description of this test is discussed in chapter 3.

EOCT passing rates for the purpose of this study are the passing rates for students taking the test for EOCT course. This is the data that is used to measure achievement and gains for making AYP and assessment through the annual Report Card/Score Card (Georgia Department of Education, 2008).

Learning styles refer to having learning strengths or preferences based on verbal ability, auditory ability, and kinesthetic ability (Sousa, 2001).

Traditional approach is the direct teaching approach where the teacher imparts knowledge through lecture while students act as passive receivers of knowledge (Kirschner, Sweller, & Clark, 2006).

Cognitive science "is the scientific study of the mind and brain and how they give rise to behavior" (Cram 101, 2007).

Differentiation, according to Sprenger (2003) is "offering students multiple ways of taking in and expressing information" (p. 2). Educators focus on "content, process, product, and environment" while addresses three basic tenets that students and teachers are both teachers and learners; everyone can learn, and that learning can be enjoyable (Sprenger, 2003, p.2).

Theory of Multiple Intelligence is the theory put forth by Gardner (2004) that suggests that students learn in many different ways and learn through various modes. He suggests that all learners have strengths and weaknesses. These include linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, interpersonal, intrapersonal, and naturalistic intelligences (Gardner, 2004).

Scope

The scope of this study involved high schools students and teachers in a suburban area. In the mixed-method study, quantitative data regarding achievement was collected from EOCT scores prior to and after the mandated implementation of differentiated instruction at a high school. Additional data regarding student preference for instruction was also compared. A qualitative investigation included surveys and interviews with students prior to and after differentiation to assess students' opinions about their own learning in a differentiated class.

Limitations

Limitations include using the Georgia Performance Standards (GPS) as the basis of content. Use of the GPS is mandated by the state so there was little control over what curriculum to teach, only how to teach it. Students who traditionally perform well

academically but suffer from test anxiety could slightly skew the results if test anxiety affects their individual EOCT scores. EOCT scores and passing rates from special populations, such as, students with disabilities, economically disadvantaged, and limited English proficiency are included in the passing rates and could skew the results. However, preliminary investigation showed that those populations have increased after the implementation of differentiated instruction. Another inherent concern was differentiation is an instructional method that draws from many theories including BBL and MI theory. Synthesizing the best concepts from these theories was a major task for any educator. However, there was a strong conceptual framework supporting differentiated instruction. A final limitation is the effectiveness of the teachers in the classroom regardless of the strategies employed. Therefore, a comparison of EOCT passing rates from year to year rather than teacher to teacher was made.

Delimitations

A delimitation is that the researcher offered the survey to all teachers who teach at the high schools regarding their use of differentiation and the choices that drive it. All teachers were invited to participate in the interviews. An invitation to participate in the student surveys and interviews was sent to all current tenth and eleventh grade students via e-mail and the auto-dialer, an electronic system that dials all the numbers in the schools data bank. This was utilized so that each student will have an equal opportunity to participate.

Assumptions

When differentiation was mandated there was little guidance as to the extent teachers needed to differentiate the curriculum. One assumption this study makes is that teachers have adhered to the mandate and differentiated instruction to some extent. The researcher also assumes that when asking for interview participants there was equal participation between those who prefer or think favorably toward differentiation and those who do not. Assumptions of this study include assuming that students and teachers will have a preference for instruction. Also, the researcher assumes that a preference leads to increased learning and that students learn best through their preference. The researcher also assumes that teachers are more effective teaching through their preference mode.

Significance of the Study

This study is significant to any educational practitioner and curriculum designer. The field of education is becoming more student centered while teacher accountability increases. Differentiation was portrayed in the literature as a bridge that can help link the gap between instruction and learning (Tomlinson & McTighe, 2006). Differentiation also considers current brain research and current research regarding best practices which help to educate the increasingly diverse student population. Achievement in differentiated classrooms is missing from the literature. This study provided some concrete data as to the effectiveness of differentiation. Since students' needs are the focus of differentiated instruction, it is important to know how the students feel DI affects their learning as well. Interviewing and surveying teachers provided data on how, when, and why novice,

beginner, and expert teachers choose to differentiate. A general survey regarding differentiation was sent to approximately 120 high school teachers of various subjects. This survey and data was used to acquire data that can be extrapolated to all teachers. By investigating the mandate of differentiation versus the voluntary implementation the researcher hoped to provide information that can help teachers and their leaders better implement any new program.

Implications for Social Change

Effective teachers adjust their technique and strategies to meet the needs of students so this research confirmed what good teachers know. Because the tradition in the United States is a commitment to excellence, demanding anything less from students would cause an identity crisis. However, a balance between equity and excellence must be delicately maintained in our classrooms. This must be a guiding principal for social change to occur in the way teachers view all students regardless of labels students may bear. Decisions, policies and procedures must be made or developed with respect for all learners (Tomlinson, 2003 p. 3).

"Differentiation can reinforce status or differentiation can liberate students from stereotypical expressions" (Tomlinson, 2001, p. 4). Equity and excellence in a teacher's classroom can free up students to do their best when they are presented with a curriculum that is challenging, engaging, and pertinent to their lives. "Equity not only grants access to but also supports success" (Tomlinson, 2001, p. 3). A differentiated curriculum provides a learning environment that challenges students in a safe, ability appropriate, high expectation classroom.

To summarize many students lose their love of learning and inquisitiveness before they enter high school. Many students face high school with anxiety and futility. For schools in the United States to remain competitive in the world market this futile outlook must change. Differentiation offers choice while engaging students, thus teaching them in their cognitive comfort zone. Differentiation can be an avenue for remediation, on-level, and above level work. Differentiation truly promotes learning for and by all. If Americans are going to provide an equitable education for all, educators, parents, and student must embrace the learning opportunities a differentiated curriculum provides. A detailed look at the literature review that follows synthesizes how following a content rich set of standards can maximize learning if integrated with learning strengths and cognitive science breakthroughs. Based on this research this study was designed to investigate both the quantitative benefits of using differentiated instruction and qualitative data on how and when to differentiate. Following the discussion of the research design is the analysis of those findings suggestions for further investigations, and practical applications. Finally, a discussion of how this research could lead to social change in our educational system concludes this study. The following chapter highlights the research that provided a theoretical foundation for differentiating instruction. By examining test sores, surveying and interviewing teachers and students this study hopes to elaborate on the phenomenon of differentiation. The methodology will be presented in chapter 3, a description of the research and data in chapter 4, and a discussion of data in chapter 5.

CHAPTER 2: LITERATURE REVIEW

Introduction

The following is a review of the literature used as the foundation for this doctoral study. This research study viewed differentiated instruction as more than just a teaching strategy. Differentiation or differentiated instruction is an instructional philosophy for teaching a diverse group of students. From that point of view the literature review addressed what differentiation is and is not based on experts in the field of education. Secondly, the literature addressed the MI theory and BBL and how they provided a theoretical framework for differentiating instruction. Criticisms of differentiation were addressed, as well as, strategies for differentiating in a science classroom. Finally, the review concludes with a discussion of how these strategies are used to design a learning environment that allows all students to succeed despite differences in interests, abilities, and ethnicity. This research provided the basis for designing a survey instrument that addresses how, when, and why teachers choose to differentiated their curriculum. The literature was collected from online data bases, peer reviewed journals, websites, and current books relating to the research topics. The focus of gathering information was based on the following questions:

1. Is there a statistically significant difference in test scores among students in physical science classes with differentiated and non-differentiated curriculum?
2. How can the MI theory and scientific inquiry be used effectively differentiate instruction?
3. Is a differentiated, inquiry-based science curriculum compatible with current

brain research (Brain-Based Learning Theory and Multiple Intelligence Theory)?

4. How do teachers develop a differentiated curriculum? What challenges, strategies, methods, choices, and basis do teachers use when planning differentiated instruction? What cues do students send that inform the teacher that differentiation is preferred or necessary?

5. How do students feel a differentiated curriculum affects their learning?

Differentiation (Differentiated Instruction)

Heacox (2002) stated that, "differentiating instruction means changing the pace, level, or kind of instruction you provide in response to individual learners' needs, styles, or interests" (p. 5). The changes enhance the learning experiences for the student. According to Heacox (2002) "the goals for differentiated instruction are":

> To develop challenging and engaging tasks for each learner.
> To develop instructional activities based on essential topics and concepts, significant processes and skills, and multiple ways to display learning.
> To provide flexible approaches to content, instruction, and products.
> To respond to students' readiness, instructional needs, interests and learning preferences.
> To provide opportunities for students to work in varied instructional formats.
> To meet curriculum standards and requirements for each learner.
> To establish learner-responsive, teacher-facilitated classrooms. (p. 1)

Tomlinson (2000) described differentiation as a philosophy rather than a strategy. Differentiation was based on the belief that students at the same grade and age are not at the same academic level, nor do students learn at the same rate in the same way. This had an impact on the curriculum which best served students if it aligns with their interests in a safe, comfortable learning environment. The central idea behind differentiated instruction was to maximize each student's potential and learning (Tomlinson, 2000, pp. 6-7).

Tomlinson and Dockertman (2002) described a differentiated classroom as a map where each student's journey is different but the destination is the same. A differentiated classroom was also flexible and students were not forced into one mold. Students had a clear sense of the standards and expectations, and teachers embraced the differences in their students (Tomlinson & Dockertman, 2002, p. 22). These components of differentiated instruction led to what Tomlinson and McTighe (2006) called "responsive or differentiated teaching" which meant that a "teacher is as attuned to students' varied learning needs as to the requirements of a thoughtful and well-articulated curriculum" (p. 18). A responsive teacher attended to the relationships with students, built an appropriate learning environment, familiarized himself with the background and needs of the students, allowed for academic growth, utilized the interest of students to improve motivation and used learning profiles to keep learning efficient (Tomlinson and McTighe, 2006, pp. 18-19). Tomlinson & McTighe (2006) suggested 10 patterns that responsive teachers practice:

1. Finds ways to get to know students more intentionally and regularly.
2. Incorporate small-group teaching into daily or weekly teaching routines.
3. Learn to teach to the high end.
4. Offer more ways to explore and express learning.
5. Regularly use informal assessments to monitor student understanding.
6. Teach in multiple ways.
7. Use basic reading strategies throughout the curriculum.
8. Allow working alone or with peers.
9. Use clear rubrics that coach for quality.
10. Cultivate a taste for diversity. (pp. 20-22)

Allowing for flexibility in working with peers or alone, clearly establishing criteria, standards and behavioral expectations, offering various learning opportunities, and developing personal relationships with students established an optimal learning

environment where students were free to meet standards through various pathways. Each student did not receive an individualized lesson plan. Differentiation meant that the learning environment was designed to allow each student to attain optimal learning and meet relegated standards. Differentiated instruction was not a way out for students who do not want to do the work. Differentiated instruction was rigorous, relevant, flexible, varied, and complex. It was an approach that teachers used to remediate, provide engaging on-level learning opportunities, as well as, enrich learning experiences for students who were ready to move beyond simply meeting the standard (Heacox, 2002; Tomlinson & McTighe, 2006). Differentiating meant that an educator understands that one type of instruction was not suitable to all students. It provided an opportunity for student strengths to emerge while providing rigorous curriculum. Differentiation was product focused. Authentic learning experiences were embedded in curriculum and assessment (Heacox, 2002; Tomlinson & McTighe, 2006).

However, well-designed, standards-focus curriculum was paramount in differentiated classrooms. Understanding by design (UbD), backward design, and beginning with the end in mind are all phrases for the curriculum design model that encouraged goal setting and reflection on the part of the teacher. It was a curriculum design model that helped educators design curriculum, lessons, and units that allowed for differentiation and for creating a standards-based classroom. This model stressed end results, evidence of learning, and learning experiences for students. When planning curriculum, educators first identified what they wantd student to know, understand, and accomplish. Content that did not promote a deeper understanding of the big ideas was

culled. The results were guided by essential questions, real world applicable questions that guide overall themes of the unit or lesson (Tomlinson & McTighe, 2006, p. 27). Secondly, when developing quality curriculum educators decided on how to evaluate learning thus ensuring that there was evidence of learning and understanding. Educators also distinguished between mastery and proficiency of standards. This stage of development is where teachers were assessors, and focused on actual evidence of learning (Tomlinson & McTighe, 2006, p. 28). Many different forms of assessments were used within a single lesson or unit. There was a variety of evidence for learning. Educators differentiated assessments, as well as, curriculum. Finally curriculum developers determined what experiences guided students in learning and developing the skills necessary for meeting or exceeding content standards. The instructional activities were of high quality. Each lesson or component guided students toward the desired goal of learning. Comprehensive understanding and critical thinking skills were not sacrificed in order to cover the vast amount of fact-oriented content. If students simply memorize facts and cannot use and apply the information, learning has not occurred (Tomlinson & McTighe, 2006, p. 28).

Some key component in using UbD and differentiation were knowing what understanding truly means, remembering the importance of all aspects of diversity in a classroom, and using reflection and metacognition as part of the curriculum. Tomlinson and McTighe (2006) described true understanding

> we can explain via generalizations…can interpret: tell meaningful stories…can apply: effectively use and adapt what we know in diverse and real contexts… have perspective: see and hear points of view through critical eyes and ears…display empathy: find value in what others might

> find odd…have self-knowledge: show meta-cognitive awareness; perceive the personal style, prejudices, projections, and habits of mind that both shape and impede our own understanding. (p. 67)

Using authentic activities led to greater understanding. Some authentic work included research, debates, scientific investigations, problem-based learning, critical analysis of literature, and writing for specific audiences (Tomlinson & McTighe, 2006, p. 68). When students saw purpose in what teachers ask them to do they were more motivated. Positive feedback was important in any classroom, but, it was especially important in classrooms where teachers were asking students to extend themselves intellectually and emotionally. This was especially true in diverse classrooms.

Diversity in a class room has several meanings. Educational classrooms are academically diverse with the inclusion, also known as the co-teaching model. Classrooms are becoming more culturally diverse as more immigrants flee to the United States for various reasons. A responsive teacher in a differentiated classroom focused on four beliefs. First, all students experienced well-designed, meaningful curriculum that encouraged critical thinking skills. This was not reserved for the higher level students, nor, did teachers assume higher level students already had these skills (Tomlinson & McTighe, 2006, p. 84). Student learned basic skills and information in order to apply that knowledge. As emerging curriculum designers, educators, sometimes move too fast and create elaborate lessons and assessments only to be disappointed with the results. But, students must have baseline information in any subject from which the teacher can scaffold (Tomlinson & McTighe, 2006, p. 85). Offering different methods and pathways to meet given standards and develop new skills and knowledge is the crux of

differentiated instruction. Offering opportunities that allowed for lower level or language deficient students to remediate was an important feature that these models allowed for that other instructional models did not. Teacher guidance was balanced with student opportunities for construction of meaning. In the spirit of constructivism differentiation allowed for students to construct meaning in different ways at different rates. Although differentiation obviously supports the constructivist theory in education there is a misconception that teachers should never tell students anything. This is not the case. Teachers attended to student knowledge and beliefs. There were situations that required direct instruction (Tomlinson & McTighe, 2006, pp. 85-86; National Research Council, 2006, p. 11). Students knew the goals, standards, and requirements within each lesson and unit (Tomlinson & McTighe, 2006, p. 86). Rubrics, modeling, and posting standards, all help students stay focused on the goals (Tomlinson & McTighe, 2006, pp. 87-88). Having students reflect on their learning in response to standards was important because it gave students an opportunity to think about success or failure. Reflection helped students know themselves better. Eventually, learned how they learn best. Self-assessment also gave students an opportunity to compare their learning to the academic standard without the pressure of peer comparison or fear of disappointing the teacher (Tomlinson & McTighe, 2006, p. 80).

When implementing differentiated instruction into classroom curriculum, key elements were important to consider. First implementing something new can be difficult and be met with resistance on many levels. Modifying content, developing meaningful lesson, and acquiring evidence of learning were the cornerstones of implementing

differentiated instruction and UbD. Based on experience, Pettig (2000) suggested when implementing differentiation into classroom practice collaborate with peers, align the learning experiences with content standards, pre-assess, as well as, post-assess students, use a learning modality inventory to design the learning experiences, be flexible in all ways, and encourage responsibility while providing choices for students (pp. 14-17). Helping students learn and succeed is an educator's primary job. Pettig (2000) accomplished this job by setting high standards while offering students a choice in pathways.

Vaughn (2005), a math teacher, differentiated instruction to overcome the students' defeatist attitudes toward math. Characteristic of the adolescent brain, Vaughn (2005) noticed that, "They rarely made the connection between completing homework, practicing skills, and doing assignments" (p. 70). With the overarching goals of understanding algebra and creating autonomous learners in mind, Vaughn created an atmosphere where each student took responsibility for learning the material, choosing their own assignments, and choosing their test date. Vaughn assisted the students by teaching them how to use the resources provided. Vaughn designed lessons where notes were presented directly and then let students chose how to exhibit mastery of the standards. The students had to master one standard before moving to another. Vaughn was able to devote more individual time to each student and re-teach when necessary (Vaughn, 2005, p. 71). Offering multiple opportunities to demonstrate mastery reduced test anxiety. In the end Vaughn's students had a passing rate of 73%, and on average the

students out performed her colleagues on the standardized end-of-course test (Vaughn, 2005, p. 73).

In order to provide a differentiated and engaging curriculum, Forsyth County Schools have focused on Schlechty's (2003) WOW protocol, where teachers focused on designing quality lessons that are diverse and standards-based. The ten standards incorporated into lesson plans from Schlechty's (2003) work are:

Standard 1: Patterns of Engagement
Standard 2: Student Achievement
Standard 3: Content and Substance
Standard 4: Organization of Knowledge
Standard 5: Product Focus
Standard 6: Clear and Compelling Product
Standard 7: A Safe Environment
Standard 8: Affirmation of Performances
Standard 9: Affiliation
Standard 10: Novelty and Variety (p. 18-19)

Teachers used these design qualities to create lessons that promote learning, and these standards are an integral part of the professional learning that takes place within the system.

Standards describe the knowledge and skills that student must obtain. Within today's academically and culturally diverse classrooms, some students may need lots of help and practice in meeting the standards while other students may meet and even exceed the standard in half the normal time. Differentiation allows for students to achieve their best. A classroom curriculum that is based on standards (SBC) shares many concepts in common with a classroom curriculum that is differentiated. A comfortable, safe (emotionally and physically) learning environment was paramount to both SBC and differentiation. In both instances,

the curriculum was high quality and based on real-life, authentic scenarios. Both SBC and differentiation was student centered. These paradigms required educators to think beyond class as usual. Pre and post assessments were necessary to gauge student knowledge. Assessing learning modalities and styles was important prior to designing the learning experiences for the students. Reflection and metacognition were an integral part of daily lessons, units, and overall curriculum. Students werer not just encouraged to think critically, they were expected to think critically about the content they were leaning and the strategies they were using to learn. Flexibility was also important in SBC and differentiated classrooms.

Standardized testing and federal mandates require that students learn content and process skills. Standards clarify the content and skills that students must learn. However, because students learn differently and at different rates strategies must be implemented to help all students learn and succeed. If not, schools are at risk for loss of funding and other necessities. Differentiated instruction provided a means for designing curriculum so that students had multiple and diverse opportunities for learning and meeting standards. Using the curriculum design model, UbD, helped educators design classroom lessons that were meaningful, authentic, and focused on content standards. Reflection was a key component in achieving standards, planning differentiated lessons, and implementing UbD. Students benefited from understanding their learning strengths and weaknesses. In essence, differentiated instruction was a curricular cornerstone for achieving designated standards and improving student learning.

Educators often view the designated standards as a median, where ideally, all students meet the standard. Instruction is the road map that students take to meet the standard. Since no two students are the same, differentiated instruction allowed for students to have multiple pathways to learning based on need, choice, and interest. This proved to be more motivating to students, as well as, more encouraging to students who do not fit the mold of traditional school.

Multiple Intelligence Theory

Searching for the root of intelligence has historically proven quite difficult. There were different viewpoints. These viewpoints led to different types of measurement and identification tools. For years educators identified “gifted” or more intelligent students based on an intelligence quotient test that used a number to identify intelligence for that person. Educational decisions were based on this measurement. Then in 1983, Gardner (1991), introduced the idea that all people have learning strengths and weaknesses. His work suggested that all people have intelligence and that this intelligence is multi-dimensional. No two people were the same, not even identical twins (Gardner, 2004). These intelligences included linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, personal, and naturalistic. Since this was not a study of MI theory an in-depth analysis will not be discussed. Gardner (2004) suggested that MI is not an educational goal but a useful tool in helping educators to reach learning goals. For this reason MI was an extremely useful and necessary tool when planning differentiated instruction. When studying learning, Gardner described three types. The first was the intuitive learner or natural learner, who learned languages and symbols because, it is

necessary for survival. This learner constructedlearning from experiences. The second type of learner was described as the traditional student who attempted to master literacy, processes, and procedures associated with traditional education. The third type of learner, was the disciplinary expert or skilled person "who has mastered the concepts and skills of a discipline or domain" (Gardner, 1991, p. 7). However, transition from one type of learner to the other was often difficult and disjointed in schools. According to Gardner (1991), gaps existed between the intuitive learner and the traditional student, between the traditional student and the disciplinary expert, and between the intuitive learner and the disciplinary expert. Using MI strategies helped students transition from one type of learner to another and master the necessary skills to make the transition (Gardner, 1991). Blending MI strategies into a differentiated curriculum helped move to disciplinary expert status. However, the biological basis of learning cannot be overlooked.

Brain-Based Learning

B.F. Skinner (1954) once stated,

> Even our best schools are under criticism for their inefficiency in the teaching… The condition in the average school is a matter of widespread national concern...The very subjects in which modern techniques are weakest are those in which failure is most conspicuous, and in the wake of an ever growing incompetence come the anxieties, uncertainties, and aggressions which in their turn present other problems to the school. (p. 54)

Currently educators and schools are still criticized for the same inefficiency, technique, and incompetence as their predecessors. This unhappiness regarding the U.S. educational system resulted in many educational reform movements. Some reforms were funded

mandates and initiatives; some were not. Legislators and multi-millionaires, like Bill Gates and Oprah Winfrey, were all sharing opinions on the state of affairs in today's educational system (as seen on April 12, 2006 airing of *Oprah*). Yet the fundamental issue why are educators still facing the same issues that researchers faced over 50 years ago remains. Poor teacher preparation was blamed. Poverty, immigration, and funding were blamed at one time or another. However, the answer may literally lie within the students themselves. Brain physiology and maturation, some researchers believed, provided some possible answers.

Skinner and other early researchers of learning, focused on reinforcement as the tool that facilitated learning. Skinner (1954) states, "the dynamics of the control exercised by reinforcement remain essentially unchanged (Wilson, et al., 1954, p. 42). The brain and mind was viewed as a "black box", where information entered and a behavior resulted. There was no knowledge of the events at the cellular level. Information regarding brain physiology was still in its infancy. However, as technology improved, researchers were able to see more that just behaviors generated by the brain. Although, the nineties were coined the decade of the brain, 2004 was a technological milestone for the brain and the technology used to study it. Researchers at the National Institute of Health performed a longitudinal study on 13 healthy subjects, where they mapped the brain using high frequency magnetic resonance imagining (MRI) (Gogtay, et al., 2004, p. 8174). This study was significant to the field of neuroscience because it was performed on healthy human subjects, as opposed to animal subjects or those with a brain injury or illness. The technology used, ensured a greater accuracy by matching brain features on

the subjects. This study found that fundamental survival process, such as sensorimotor, matured first and the portion of the brain that is responsible for higher order thinking skills developed much later (Gogtay, et. al., 2004, p. 8174-8175). Piaget's first stage of development is sensorimotor, as well, suggesting that this process lays the foundations of future intellect (Phillips, 1969, p. 13). While this discovery was not new to educators, it does suggest the importance of art, music, and physical education classes during the early school years. Unfortunately, these classes were the first to be removed from the curriculum when funding is scarce. Sousa (2001) explained, "Today's students are acclimated to multi-sensory environment. They are more likely to give attention if there are interesting, colorful visuals and if they can walk around and talk about their learning (p. 32). The nearest electronics stores demonstrate a human's inclination toward sensorimotor functioning. Another discovery pertinent to education was the fact that "the dorsal lateral prefrontal cortex, important for controlling impulses, is among the latest brain regions to mature" (Giedd, 2004, p. 77). This region of the brain does not mature until the early twenties. A future investigation includes studying a relationship between the morphological and behavior changes in order to see if there is a correlation (Giedd, 2004, p. 77). Another significant structure in the brain that was active during adolescence is the hippocampus. This area was significant is memory and decision making (Giedd, 2004, p. 81). This information gave credence to the emotional connection to learning that educators use on a daily basis.

There are several commonalities kept repeatedly appearing while investigating differentiation, learning styles, and BBL. Scaffolding was a brain-based strategy that

helps students connect to prior knowledge to facilitate learning. It was also a foundational component of differentiation, as well as, important to teaching to specific learning styles. Emotion was a critical component of learning and also found in these three approaches. Chunking material into small manageable pieces was another commonality (Marzano, 2003; Willis, 2006).

Brain-based learning has many critics who say that brain function does not explain learning. Davis (2004) suggested that cellular function actually does very little to explain how one learns. Davis stated that, "Learning involves knowledge, memory, understanding, belief, motivation, and attitude" (p. 24). Since these processes all originate in the brain, brain-friendly strategies helped students recall, memory, analytical thinking, and learning (Sousa, 2001). Yet, educators often faced reform movements that target large masses rather than using these strategies in classroom practice.

Constructivism, a foundational pedagogy for educators mentioned earlier suggested that students learned when they constructed their own learning from within (Chrenka, 2001). In light of the recent research on brain maturation the very neuronal action required for higher-order thinking skills is not fully developed so expecting students to be automatically invested in their education is a lofty goal. From this perspective BBL strategies and constructivism appeared almost diametrically opposed. However, as educators studied the heart of constructivism they found that it was an active process that relied on the expertise of the teacher to provide the appropriate scaffolding for students to construct learning and meaning (Chrenka, 2001). Scaffolding which is the strategy of connecting current knowledge to prior learning was a common theme that

appeared in the theories and strategies that provided a foundation for differentiation. BBL strategies aided teachers in facilitating learning in a constructivist classroom. The popular trend toward SBC, differentiation, and UbD also benefited from BBL strategies. When using these strategies even when teaching predetermine standards learning was active. The standards were shared with the students and the assessments were product focused. Lessons and activities were geared toward the students' appropriate learning styles. Students were often given choices through differentiated instruction (O'Shea, 2005, p. 2-7). In order to be successful educators designed lessons that not only meet the criteria above were also developmentally appropriate both cognitively and behaviorally. Knowledge of the physiological process of the brain and how it works helped educators meet this goal and have successful lessons. While there was numerous information describing different uses of these strategies, there was little research on achievement. It was important for educators to remember that effective teaching used a multitude of strategies, approaches, and skills. The essence of differentiation regardless of the foundation was to make learning meaningful to the individual student. Using differentiated instruction was a common tool in this curriculum, but the data for achievement was virtually absent. However, with the number of state mandated standardized tests increasing, data on achievement is slowly becoming available. This study used data from the state mandated EOCT tests to compare achievement scores of students participating in a differentiated curriculum versus a non-differentiated curriculum.

Goodnough (2005), a preservice science methods professor, implemented problem based learning into her course to help her students face the real-world of teaching prior to their first job. Problem based learning is a brain-friendly strategy that promotes critical thinking while connecting to real life experiences. They were given real problems to solve that involved everything from gender issues to curriculum design (Goodnough, 2005, 290). By implementing action research she was able to adapt to the needs of her students and prepare them to be better teachers.

Skinner (1954) said that

> Education is perhaps the most important branch of scientific technology. It deeply affects the lives of all of us. We can no longer allow the exigencies of a practical situation to suppress the tremendous improvements which are within reach. The practical situation must be changed. (Wilson, et al., 1954, p. 50)

Goodnough (2005) recognized that preparing teachers to face the realities of teaching was one of the most important aspects of an education professor. By creating practical, real life situations for her students she was helping to improve education in general. Not only was she preparing her students for the challenges they will face, she was modeling effective teaching by making learning pertinent, emotional, and challenging. These were all strategies that brain-based learning theorist promote.

BBL is important to education because students spend a vast amount of time in the classroom during critical neurological development (Rushton & Larkin, 2001, p. 25). According to Eric Jensen (2000), brain research “does not prove anything about educational practice. It may however suggest a particular pathway” (p. 76). Schools obviously have several considerations, such as, personnel, budgets, culture and standards.

However, using brain research led to a more productive use of time (Jensen, 2000, p.76). Researchers suggested that it is the educator's job to take the neuroscience from researchers and apply that knowledge to current educational best practices (Rushton & Larkin, 2001, p. 25). BBL strategies transcend learning styles and take learning to a higher level. Jensen (2000) briefly described 16 different types of learning brains (p. 76). Jensen also dispels the myth that, "learning styles and multiple intelligences are brain-based theories" (p.78). Jensen (2000) contended that, "These theories make good sense on the basis of what we know about the brain. Both address the uniqueness of the brain. However, they were developed before recent discoveries in neurology and have stronger roots in psychology and social science" (p.78). For students to learn, they must practice retrieval, acquisition and referral of knowledge. This research displayed a need for strategies such as repetition and connecting to prior knowledge. It stressed the importance of problem solving and inquiry. Student reflection was also an important key in the learning process (Hardiman, 2001, p. 55). Proponents suggested allowing students to demonstrate learning through multiple modes, such as, experiments, visual displays and group projects (Hardiman, 2001, p.52). Other results of brain research affected education as well. Much of the research focused on stress levels and an emotionally safe learning environment. Some learning situations, like memorization, functioned under high stress, while others, like reflection and analytical thinking, functioned best at low stress levels. Regardless, a comfortable classroom atmosphere appeared to be optimal for learning to take place. Patterns and emotions also played a vital role in strategies (Weiss, 2000, p. 22). Motivation was also addressed through brain research. There were still many

misconceptions regarding learning and the brain."The brain makes a connection and generalizes even though the generalization might be wrong" (Weiss, 2000, p. 22). The brain struggled for closure even if closure led to erroneous learning. This was potentially source for many of the misconceptions that students had, especially in science.

Integrating brain-based learning strategies into the curriculum improvee student performance. Research revealed that the brain does not reach maturity until the early twenties in most people. The ability to make rational decisions and control impulses was the last ability to mature (Price, 2005, pp. 24-25). A teen's ability to distinguish between risky and safe behavior was also affected by the presence of peers (Price, 2005, p. 24). In other words their executive function is diminished. Price (2005) stated,

> Executive function is the ability to interact in a self-directed, appropriate, organized, and purposeful manner. The prefrontal cortex plays a vital role in guiding executive function, which is also influenced by such areas of the brain as the hippocampus (which coordinates memory), the amygdale (which coordinates emotional processing), and the ventral striatum (which coordinates reward-processing). The prefrontal cortex is less mature, however, in young adolescents than in adults. (p.24)

To facilitate learning, responsibility and the development of critical thinking skills teacher leaders provided, "adolescents with sufficient scaffolding, or a good balance of support and autonomy" (Price, 2005, p. 25). Price (2005) suggested that, in order to help students succeed, educators should "ensure that schools provide adolescents with vital support" and teachers should "take advantage of adolescent passion" (p.25). The emotional connection to learning was a theme that is constant in the research on BBL, differentiation, and standards-based curriculum (Sprenger, 2005, p. 32).

Sprenger's (2005) research contrasted the drill and practice method with the newer constructivist approach to education. This scenario was an example how the teenage brain affects learning. Amy, who represents teenagers, was a typical freshman who did not receive the proper nutrition or enough sleep. She as a slave to social pressures and her maturing body. Amy often slept in classes that did not engage students. Some teachers integrated activities, role-playing, or pair-share strategies to get unengaged students moving in order to stimulate the brain. Movement actually helped memory because new research suggests that the cerebellum which coordinates gross movement also "coordinates cognitive thought processes and that the more physical exercise adolescents get, the better their brains will process information" (Sprenger, 2005, p. 30). Therefore, "academic classrooms should also include movement to activate and strengthen this important brain structure" (Sprenger, 2005, p. 30). Classes that appealled to emotion also appealled to teens. For example, Amy enjoys reading *Romeo and Juliet* in English class (Sprenger, 2005, p. 30). During the teen years memory and communication skills improved (Sprenger, 2005, p. 31). Sprenger (2005) stated that, "This is an excellent time in a student's development for teachers to encourage communication activities, such as debates, reader's theater, and oral presentations" (p. 31). Those activities were not only activities that improve brain development but, they were also excellent performance assessments for a standards based curriculum. Problem based learning activities connected students with real world issues and made learning pertinent and meaningful (Sprenger, 2005, p.32). This activity was another strategy, supported by BBL, which is

used in a SBC, promotes critical thinking skills, and emotionally connects the students to learning.

Science Specific: Direct Instruction Versus Inquiry

Within the realm of science education there is a long standing debate about which instructional strategies are more effective, those of direct instruction or those of inquiry. The term inquiry has many definitions. Dantonio (2001) explained that professional inquiry [in teaching] is, "studying the attributes of effective instruction, as well as making judgments about the effects of various learning techniques on their students" (p. 7). Ultimately this encouraged teachers to grow and be dynamic as opposed to becoming stagnant. As a consequence students grow and learn (Dantonio, 2001, p.7). The National Research Council (2001) defined scientific inquiry in this way:

> Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world. (p. 23)

Whether inquiry was viewed as a professional practice or a learning strategy, it was a process that encourages observing, hypothesizing, analyzing, and reflecting (National Research Council, 2001; Llewellyn, 2002). These were strategies promoted by differentiation, BBL, MI theory, and scientific inquiry.

According to the Bell, Smentana, and Binns (2005) and the Washington Virtual Classroom (2005) there were three types of inquiry strategies that a teacher, especially a science teacher can use in the classroom. First type was structured inquiry which allows students to investigate through experiential investigations that require problem-solving

skills. Structured inquiry provided the most guidance, as its name suggests. Often students were given a procedure to follow but the outcome is experienced rather than foreshadowed by something in the investigation. One example was a chemical reactions lab in physical science or chemistry. A traditional cookbook lab gave the purpose of the lab to be to observe the different types of chemical reactions and list the pieces of evidence for chemical reactions observed. In a structured inquiry lab, the procedure was given but the students formed their own hypotheses about what they expect to happen. Then as a conclusion the students had to create a list of signs of chemical reactions before being told what the signs of chemical reactions were. It was the difference in experiencing the lab as an investigator instead of as an observer. The second type of inquiry according to Washington Virtual Classroom (2005) was guided inquiry. Students were provided with a problem, but they devised the strategy to solve this problem. They received guidance from the instructor (Bell, Smentana, & Binns, 2005). The instructor worked with each group to provide scaffolding and clues to help students succeed. Open inquiry, the third type, was much like guided inquiry except that students created a problem to study that is of interest to them. The open inquiry approach allowed students to take ownership and responsibility for the lab. Thus, the students were more motivated (Bell, Smentana, & Binns, 2005; Washington Virtual Classroom, 2005). Using these strategies judiciously in science classes helped students move from concrete to abstract thinkers. This inquiry approach improved analytical skills and promoted collaboration within a science class.

Inquiry also provided an opportunity for students to practice authentic assessment and act like scientists. Wolfe (2001) states that, “Although an understanding of scientific concepts is critical, the larger goal of science instruction is to help students learn to think and act like a scientist” (p. 174). Because scientists described experiments and explained hypotheses it is important that students practiced and used these skills. Part of the inquiry process was analyzing results and collaborating and sharing the results of the investigation (Llewellyn, 2002). “Inquiry-based laboratory experiments appear to motivate students to work with more care and better precision in the laboratory and ask more creative questions” (Bernstein, 2003, p. 62). In Bernstein’s (2003) chemistry lab students verified a calculation taught through direct instruction. Berstein reported that the cookbook type lab was basically incidental and a verification of what had already been taught. By allowing students to form hypotheses, make predictions, and formulate conclusions Berstein converted a cookbook lab into an inquiry-based lab. Colleagues shared with Berstein that student involvement was increased, and they became active learners in the process. The students were more responsible for learning (Bernstein, 2003, p. 63).

Some teachers were reluctant to use inquiry in their science class. One survey by reportd that only 55% percent of the science department used an inquiry based strategy at least once a week (Graham, 2007). Time constraints or ineptitude prevented the use of inquiry in a science class. However, traditional labs can be converted to inquiry-based labs rather quickly. Volkmann and Abell (2003) converted their laboratory investigation to an inquiry based lab by following these steps. First they changed the purpose of the lab

to a question that would encourage the students to hypothesize about the outcome. The students had to make nails rust. As a class they set up variables and focused on evidence. The students provided evidence of rusting, then analyzed how and why it rusted based on their observations. Students were encouraged to work cooperatively in groups, and they presented their data (Volkmann & Abell, 2003). Volkmann and Abell (2003) reportd that challenging students to look at an everyday process in a new light encouraged thinking and a "deepened understanding" (p. 41). Mao and Chang (1998), two Earth science teachers, did a comparison study between classes that were taught using inquiry and those taught through a more traditional approach (p. 93). They also surveyed students in these two situations regarding their feeling toward science. Mao and Chang (1998) found that,

> a) The inquiry-oriented instructional method produced significantly greater achievement among ninth grade Earth science students than the conventional teaching approach on both astronomy content ($F=9.45$, $p<0.01$) and meteorology content ($F=8.41$, $p<0.01$), and that (b) students in the experimental [inquiry taught] group developed significantly more positive attitudes toward Earth science than did those in the control group [traditionally taught] (p. 93).

These researchers demonstrated the success of using inquiry in science classrooms and suggested that its use become an integral part of a science curriculum (Mao & Chang, 1998, p. 99).

However, some researchers felt that direct instruction was a better teaching strategy than inquiry. Kirschner, Sweller, and Clark (2006) purposed that direct instruction was more effective and better for students than inquiry, problem based learning, discovery methods, and other constructivist models. Kirschner, et al. (2006) suggested that inquiry assumed that students had correct and sufficient prior knowledge to complete the task at hand which was not always the case. In this situation scaffolding

was important when planning instruction. Not all students were at the same level academically. Inquiry based teaching allowed for a teacher to interact with students and personally assess knowledge while dispelling misconceptions. Stewart, finalist for Georgia Teacher of the Year, teaches ninth grade conceptual physics using an inquiry-based curriculum. According to Stewart (personal communication, March 17, 2007), "The days of teaching science from behind a desk are over. You cannot use inquiry and sit behind your desk and grade papers. But, I know my students better, and they know Physics better." Kirschner, et al (2006) suggested that the teacher was absent or ineffective during an inquiry activity which led to students drawing the wrong conclusions. However, students drew equally wrong conclusions during direct instruction. The brain will reach its own conclusion even if it is wrong. If a teacher only teachers through direct instruction he or she cannot know what conclusions the students are reaching. There must be discourse between students and teachers in a classroom. Instead of providing only facts teachers using inquiry helped the students to hypothesize, question, seek answers, experiment, and form conclusions (Llewellyn, 2002).

Inquiry also allowed for differentiation of instruction and assessment. Inquiry, especially guided and open, allowed for students to learn science using their strengths and interests. This aligns with the current research on differentiation (Tomlinson, 2001; Sprenger, 2003). Many educators saw inquiry and differentiation as only an instructional strategy. Both differentiation and inquiry are pedagogical approaches to teaching science. Differentiation was accomplished through inquiry (Tomlinson, 2001; Graham, 2006).

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Pre-service science teachers should begin their inquiry experience with college course work that is inquiry-based in nature. In one example this provided the pre-service teacher an experiential knowledge base to create a foundation for teaching inquiry in their own classes (Miller, 2003, p. 154). Citing a study of college students taking inquiry-based geology and physical geography versus traditionally taught classes, Miller (2003) found that, “numerous educational studies have shown that learning outcomes are much greater for students who have taken an inquiry course versus a lecture type course” (p. 154). New teacher began their careers with a firm foundation in content and inquiry methods that ultimately increased confidence and effectiveness in their future classrooms. Pre-service and beginning teachers were not the only teachers who needed professional development in using inquiry strategies in science classrooms. In a survey of science teachers at a suburban high school100% of respondents said that they would participate in professional learning opportunities that promote inquiry-based strategies (Graham, 2007). Because science teachers have an analytical background data must be presented that supports their practices or professional learning opportunities.

A lesson study is a type of study group that focuses on personal practices. One lesson study team collaborated to solve research questions involving a topic. The team met periodically after observing one another in class focusing on the topic of research. As a teacher leader, mentors facilitated this process in their own departments. In science classes, mentors and teacher leaders lea lesson study teams that focused on the effectiveness of inquiry based learning (Graham, 2007; Lewis, Perry, & Hurd, 2004; Richardson, 2004; Wang-Iverson, 2002). This type of professional development was site-

based, job embedded, and research driven meeting the National Staff Development Council's (2001) criteria for effective staff development.

The National Research Council (2000) published the results of an intense research project that examined current brain research, instructional strategies, educational pedagogy, and educational psychology. The results of this study suggested that students should be taught using a variety of strategies that addressed different learning styles in a comfortable, student centered environment. Students need the opportunity to explore, question, and create (National Research Council, 2000). The different types of inquiry, as well as differentiated instruction, provided for these opportunities. Kirschner et al. (2006) suggested that the teacher was absent from the inquiry process. However, based on the experiences of other educators, the teacher was an integral part of the inquiry process. Stewart (personal communication, March 17, 2007) stated that she knows her students better on a personal and academic basis because of the interactions with students in a one-on-one or small group situation. According to Kirschner et al. (2006) constructivism, problem based learning, and inquiry ignore current brain research which was simply not true. According to Wolfe (2001), students needed experiences that encourage creative thinking, formation of new knowledge, and the pursuit of personal interest. Inquiry and differentiation provided for these opportunities. To trigger the learning process students connected new information to prior knowledge and confronted problems that led to a desire to solve the problem. There was a connection to emotion which facilitates learning and memory (Wolfe, 2001). Kirschner et al (2006) suggested that inquiry ignores the connection to prior experiences and long-term memory. They also stated that inquiry

allows too great of a cognitive load for many students. Scaffolding and curriculum design were important components in planning appropriate instruction to avoid cognitive overload. Educators designd instructional experiences that connectd to prior knowledge yet still led to new questions.

Based on a triangulated study implemented at a suburban area high school time to implement inquiry lessons was a common theme that prevented teachers from teaching science through this approach (Graham, 2007). A lesson study implemented to investigate the learning that occurs in a laboratory investigation required collaboration and time to observe other teachers classes. In a survey conducted within the science department teachers reported that time constraints affected their use of inquiry methods in class. They also reported that they were interested in staff development that prepared them to use inquiry in classes. Coincidentally, the respondents felt that inquiry could be used to differentiate the curriculum and assessment. The third component of the triangulated study was an analysis of the professional development plan. The school provided for professional learning during early release days once per month. These were half days and did not provide time for observation of other classes (Graham, 2007).

Lesson study, developed in Japan, was an excellent opportunity for teachers to collaboratively investigate issues and strategies within in their teaching environment (Lewis, Perry, & Hurd, 2004; Wang-Iverson, 2002). Because the lesson study team developed their own research questions teachers chose topics and problems that were specifically tailored to their own needs. Lesson study groups were organized in such a way that beginning, mid-career, and late-career teachers worked together. Lesson study

also used a facilitator that ensured the meeting and process flowed smoothly. Within the framework of a lesson study there were opportunities for many collegial interactions. Teachers collaborated, offered suggestions, mentored, and coached one another. Following this process helped teachers analyze the effectiveness of differentiating a science curriculum through inquiry. Danielson (1996) stated that

> what teachers should know and be able to do in the exercise of their profession. In this framework, the complex activity of teaching is divided into 22 components clustered into four domains of teaching responsibility: planning and preparation (Domain 1), classroom environment (Domain 2), instruction (Domain 3), and professional responsibilities (Domain 4). (p. 1)

Mentoring inquiry lessons assisted with the implementation of these inquiry-based lessons by science teachers and was connected to these four domains. Assisting colleagues, new and veteran, with planning inquiry based and differentiated activities that effectively meet the needs of their students, built trust and collegiality within the science department. Planning and coteaching activities helped to build the teacher's confidence. A confident teacher created a classroom environment that was student focused, standards based, and engaging to students. This type of environment provided for more learning opportunities for students because the instruction was engaging, pertinent to their lives, and academically focused. Sharing ideas, assisting in planning the curriculum and instruction with colleagues is an educator's professional responsibility. As a profession, educators are beholden to one another to be mentors and colleagues in the truest sense of the word. Collegial relationships were necessary if teacher want to improve the art and science of teaching and learning.

Research documented that many teachers leave the teaching profession within the first three years of teaching due to feelings of isolation and overwhelming amounts of work (Millinger, 2004; Boreen, et al., 2000). Mentoring and other collaborative relationships reduced these feeling and improve job satisfaction for all teachers, beginning and novice. Because the education profession is at the mercy of federal, state, and local legislators the responsibilities of teachers and schools are dynamic. Teachers must be flexible and adventuresome, willing to try new things. Collegial relationships helped with these tasks. Sharing resources and ideas with one another reduced workloads for all teachers. This was especially true for inquiry-based activities and differentiated lessons.

Inquiry and differentiated lessons take time to develop. Both were more effective because they address learning styles, interests, and the required standards. These lessons were engaging and academically appropriate for students. Inquiry and differentiation complemented one another as part of a curriculum. No teacher should only use one type of instruction. Effective teaching environments include a variety of teaching strategies to meet the diverse needs of learners in the class.

The research in this study clearly demonstrated that inquiry based activities engage students, promote higher order thinking skills, and are necessary in a science class. Inquiry was the only strategy used in a science class, but it was included on a regular basis. The different levels of inquiry can be used to differentiate instruction as well, especially with open inquiry. Students can use their strengths and creativity to solve

problems. Inquiry also encourages questioning, hypothesizing, experimenting, analyzing, concluding, and reflection.

Inquiry was a strategy that was compatible with brain-based learning strategies. For students to learn they connected new knowledge to solve an engaging problem or question. Inquiry promoted student engagement. Inquiry required students to use their prior knowledge, as well as, new knowledge to solve problems. Creativity and reflection were also important to the inquiry process. Inquiry and differentiation were used together to meet standards and create a comfortable student centered learning environment that promoted student learning.

The heart of the teaching profession is to help students succeed in the relatively short time that they pursue an education. Every teaching situation is different; every teacher is different. However, it is the responsibility of education professionals to study the research and adapt the successful practices it to their current situations. There will never be one easy solution to the problems that plague the educational system. It is a dynamic entity that changes as society changes. Educators must continue to create innovative strategies to address the needs of students. These ideals were achieved by implementing best practices from the most successful methods in education. By focusing on achievement in a differentiated curriculum versus achievement in a non-differentiated curriculum the researcher provided data on the effectiveness of differentiation. More importantly the research hoped to gain insight on how successful teachers chose when, where, and how to differentiate because there was very little data in the research on this topic. Multiple strategies and activities were available but the choices behind using those

are not explain. The study also addressed student perspectives regarding a differentiated curriculum because in the end if students are not engaged it will not be effective.

A mixed-method research protocol allowed integration of the specificity of numerical data with the dynamic human element when performing educational research. Hatch (2002) stated that a researcher who is not comfortable with qualitative research should not do it. However, when performing research in an educational setting it is impossible to account for all the variables simply with black and white numerical data. The human element cannot be removed from educational research. For this reason, a mixed-method approach provided an avenue that intersected to form a more complete picture of who, what, when, where, and why. Before making changes to conform to a trend, educators must have data to support change. Students and teachers may prefer particular methods but if they do nothing to improve student learning, then, from the viewpoint of accountability, they achieve little. According to Creswell (2003), mixed method research allows a researcher to delve deep into reasons while exploring cause and effect. Chapter 3 contains details of planning the mixed method study.

CHAPTER 3: METHODOLOGY

Introduction

Differentiation is an instructional approach that has been adopted by many teachers and many school systems. One districts mandated that differentiated instruction be utilized in classrooms as a foundation for the curriculum. While the educational literature was full of accolades for differentiated instruction, quantitative data to support this claim is rare. Also many strategies, activities, and resources on how to differentiate instruction were present in the literature. Information pertaining to how and why teachers choose which strategies to utilize when planning differentiation was also missing from the research.

Purpose of Study

The purpose of this concurrent, mixed-method study was to address the effectiveness of mandated differentiated instruction in a suburban area high school. Data collection for this study was approved on November 11, 2008. The approval number was 11-11-08-0324880. In an effort to move beyond traditional classroom practices educators were embracing research that suggests students have multiple modes through which they learn. Gardner's (1991) explanation of learning established a framework that educators used to provide students with different learning opportunities. His work illuminated the idea that schools were attempting to educate students in ways that are diametrically opposed to the way that they learn. Gardner (2004) described the MI theory which described the multiple modes through which one can learn culminating in learning strengths for students. Along with MI, BBL addressed the physiological aspects of

learning (Sprenger, 2003). However, putting these concepts and theories into a workable product for teachers was difficult, hence, the development of differentiated instruction as an approach to teaching (Sprenger, 2003; Tomlinson, 2002; Tomlinson, 2003, Dockertman, 2002). Differentiation within the classroom learning environment was one-way that schools were attempting to address the various needs of learners to improve student learning. In order to examine the effectiveness of differentiated instruction initial passing rates on standardized tests before and after the implementation of differentiation was compared. Surveys and interviews examined student and teacher attitudes toward differentiation. Both teachers and tenth and eleventh grade students were asked to participate in a survey. Teachers were asked to participate in individual interviews while students were asked to participate in a focus group interview. The researcher used triangulation between passing rates, interviews, and surveys to compare and contrast the data collected and the conclusions drawn. A concurrent, mixed-method research approach was used to answer the following research questions.

Research Questions and Hypotheses

1. Is there a difference between the initial passing rates on standardized tests in a suburban area high school before the use of differentiated instruction was mandated and after?

H_0 1- Null Hypothesis: There is no significant difference in the initial passing rates on the EOCT prior to the mandate of differentiation and the initial passing rates on the EOCT following the mandate of differentiation.

H_A 1- Alternative Hypothesis: There is a significant difference in the initial passing rates on the EOCT prior to the mandate of differentiation and the initial passing rates on the EOCT following the mandate of differentiation.

The variables for Hypothesis 1 in the quantitative portion of the study was the mandating of differentiation as a teaching approach (independent) and the EOCT initial passing rates (dependent). A comparison of passing rates is the mechanism used for collecting the quantitative data. This data is public record and part of the report card for each school as it is evaluated by the Governor's Office of Student Achievement.

2. Is there a difference between the initial passing rates on standardized test between a school where differentiation is mandated and where it is not?

H_0 2-Null Hypothesis: There is no statistically significant difference between the initial passing rates among high school students on the Georgia End-of-Course Tests for students who attend a school where differentiation is mandated and those who attend a school where differentiation is not mandated.

H_A 2-Alternative Hypothesis: There is a statistically significant difference between the initial passing rates among high school students on the Georgia End-of-Course Tests for students who attend a school where differentiation is mandated and those who attend a school where differentiation is not mandated.

This investigation compared EOCT passing rates between two schools, one that mandated that differentiation be used and the other does not. The independent variable for Hypothesis 2 is the mandated or non-mandated instructional approach. The dependent variable is the passing rates.

3. What strategies, methods, successes, and failures are educators facing when differentiating?

Data to answer this question was collected through interviews with teachers and through a survey developed by the researcher.

4. What are the students' perceptions regarding differentiated instruction and how does it affect their educational process?

Data to answer this question was collected through focus group interviews with students and through a survey. There was an initial focus group interview.

A concurrent, mixed method study was chosen in order to thoroughly investigate differentiated instruction. For a comprehensive study of the use of differentiated instruction both quantitative and qualitative research questions were asked. From a theoretical perspective mixed method research best fit the study as well. Mixed method research protocols allowed for deductive "theory testing and verification or inductive as in an emerging theory or pattern" (Creswell, 2003, p. 136). While differentiated instruction is a curricular approach and not an educational theory that researchers can test, it integrated several of the most current theories in education to include constructivism, MI theory, and BBL. While these served as a basis for differentiating the curriculum, whether or not teachers utilize these theories, was a component of this investigation. This lent itself to the possibility of emerging patterns regarding teachers' use of these theories. Mixed method research protocols were flexible enough to allow both avenues to be explored in this investigation. Mix method research also provided for

multi-dimensional questions to be answered; the what, how, and why teachers, students, and the educational community should buy into differentiated instruction.

According to Hatch (2002), educators are drawn to qualitative research because of its human element. Qualitative research provided data from students as whether or not this instructional approach was making a positive impact on their educational experience. The qualitative elements in this research project included exploring the implementation of differentiation at one high school. This study investigated how educators chose to differentiate and their reasons for choosing certain lessons to differentiate . The study also investigated what strategies or methods were use. These match Creswell's (1998) description of qualitative research (p. 17).

Education is so fluid and at the mercy of legislators and other stakeholders, thus the human side of teaching and learning simply cannot be ignored. The qualitative portion of this study investigated the reasons teachers choose to differentiate instruction and the strategies and educational research used when planning to differentiation. The research searched for patterns, commonalities, and preferences that emerged from interviews with teachers and students. Another qualitative component included investigating how students feel differentiation affected their ability to learn the standards.

The quantitative components of this investigation used statistical analysis to evaluate differences in the passing rates on the End-of-Course Test between two high schools, one where differentiation was mandated and one where it was not and between the passing rates on the EOCT before differentiation was mandated and after. Quantitative data was also collected through a survey of teachers' attitudes, choices, and

use of differentiated instruction, and a survey of students' attitudes and participation in a differentiated curriculum.

Research Design

A mixed method approach was chosen because it addressed the research problem from many different perspectives. The foundational concepts of this study included the instructional approach, student learning, and accountability based on achievement scores. The reality was that schools were judged by their standardized test scores. Since the school at the center of this research adopted the instructional approach to improve student learning and ultimately satisfy accountability measures, the researcher was utilizing mixed method approach to address the essential components of who, what, where, when, and why. The subjects in this study are current tenth and eleventh grade students, as well as, the teachers at two schools one that mandated differentiated instruction and one that did not. The teachers were chosen because they were the ones responsible for implementing differentiated instruction. The students were chosen because they participated in differentiated instruction and were the test takers. They provided qualitative data in the form of interviews and quantitative data in the form of surveys and a collective passing rate. The study used data from EOCTs over a course of five years. Data from the two schools was compared and interviews conducted on site. The schools were similar in demographics and were in the same district so they received similar professional training from the district office. The problem that research investigated was how the schools addressed individual student needs and meet the accountability measures set forth by federal, state, and local governments (Creswell, 2003; 1998).

A mixed method approach was appropriate because it addressed the need for comparison through test scores with numerical data. However, it also allowed for a voice from those teachers that are delivering differentiation and a voice from the students. A mixed method approach allowed the researcher the chance to create an entire picture of this phenomenon.

Overview of Procedure

Quantitative data collection included collecting EOCT passing rates before and after the implementation of differentiation for the high school at the center of this investigation. Quantitative data collection also included collecting EOCT passing rates for a demographically similar school within the same system and comparing those to the case study school. *Two tailed t test*s were performed. Qualitative data collection occurred through individual interviews with teachers and focus group interviews with a group of students at the case study school. Teachers and students participated in a survey that contain *likert scale* type questions, as well as, open ended questions. All data collection occurred simultaneously.

Quantitative Inquiry

This quasi experimental study used data collection that occurred concurrently. EOCT passing rates were a matter of public record as part of the report card for the schools' whose scores were being compared in this quasi experimental investigation. The researcher utilized pre treatment and post treatment protocol for collecting data from the school at the focus of this investigation, which was called the DI school. EOCT passing rates two years prior to the mandate that teachers differentiate instruction were compared

to three years following that mandate to see if there is a significant difference between the EOCT passing rates prior to the implementation of school wide differentiation with the scores post implementation of differentiation. A *two tailed t test* was performed on the data collected from the Governor's Office of Student Achievement on the Georgia Department of Education website comparing EOCT passing rates before and after the implementation (www.gadoe.gov). This data was used to evaluate Hypothesis 1.

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Data from this same site was compared between one school that mandates differentiation and another that does not. A *two-tailed t test* was performed comparing EOCT passing rates for congruent years. The same test was used to evaluate Hypothesis 2. The instructional approach (differentiation) is the independent variable and the passing rate is the dependent variable. Research questions three and four were investigated using interviews and surveys. The survey was developed by the researcher and validated by leaders in educational research, Carol Tomlinson and Rick Wormeli.

Qualitative Inquiry

The researcher interviewed teachers individually to gather additional data in how they approach differentiation addressing research question three. Data to answer question four was collected through focus group interviews with students and through a survey that contains some open ended questions developed by the researcher that investigated students' attitudes toward differentiation.

The number of students taking the EOCT in each subject area varied each year. Therefore the score used in this study is the passing rate of test takers not the average of

scores of all students taking the scores. Since differentiation was required by all teachers to some degree in the experimental school EOCT initial passing rates by subject area were chosen rather than compare teacher to teacher effectiveness with differentiation. A teacher to teacher comparison would be skewed based on the general effectiveness of the teacher. Students could have inadvertently homogeneously grouped based on class schedules that may require students to have a single specialized classes that skews their schedule.

Instrumentation and Materials

End-of-Course Tests

Statistical analysis was performed by using difference test analysis since the researcher was comparing two sets of data at a time, EOCT percent passing rates before the implementation of differentiation and EOCT percent passing rates post implementation. A level of significance of $p \leq 0.05$ was used. This level of significance was congruent with current educational research and represents the chances of a Type I error (Gravetter & Wallanau, 2005). The two schools used in this comparison were similar in demographics in regards to ethnicity and economics. The following information is found on the Georgia Department of Education (GaDOE) (2008) website. The data is from the Office of Standards, Instruction and Assessment (www.gadoe.gov). The GaDOE (2008) describes its reasons for administering the EOCT as

> The purposes of the Georgia Student Assessment Program are to measure student achievement of the state mandated curriculum, to identify students failing to achieve mastery of content, to provide teachers with diagnostic information, and to assist school systems in identifying strengths and

weaknesses in order to establish priorities in planning educational programs.

The A+ Educational Reform Act of 2000,O.C.G.A. §20-2-281, mandates that the State Board of Education adopt end-of-course assessments in grades nine through twelve for core subjects to be determined by the State Board of Education. With educator input, and State Board approval, the End-of-Course Assessment program is therefore comprised of the following eight content area assessments:

- Mathematics
  - Algebra I
  - Geometry
- Social Studies
  - United States History
  - Economics/Business/Free Enterprise
- Science
  - Biology
  - Physical Science
- English Language Arts
  - Ninth Grade Literature and Composition
  - American Literature and Composition

What is the purpose of the EOCT?

Improved teaching and learning are the main focus of Georgia's education system. The EOCT align with the Georgia curriculum standards and include assessment of specific content knowledge and skills. The assessments provide diagnostic information to help students identify strengths and areas of need in learning, therefore improving performance in all high school courses and on other assessments, such as the GHSGT. The EOCT also provide data to evaluate the effectiveness of classroom instruction at the school and system levels.

Who is required to take the EOCT?

Any student enrolled in and/or receiving credit for an EOCT course, regardless of grade level, was required to take the EOCT upon completion of that course. Middle school students completing an EOCT course must take the EOCT regardless of whether they are receiving high school

credit. Students enrolling from non-accredited programs are required to take and pass the EOCT prior to receiving credit for the course.

How does the EOCT affect the student's grade?

The EOCT is administered upon completion of one of the above courses. Beginning with the 2004-2005 school year, a student's EOCT score is averaged in as 15% of the final course grade. The student must have a final course grade of 70 or above to pass the course and earn credit toward graduation. When the student repeats a course to earn credit for graduation, he/she would participate in the EOCT at the end of the repeated course. EOCT scores will not be "banked". The EOCT is also one criterion for a student to receive a variance for the Georgia High School Graduation Test (GHSGT).

When are the EOCT administered?

There are three main administrations of the EOCT: Winter, Spring and Summer. In addition, on-line Mid-Month administrations may be given in August, September, October, November, February and March.

What is the format of the EOCT?

The EOCT can be administered via paper-and-pencil assessments or in an on-line format. Paper-and-pencil assessments are only available during the main administrations. Online assessments are available for all administrations. Each test is administered in two 60 minute sections. One or two-day administration schedules may be selected by systems.

Scores and Reports

Systems will receive a full set of reports for each administration. These reports include:

Class Roster Reports (electronic only) with a 5-day turnaround (Rapid Scoring) – Give scale score, grade conversion score, performance level and domain level information for each student in a specific class

> Individual Student Reports (electronic or paper for 2007-2008) - Include scale score and a grade conversion score. One copy should be filed in the student's permanent record and one given to student/parent
>
> Summary Reports (system, school and class) – Generated by subject and present summary statistics for a particular group of students.
>
> Content Area Summary Reports (system and school) – Provide information for school, system and state at the Domain Level. (Georgia Department of Education, retrieved May 28, 2008)

Validity and Reliability of End-of-Course Tests

Based on an excerpt from the technical manual for the Georgia End-of-Course Tests, "Validation is the process of collecting evidence to support inferences from assessment results" (Georgia Department of Education, 2007, p. 47). A valid test measures what it was designed to measure and affirms interpretations of the results. Evidence of validation of the EOCT included expert groups developing test items, correlation to performance standards "scaling, equations, and quality control" (Georgia Department of Education, 2007, p. 47). Committees of educators collaborated with item developers, assessment experts, and staff members from the GaDOE to review test items, which included those being field tested. They also offered suggestions on improving test items or eliminating certain items all together. This collaborative group also compared the test items to the content standards to confirm that the test measures what it was intended to measure. The GaDOE takes steps to ensure that educators in these collaborative groups had a diverse background. The PEARSON educational company also confirmed these steps to validate the test. The classification accuracy reported 80%

for the 2007 administration which correlated to industry standards. Item point biseral and Rasch item fit statistics were used to measure construct validity. Criterion related validity is used to predict performance based on this assessment. This was an ongoing process by the GaDOE during which it works with school districts to collect data on performance and achievement. To summarize the GaDOE used educator input, statistical measures, and expert analysis to ensure that the EOCT is a valid test (Georgia Department of Education, 2007).

Reliability relates to the consistency and precision of test scores which allows it to be used to make inferences regarding a student's performance (Georgia Department of Education, 2007). The GaDOE and PEARSON rely on internal-consistency estimation for reliability. To measure reliability coefficient alpha or Cronbach alpa was used since the items on the test were homogeneous based dimensionality analysis. This report provided a detailed alpha for each test. However, the range is .86 to .93. The standard rrror of measure (SEM) is 3.33 – 3.83 for scores that fall between 67 – 75 which translates into a high reliability (Georgia Department of Education, 2007).

Surveys

A survey was a offered to a total of 120 teachers and to approximately 1000 tenth and eleventh grade students during the 2008-2009 school year. The student survey is included in Appendix A. The survey sought to determine whether or not students preferred differentiated instruction versus a traditional lecture driven classroom. The teacher survey, also found in Appendix A, explored the strategies teachers chose when differentiating instruction, how they decided when, and what lessons to differentiate. The

surveys were designed by the researcher based on the current research on the topic of differentiation. An expert in the field, Carol Ann Tomlinson, reviewed the surveys in order to validate them. Dr. Tomlinson is a professor at the University of Virginia and considered the leading expert and pioneer for differentiation. She is the author of numerous books and articles, many of which were part of the literature review. Another educational researcher, author, speaker, and expert on differentiation is Rick Wormeli. He has also reviewed the surveys in order to validate them. Data collection was approved The survey data was collected and Cronbach's alpha test of reliability was performed on each of the surveys. This test was chosen because the surveys are likert type and used an interval scale with equivalent anchor points (Gravetter & Wallanu, 2005). The survey component is exploratory in nature. The analysis will largely be descriptive statistics. However, if during analysis significant differences are suspected, inferential statistics may be used to further investigate. A detailed analysis of the statistics can be found in chapter 4.

Qualitative Investigation

The qualitative tradition chosen for this investigation was the case study approach. A case study was chosen because interviews are the primary data source for the qualitative portion of the investigation. Interviewing teachers and students is important in order to determine their understanding, use of, and preference for or against differentiation. According to Hatch (2002), those who do not feel comfortable with qualitative research should not use it for research. However, case study integrated with the quasi-experimental quantitative component provided for a blending of pos positivism

with constructivist approach to research that is congruent with quantitative protocols. A case study allowed for the exploratory nature of qualitative research and the systematic approach to data collection necessary in mixed method research (Hatch, 2005, Creswell, 2003, 2005; Merriam, 2002). Creswell (2003) stated that mixed method research strategies are useful to explore and explain phenomena. In this study the phenomena is the mandated use of differentiation. Therefore, a case study focused on the effects of this event were relevant. A case study utilized a bounded system. This study was considered bounded because the focus was on an event in a school within a specified time frame. Thus it adhered to a major criterion for case study (Creswell, 1998). Since the researcher was a teacher at the school under investigation she was a participant in this study. However, it allowed for her to have in depth knowledge of the workings of the school and access to many types of resources and the participants (Creswell, 1998, p.39).

Using multiple forms of data collection not only provided for comparison but it also offsets the weakness inherent in only of type of data collection and research. In mixed method research results are often well-validated and substantiated because of the multiple modes through which data is collected (Creswell, 2003).

The qualitative data collection occurred through individual interviews with teachers and a focus group interview with students. A focus group was chosen for the students because the students may be intimidated by an individual interview and would feel more comfortable with their peers. The student interview was held in a private conference room during a time convenient for the group members. Individual teacher interviews were held at the convenience of the interview participants who volunteered for

the interview. Follow up individual interviews were used to collect the appropriate data. Follow up interviews were an opportunity to validate interview results and increase reliability. If this did not yield enough participants then a numbers table was going to be used to identify possible participants who would then be issued a personal invitation (Gravetter & Wallanau, 2005). The researcher was making the assumption that teachers equally interested and disinterested in differentiation were willing to participate. The criterion to participate for teachers includes being a faculty member the DI school. For students, the criterion is to be a tenth or eleventh grade student the DI school because they have participated in differentiation and taken several end-of-course tests. Students were invited to participate in the interviews through email and an automatic dialer that contacts them through their home phone.

Reliability of Research

End of Course Tests: The GaDOE and PEARSON rely on internal-consistency estimation for reliability. To measure this coefficient alpha or Cronbach alpa was used since the items on the test are homogeneous based dimensionality analysis. This report provides a detailed alpha for each test. However, the range is .86 to .93. The SEM is 3.33 – 3.83 for scores that fall between 67 – 75 which translates into a high reliability (Georgia Department of Education, 2007).

Student and Teacher Surveys: The researcher provided a summary of results on a website so that those who participated in the surveys can read the results and comment. Expert group analysis was also used to review the instrument. Once research approval was granted (approval number: 11-11-08-0324880) and the surveys

completed, the researcher performed a Cronbach's alpha test to ensure reliability (Creswell, 2003; Bracey, 2003). The company, Statistics and Dissertation Services, LLC was employed to assist the researcher in these areas.

Interviews: To ensure that the interpretation and the analysis of the data was reliable member checking and triangulation of data was utilized (Merriam, 2002).

Focus Group Interviews: Students were asked to participate in a focus group interview. A focus group was chosen so as not to intimidate the students. The researcher felt that the students would be more comfortable talking as a group rather than as individuals thus providing more realistic and reliable data.

Validity

End of Course Tests: Evidence of validation of the EOCT included expert groups developing test items, correlation to performance standards “scaling, equations, and quality control” (Georgia Department of Education, 2007, p. 47). Committees of educators collaborated with item developers, assessment experts, and staff members from the GaDOE, to review test items, which include those being field tested. They also offered suggestions on improving test items or eliminating certain items all together. This collaborative group also compared the test items to the content standards to confirm that the test measures what it is intended to measure. The GaDOE took steps to ensure that educators in these collaborative groups had a diverse background. The PEARSON educational company also confirmed these steps to validate the test. The classification accuracy for the EOCT is repored as 80% for the 2007 administration which correlated to industry standards. Item *point biseral* and *Rasch* item fit statistics

were used to measure construct validity. Criterion related validity was used to predict performance based on this assessment. This was an ongoing process by the GaDOE during which it works with school districts to collect data on performance and achievement. To summarize the GaDOE uses educator input, statistical measures, and expert analysis to ensure that the EOCT is a valid test. The GaDOE considers experienced teachers that participate in an application process as experts in their field. These include National Board Certified Teachers and Master Teachers (Georgia Department of Education, 2007).

Student and Teacher Surveys**:** Member checking was utilized by the researcher. The researcher provided a summary of results on her website so that those who participated in the surveys can read the results and comment. Two expert educational researchers previously described in this study, Carol Ann Tomlinson and Rick Wormeli, provided validation for the survey instrument. The company, Statistics and Dissertations Services, LLC was employed to assist the researcher in the area of reliability by performing a Cronbach's Alpha.

Interviews: Because qualitative data collection was based on interpretations and analysis, member checking of the data was used to validate the interview results (Merriam, 2002).

Focus Group Interviews: Students were asked to participate in a focus group interview. In order to validate the results, there was a follow up focus group meeting in order for member checking to take place.

Because differentiation can be quite diverse from teacher to teacher the first question to both the individual and focus group interview participants were asked is to define differentiation from their perspective. The reason for this was so the researcher can ensure that the definition for this study and the participant were aligned. From this point a discussion on effects, strategies, and preferences followed. However, it was most important to make sure that the researcher and the participant understand the other's view point. Tomlinson (2001) stressed that differentiation can be very different one teacher to another. Since a component of this study was to understand how and why teachers differentiate it was important to follow up with questions in both individual and focus group interviews that pertain to strategies, successes, failures, and adaptations regarding differentiation. A list of questions to start the interview is listed at the end of this chapter. These served as a guide. However, the researcher let the participants' responses guide the interview (Hatch, 2002; Rubin & Rubin, 2005).

Setting and Sample

The participants in the study were chosen from a suburban area high school and consisted of students and teachers. Students in core classes across Georgia take an EOPCT as the final assessment for the course. This data provided a basis for comparison at the student, teacher, school, and district levels. For this reason passing rates which were reported as percentages were used as the quantitative data. This was the only data necessary to address the hypotheses and the first and second research questions. For research questions three and four a mix of surveys and interviews were used. Tenth and eleventh grade students were asked to participate in an online survey; 120 teachers in the

schools were asked to participate in an online survey. Teachers were emailed a link that took them to the online survey on www.surveymonkey.com. Because of the small size of the population all faculty members were asked to participate in the survey (Gravetter & Wallanau, 2005). The population of students was approximately 1000. Using a sample size calculator a sample size of 480 was calculated (www.danielsloper.com, 2008). Therefore, all tenth and eleventh grade students were invited to participate through an email invitation and by the automatic dialing system in the school which calls their home phones with announcements. The researcher hoped for 50% participation. This sample size provides for a power of .80 and an anticipated effect size of .02 (www.danielsloper.com). The surveys were administered over a period of two weeks allowing time for teacher and student volunteers to participate. In addition to an email, a link to the survey appeared on the researcher's webpage for students to access from any computer. The EOCT data for the years under scrutiny for this study was attained simultaneously from the schools report card online with the state department of education and verified through records kept on the school grounds. All faculty members were asked to participate; 12 faculty members were chosen and asked to participate in an individual, 20 minute interview with follow ups as necessary to saturate the data (Hatch, 2002; Creswell, 1998). An interview protocol was used. Twenty students were asked to participate in a focus group interview. Ideally these were students who have volunteered. If too many participants volunteer (over 20) then a sample was randomly chosen on a numbers table.

Researcher's Role

The role of the researcher in this investigation was as a data collector, interviewer, survey designer, co-worker, and possible teacher. Because the researcher taught at the DI that has implemented differentiated instruction she is an active part of the research process. The researcher was the classroom teacher of two of the students surveyed and interviewed. One-hundred thirty-three ninth and tenth grade students were under the direct care of the researcher. Since the implementation of differentiation the researcher has taught approximately 480 students. The researcher is also a co-worker of the teachers who were interviewed.

The researcher designed the survey instruments utilized in this study. Internal validity of the instrument will use a Cronbach's alpha test to validate the instrument. Also, a focus group of students who are familiar and comfortable with the researcher participated in a discussion about each of the elements of the survey to ensure validity. The researcher sent a letter home to parents, students, and teachers as to the nature of the research and reasons as to how and why they were chosen to participate in the interview in order to attain permission. Appropriate permission was attained from the students' parents. The only criteria for students and teachers to be a participant was to attend or work at the schools participating in the study. The student interviews occurred in a private conference room of the participating school. Teacher interviews occurred at their convenience. The names and any identifying factors were removed from all data collected. Every strategy possible was used to ensure anonymity and professionalism in the survey, interview, and research process. The interviews were necessary to get to the

heart of the research questions associated with the study. For example, interviews were necessary to determine how students feel about differentiated instruction and how teachers choose to differentiate lessons.

Table 1

Data Collection Strategies

Data	Significance	Source	Type
EOCT initial passing rates before and after for DI school	Statistically significant difference	School records; state report card	quantitative
EOCT initial passing rates non DI school previous 5 years	Same; compare the two schools	same	quantitative
Student focus interviews	Attitudes and preferences	Students	qualitative
Student surveys	same	students	both
Teacher interviews	Strategies, attitudes and experiences	Teachers	qualitative
Teacher surveys	same	same	both

As data was collected and coded during the interviews it was analyzed and used to develop more questions and to synthesize answers to the research questions. Triangulation of the data at the end of the collection provided an evaluation of the

process of implementing differentiated instruction and how that has affected student and teacher attitudes toward learning and achievement.

Ethical Protection of the Participants

Every effort was made to ensure the anonymity of the participants in the study. Since the quantitative data was a collective passing rate there is no way to connect a person to any piece of that data. The interviews were audio recorded, transcribed, and kept for a period five years. The audio files were downloaded to the researcher's personal computer and password protected. A disclosure statement from both the researcher was provided to the participant to ensure total and complete confidentiality. There was nothing in this study that would ask students or teachers to disclose intimate or personal information that could be used to harm or exploit. The participants' identities will not be made known to anyone other than the researcher.

This interview protocol was simply used as a guide to initiate the interview process with teachers. The participants' responses guided the interview (Hatch, 2002 & Rubin & Rubin, 2005). The following questions served as an interview protocol:

1. Explain to me your definition or idea of what differentiation or differentiated instruction is?
2. How do you decide when, how, and what lessons to differentiate?
3. What strategies, theories or concepts are your bases for differentiating instruction?
4. How do you feel differentiated instruction affects student learning and engagement?

5. Describe any successes and failures that you have had using differentiated instruction.
6. How do the atmosphere and learning environment differ between a traditional curriculum and one that is differentiated?
7. Is there anything else you would like to share or feel is important?

These questions were used as a guide for the interview process. Based on Hatch (2002) and Rubin and Rubin (2005) a protocol is only a guide that helps you to prepare for an interview. Because a researcher never knows what data a participant will provide, the researcher should allow the participants' responses to guide the interview process. The protocol above was used to provide baseline data on the participants' definition of differentiation and gather data regarding differentiation occurring in the teacher's classroom. Since this was the basis of the qualitative portion of this research these questions were a valid way to start an interview. The data from the interview was transcribed and coded based on strategies, characteristics, reasons, effects of, and foundations of differentiation. The researcher was not limited to only these categories, however. After coding and analyzing the researcher administered follow up interviews as necessary. Through careful data collection and analysis the researcher reported the data in the following chapter.

CHAPTER4: PRESENTATION AND ANALYSIS OF DATA

Introduction

Four years ago teachers in a suburban high school were given the directive to differentiate instruction in an effort to improve student achievement. In order to investigate the effectiveness of mandated differentiated instruction, a concurrent, mixed-method approach was utilized. Quantitatively, surveys were administered to teachers and students in two high schools, one where differentiation was mandated and another where it was not. Statistical analysis of passing rates on state mandated EOCT exams were compared between the two schools and before and after the implementation of differentiation. Another quantitative strategy to measure the impact of differentiated instruction utilized *t test* analysis of passing rates on standardized tests before and after the implementation of differentiated instruction and *t test* statistical analysis between the high school mandated to differentiate instruction and a compatible high school that was not mandated to differentiate instruction. Qualitatively, a case study approach was used to collect interview data from teachers and students at the school that is mandated to provide differentiated instruction. The qualitative and quantitative data was collected simultaneously.

Quantitative Data

1. Is there a difference between the passing rates on standardized tests in a suburban area high school before the use of differentiated instruction was mandated and after?

H_0 1- Null Hypothesis: There is no significant difference in the passing rates on the EOCT prior to the mandate of differentiation and the passing rates on the EOCT following the mandate of differentiation.

H_A 1- Alternative Hypothesis: There is a significant difference in the passing rates on the EOCT prior to the mandate of differentiation and the initial passing rates on the EOCT following the mandate of differentiation.

The variables for Hypothesis 1 in the quantitative portion of the study was the mandating of differentiation as a teaching approach (independent) and the EOCT passing rates (dependent). The dependent variable for Hypothesis 1 is EOCT passing rates prior to and after the implementation of differentiated instruction. A comparison of passing rates was the mechanism used for collecting the quantitative data. An independent measures *t test* was performed on the data. The following six tables relate to Hypothesis 1.

For Ninth Grade Literature the null hypothesis is rejected, $t(3)$; $p<.05$, $t = 3.342$. Descriptive statistics can be found in Table 2 and Table 3.

Table 2

Ninth Grade Literature t Test Comparison Before and After the Implementation of Differentiation

	Pre or Post	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	2	87.5000	3.53553	2.50000
	2.00	3	77.6667	3.05505	1.76383

Pre or Post refers to the years before differentiation was mandated and after. The 2 years prior to the mandate of differentiated instruction are represented by 1.00, and 2.00 represents the 3 years of mandated differentiated instruction.

Table 3

Independent Samples t Test for Ninth Grade Literature Passing Rates Before and After Differentiation

	Levene's Test for Equality of Variances		*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	0.072	0.806	3.342	3	.044	9.83333	2.94235	0.46947	19.19720
Equal variances not assumed			3.214	1.996	.085	9.83333	3.05959	-3.35606	23.02273

For American Literature, the null hypothesis fails to be rejected, $t(3)$; $p>.05$, $t=1.040$. Descriptive statistics can be found in Table 4 and Table 5.

Table 4

American Literature t Test Comparison Before and After Implementation of Differentiation

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	2	95.5000	2.12132	1.50000
	2.00	3	86.0000	12.16553	7.02377

Academic year refers to the years prior to and after the mandate to differentiate instruction. The 2 years prior to the mandate of differentiated instruction are represented by 1.00, and 2.00 represents the 3 years of mandated differentiated instruction.

Table 5

Independent t Test Samples for American Literature Passing Rates Before and After Differentiation

	Levene's Test for Equality of Variances		*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	6.372	.086	1.040	3	.375	9.50000	9.13631	-19.57583	38.57583
Equal variances not assumed			1.323	2.178	.308	9.50000	7.18215	-19.10918	38.10918

For Physical Science the null hypothesis fails to be rejected, $t(3)$; $p>.05$, $t=.294$. Descriptive statistics can be found in Tables 6 and 7.

Table 6

Physical Science t Test Comparison Before and After Implementation of Differentiation

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	2	76.0000	8.48528	6.00000
	2.00	3	73.0000	12.28821	7.09460

Academic year refers to the years prior to and after the mandate to differentiate instruction. The 2 years prior to the mandate of differentiated instruction are represented by 1.00, and 2.00 represents the 3 years of mandated differentiated instruction.

Table 7

Independent Samples t Test for Physical Science Passing Rates Before and After Differentiation

	Levene's Test for Equality of Variances		*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	.984	.394	.294	3	.788	3.00000	10.19259	-29.43737	35.43737
Equal variances not assumed			.323	2.908	.769	3.00000	9.29157	-27.10378	33.10378

For Biology, the null hypothesis is rejected, $t(3)$; $p<.05$, $t=3.342$. Descriptive statistics follow in Tables 8 and 9.

Table 8

Biology t Test Comparison Before and After the Implementation of Differentiation.

	Pre or Post	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	2	87.5000	3.53553	2.50000
	2.00	3	77.6667	3.05505	1.76383

Pre or Post to the years prior to and after the mandate to differentiate instruction. The 2 years prior to the mandate of differentiated instruction are represented by 1.00, and 2.00 represents the 3 years of mandated differentiated instruction.

Table 9

Independent Samples t Test for Biology Passing Rates Before and After Differentiation

	Levene's Test for Equality of Variances		*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	.072	.806	3.342	3	.044	3.00000	9.83333	2.94235	19.19720
Equal variances not assumed			3.214	1.996	.085	3.00000	9.83333	-3.35606	23.02273

For Algebra I, the null hypothesis fails to be rejected, $t(3)$; $p>.05$, $t=-.358$. Descriptive statistics follow in Tables 10 and 11.

Table 10

Algebra I t Test Comparison Before and After Implementation of Differentiation

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	2	67.5000	12.02082	8.50000
	2.00	3	71.0000	10.00000	5.77350

Academic year refers to the years prior to and after the mandate to differentiate instruction. The 2 years prior to the mandate of differentiated instruction are represented by 1.00, and 2.00 represents the 3 years of mandated differentiated instruction.

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Table 11

Independent Samples t test for Algebra I Passing Rates Before and After Differentiation

	Levene's Test for Equality of Variances		*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	.182	.699	-.358	3	.744	-3.50000	9.78235	-34.63182	27.63182
Equal variances not assumed			-.341	1.930	.767	-3.50000	10.27538	-49.28043	42.28043

For Geometry, the null hypothesis fails to be rejected, $t(3)$; $p>.05$, $t=-.557$. Descriptive statistics follow in Tables 12 and 13.

Table 12

Geometry t Test Comparison Before and After Implementation of Differentiation

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	2	70.5000	4.94975	3.50000
	2.00	3	73.3333	5.85947	3.38296

Academic year refers to the years prior to and after the mandate to differentiate instruction. The 2 years prior to the mandate of differentiated instruction are represented by 1.00, and 2.00 represents the 3 years of mandated differentiated instruction.

Table 13

Independent Samples t Test for Geometry Passing Rates Before and After Differentiation

	Levene's Test for Equality of Variances		*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	.341	.600	-.557	3	.616	-2.83333	5.08720	-19.02308	13.35642
Equal variances not assumed			-.582	2.605	.607	-2.83333	4.86769	-19.74365	14.07698

2. Is there a difference between the passing rates on standardized test between a school where differentiation is mandated and where it is not?

H_0 2-Null Hypothesis: There is no statistically significant difference between the passing rates among high school students on the Georgia End-of-Course Tests for students who attend a school where differentiation is mandated and those who attend a school where differentiation is not mandated.

H_A 2-Alternative Hypothesis: There is a statistically significant difference between the passing rates among high school students on the Georgia End-of-Course Tests for students who attend a school where differentiation is mandated and those who attend a school where differentiation is not mandated.

The EOCT exams were state mandated tests that are given at the end of a course. They are scored by the State Department of Education's Assessment Division. Individual and cumulative passing rates were tabulated for each school and district as part of the Report Card per No Child Left Behind. These scores were public domain on the State of Georgia's Department of Education (www.gadoe.gov). They are also kept on file at the

district office and within each school. The next six tables illustrate the statistics that support Hypothesis 2.

The null hypothesis fails to be rejected for ninth grade literature, $t(8)$; $p>.05$, $t= -.503$. Descriptive statistics follow in Tables 14 and 15.

Table 14

Ninth Grade Literature t Test Comparison Between Two Schools

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	5	81.6000	6.06630	2.71293
	2.00	5	84.2000	9.83362	4.39773

The differentiated instruction school is represented by 2.00 and the control school is represented by 1.00.

Table 15

Independent Samples t Test for Ninth Grade Literature Passing Rates Between Two Schools

	Levene's Test for Equality of Variances		*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	.919	.366	-.503	8	.628	-2.60000	5.16720	-14.51559	9.31559
Equal variances not assumed			-.503	6.659	.631	-2.60000	5.16720	-14.94636	9.74636

The null hypothesis fails to be rejected for American literature, t(8); $p>.05$, $t= .114$.

Descriptive statistics follow in Tables 16 and 17.

Table 16

American Literature t Test Comparison Between Two Schools

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	5	89.8000	10.10940	4.52106
	2.00	5	89.0000	11.93734	5.33854

The differentiated instruction school is represented by 2.00 and the control school is represented by 1.00.

Table 17

Independent Samples t Test for American Literature Passing Rates Between Two Schools

	Levene's Test for Equality of Variances		*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	.088	.744	.114	8	.912	.80000	6.99571	-15.33214	16.93214
Equal variances not assumed			.114	7.789	.912	.80000	6.99571	-15.40862	17.00862

The null hypothesis fails to be rejected for physical science, $t(8)$; $p>.05$, $t=.187$.

Descriptive statistics follow in Tables 18 and 19.

Table 18

Physical Science t Test Comparison Between Two Schools

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	5	74.2000	9.80816	4.38634
	2.00	5	72.8000	13.57203	6.06960

The differentiated instruction school is represented by 2.00 and the control school is represented by 1.00.

Table 19

Independent Samples t Test for Physical Science Passing Rates Between Two Schools

	Levene's Test for Equality of Variances		*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	.415	.537	.187	8	.856	1.40000	7.48866	-15.86888	18.66888
Equal variances not assumed			.187	7.283	.857	1.40000	7.48866	-16.16947	18.96947

The null hypothesis fails to be rejected for biology, $t(8)$; $p>.05$, $t=.120$. Descriptive statistics follow in Tables 20 and 21.

Table 20

Biology t Test Comparison Between Two Schools.

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	5	79.0000	10.67708	4.77493
	2.00	5	78.2000	10.47378	6.68402

The differentiated instruction school is represented by 2.00 and the control school is represented by 1.00.

Table 21

Independent Samples t Test for Biology Passing Rates for Two Schools

	Levene's Test for Equality of Variances		*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	.008	.930	.120	8	.908	.80000	6.68880	-14.62439	16.22439
Equal variances not assumed			.120	7.997	.908	.80000	6.68880	-14.62538	16.22538

The null hypothesis fails to be rejected for algebra I, $t(8)$; $p>.05$, $t=.449$. Descriptive statistics follow in Tables 22 and 23.

Table 22

Algebra I t Test comparison between two schools.

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	5	69.6000	9.47629	4.23792
	2.00	5	67.0000	8.80341	3.93700

The differentiated instruction school is represented by 2.00 and the control school is represented by 1.00.

Table 23

Independent Samples t Test for Algebra I Passing Rates Between Two Schools

	Levene's Test for Equality of Variances		*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	.193	.672	.449	8	.665	2.60000	5.78446	-10.73899	15.93899
Equal variances not assumed			.449	7.957	.665	2.60000	5.78446	-10.75155	15.95155

The null hypothesis fails to be rejected for geometry, t(8); p>.05, *t*=.736. Descriptive statistics follow in Tables 24 and 25.

Table 24

Geometry t Test Comparison Between Two Schools.

	Academic Year	*N*	Mean	Std. Deviation	Std. Error Mean
Pass Rate	1.00	5	72.2000	5.06952	2.26716
	2.00	5	70.0000	4.35890	1.94936

The differentiated instruction school is represented by 2.00 and the control school is represented by 1.00.

Table 25

Independent Samples t Test for Geometry Passing Rates Between Two Schools

	Levene's Test for Equality of Variances		*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	.152	.707	.736	8	.483	2.20000	2.98998	-4.69491	9.09491
Equal variances not assumed			.736	7.824	.483	2.20000	2.98998	-4.72197	9.12197

The directive to use differentiated instruction began during the 2005-2006 school year. A *t test* was used to compare passing rate data because

> The particular advantage of the t-statistic, is that the t statistic does not require any knowledge of the population standard deviation. Thus, the t statistic can be used to test hypotheses about a completely unknown population…The t statistic is used when a researcher wants to determine whether or not a treatment causes a change in a population mean. (Gravetter, 2005, p. 107)

Specifically, an independent-measures *t test* for two independent samples was used because the researcher has "no prior knowledge about either of the two populations (or treatments being compared" (Gravetter, 2005, p. 121). There are some limitations to this particular statistical test due to mitigating factors, such as the small sample size. The 2003-2004 school year was chosen as the starting point for data collection because the academic standards changed in the state where the participating schools are located. The standards changed from quality core curriculum objectives to the Georgia performance standards (GPS). Also, during the 2007-2008 school year the system level administration changed the daily schedule from a four by four, 90 minute block schedule to a seven, 50

minute per period day where the students were in the classes for an entire year versus only a semester on the block schedule. This confounding variable required a significant change to the mindset of how students go about school and had the possibility to affect testing performance.

Survey Results

Sixty-six teachers and 76 students participated in the study. The descriptive statistics for the teachers' and students' demographics are listed in Tables 26 and 27, respectively. Fifty-one (79.7%) of the teachers were female, and 13 (20.3%) were male. A majority (37, 56.9%) of the teachers reported having 12 or more years of teaching experience.

Thirty-nine (53.4%) of the students were male, and 34 (46.6%) were female. A large majority (57 or 76.0%) of the students were 15 to 16 years of age. The student participants were asked to indicate which instructional strategy they preferred. The students' responses were as follows: 18 (24.7%) preferred the direct only approach, 29 (39.7%) preferred the differentiated approach and 26 (35.6%) indicated that they had no preference.

Table 26

Descriptive Statistics for the Teachers' Demographics

Variable	*n*	%
Gender		
Female	51	79.7
Male	13	20.3
Teaching Experience		
0 – 3 Years	10	15.4
4 – 7 Years	8	12.3
8 – 11 Years	10	15.4
12 – 15 Years	11	16.9
16 – 19 Years	4	6.2
20 – 24 Years	11	16.9
25 – 30 Years	7	10.8
More than 30 Years	4	6.2

Table 27

Descriptive Statistics for the Students' Demographics

Variable	*n*	%
Gender		
Female	34	46.6
Male	29	53.4
Age		
14 Years	8	10.7
15 Years	22	29.3
16 Years	35	46.7
17 Years	8	10.7
18 + Years	2	2.7
Instructional Strategy Preference		
Direct Only Approach	18	24.7
Differentiated Approach	29	39.7
No Preference	26	34.2

Research Question 3: What strategies, methods, successes, and failures are educators facing when differentiating instruction?

An independent samples *t test* was conducted to determine if there was a significant difference between the teachers from School A or DI school and the teachers from School B or control school on their overall attitudes towards differentiated instruction. Several participants had missing data points from the survey. An imputation strategy was the preferred way of dealing with the missing data so the researcher could minimize the exclusion of participants from the analysis. Mean imputation is an effective way of dealing with missing data when the proportion of missing values is small (i.e., less than 20%) (Tabachnick & Fidell, 2007). This process was used for all but one participant who failed to answer 11 (20%) of the 55 items on the survey. The descriptive statistics for each survey item are listed in Appendix B.

The overall (mean composite) attitude scores were standardized, and the resulting z-scores were used to identify outliers. Participants with a z-score greater than $|3|$ were removed. This process revealed one outlier in the data. There were concerns with the small sample sizes in each group and its effect on the assumptions of normality and homogeneity of variance. Thus, a Kolmogorov-Smirnov test was conducted on the attitude scores for each group. Both tests were not significant, suggesting the distribution of the scores did not significantly differ from normality for each group. Levene's test was not significant, suggesting that the two groups had equal variances. The means and standard deviations of overall attitude scores for both groups are listed in Table 3. The *t test* (Table 29) failed to reveal a significant difference in overall attitudes towards

differentiated instruction between the teachers from School A and the teachers from School B, t (62) = -1.80, $p > .05$.

Table 28

Means and Standard Deviations of Teachers' Overall Attitude Scores by School Group

School Group	*N*	*M*	*SD*
School A	28	3.40	0.20
School B	26	3.50	0.27

Table 29

Independent Samples t Test on Teachers' Overall Attitudes by School Group

						95% CI of the Difference	
Dependent Variable	*t*	*df*	Sig.	Mean Difference	*SE*	Lower	Upper
Overall Attitudes	-1.80	62	.077	-0.11	0.06	-0.22	0.01

Research Question 4: What are the students' perceptions regarding differentiated instruction and how does it affect their educational process?

An independent samples *t test* was conducted to determine if there was a significant difference between the students from School A and the students from School B on their overall attitudes towards differentiated instruction. A mean imputation strategy was used again to deal with the missing data points when the proportion of missing data was small. This process was effective for all but 1 student participant who

failed to answer 20 (57.1%) of the 35 survey items. The descriptive statistics for each survey item are listed in Appendix C.

The overall attitude scores were standardized, and the resulting z-scores were used to identify outliers. Participants with a z-score greater than │3│ were removed. This process revealed 1 outlier in the data. A Kolmogorov-Smirnov test was conducted on the attitude scores for each group. Both tests were not significant, suggesting the distribution of scores did not significantly differ from normality for each group. Levene's test was not significant, suggesting that the two groups had equal variances. The means and standard deviations of overall attitude scores for both groups are listed in Table 5. The *t test* (Table 6) failed to reveal a significant difference in overall attitudes toward differentiated instruction between students from School A and students from School B, t (72) = 1.64, $p > .05$.

Table 30

Means and Standard Deviations of Students' Overall Attitude Scores by School Group

School Group	*N*	*M*	*SD*
School A	61	3.57	0.36
School B	13	3.39	0.33

Table 31

Independent Samples t Test on Students' Overall Attitudes by School Group

						95% CI of the Difference	
Dependent Variable	*t*	*df*	Sig.	Mean Difference	*SE*	Lower	Upper
Overall Attitudes	1.64	72	.106	0.18	0.11	-0.04	0.40

A Mann-Whitney test was conducted to determine if the teachers and students significantly differed in their responses to similar questions from the differentiated instruction surveys. Specifically, the test was used to compare the students' responses to the item, "If a teacher gives me a pre-test or quiz at the beginning of a unit to see what I know, it helps me focus on what I need to learn during the unit of instruction," to the teachers' responses to the following item: "Pre-testing is necessary for successful lesson planning." The Mann-Whitney is the non-parametric equivalent of the independent samples *t test*. This statistical approach was utilized for this research question because the dependent variable is not continuous as it was operationalized with a single likert scaled item.

The descriptive statistics for the students and teachers are listed in Table 7. The Mann-Whitney (Table 33) revealed a significant difference between the teachers and students in their responses to these 2 survey items, $U = 1692.00$, $p < .01$. The test indicates that the students ($M = 3.71$) had a more positive perception than the teachers ($M = 3.13$) concerning the use of pre-testing in the classroom.

Table 32

Descriptive Statistics for Teachers' and Students' Overall Attitude

Group	*N*	Mean Rank	Sum of Ranks	Min.	Max.	*M*	*SD*
Student	75	80.44	6033.00	1.00	5.00	3.71	1.17
Teacher	65	59.03	3837.00	1.00	5.00	3.13	0.96

Table 33

Mann-Whitney Tests

Mann-Whitney U	Sig.
1692.00	.001

Internal Consistency Reliability for Student & Teacher Surveys

Several Cronbach's alphas were calculated to determine the level of internal consistency reliability for the teacher and student surveys for this test administration. The Cronbach's alphas (Table 34) revealed that both the teacher and student surveys demonstrated sufficient levels of internal consistency reliability, 82 and .83, respectively.

Table 34

Cronbach's Alphas for Teacher & Student Surveys

Instrument	Cronbach's Alpha	*N* or items
Teacher Survey	.815	55
Student Survey	.833	35

Qualitative Data

Qualitative Research Questions

Research Question 3: What strategies, methods, successes, and failures are educators facing when differentiating instruction?

Research Question 4: What are the students' perceptions regarding differentiated instruction and how does it affect their educational process?

In an effort to answer this question 12 teachers participated in individual interviews lasting from 30 minutes to one hour. An interview protocol provided the foundation for the interview. However, in the spirit of interviewing the participants comments were the guiding force for the interview. The data was transcribed and then coded for similar and contrasting information. The data was then analyzed to look for strategies that teachers use to plan differentiated units. Then, data was reanalyzed to look for points of frustration with planning differentiated units. Nine students participated in a focus group interview that lasted approximately 45 minutes. The data was transcribed and analyzed to determine what type of learning environment the students preferred, one that has characteristic more congruent with a direct-only approach or one that has more in common with a differentiation. The coding process follows Creswell's (1998) approach of organizing files, reading, describing, classifying, interpreting, and representing. The individual teacher and student focus group interviews were audio recorded and then transcribed. Field notes were also taken during the interviews. Each participant has their own data file. Each of these files were read and distinguishing characteristics and views regarding differentiation were noted. Then the distinguishing features were compared and commonalities lead to categories. These were then interpreted as two basic features,

positive and negative outcomes of implementing differentiation. Discussion and data tables follow in the next section.

Teacher Interview Findings

1. Explain to me your definition or idea of what Differentiation or Differentiated Instruction is?

The root word of differentiation is different and teachers had many ideas and approaches to differentiating instruction, student learning and assessment. One teacher defined differentiation as, "Mixing up work; assess in different ways. Teach to students' different strengths." Another participant described it as the, "same content delivered through different methods and different products." For many of the participants the focus was on the student and his or her individual needs. During differentiated lessons, "Each student gets a focus and choices in how knowledge and assignments are mastered." Some participants had activities suitable for different ability levels. According to one teacher it was important to, "Recognize that students are different and that they learn differently with different learning styles. [Differentiation is] how the teacher is going to reach each child with regard to standards and strategies." Several participants taught lessons based on their students' learning styles. As one participant described, "This is something we have been doing all along; providing students with choices, learning in different ways, meeting the needs of individuals if possible. Teachers also differentiated on the fly by addressing immediate needs for different kids so that the concept was not taught the same, and it changed in response to student needs."

2. How do you decide when, how, and what lessons to differentiate?

Offering students choices in the types of assignments and assessments was an integral part of the way these teacher approach differentiation. "If they [the students] choose something to do then it is more engaging." One participant stated, "I let them show mastery of literature in many different ways." One History teacher explained, "Choices are an integral part of planning differentiated instruction. In AP I get assignments for the regular classes and set up identical lessons with different ability levels." Some teachers let them choose between working with a group or individually. "After I get to know the students, I give them choices in types of assignments. I let them choose to work with a group or individually. Or, I may put them in ability groups."

Ability is another foundation of differentiation for these participants. One participant used ability when planning tiered lessons. Knowing the students' abilities means the teacher was focused on the students and their needs. To accomplish this, teachers emphasized the importance of knowing their students. One teacher commented that a teacher “Must know kids to determine the best approach, choice, and response. I use Bernice McCarthy’s 4-MAT Learning Cycle to plan differentiated lessons.” Another teacher commented, “I differentiate all the time based on what I see in the student. It can’t be direct only; you must grab the students’ attention.” Another teacher emphasized that, “Differentiation is different for each class because it depends upon the students. The beauty of differentiation is that you get to know students.” Both formative and summative assessments were differentiated as well.

3. What strategies, theories or concepts are your bases for differentiating instruction?

The faculty members interviewed described several different strategies to differentiate instruction and assessments. They included the following: tiered type

projects with ability groups, art-based projects, deficiencies, special education status, formative work, non-native speakers, interest, work ethic, student centered projects, use of technology, discussions, learning styles, Gardner's multiple intelligences, Japanese Lesson Study Model, McCarthy's 4-MAT Learning Cycle, student engagement survey, students' strengths versus their needs, layered or tiered lessons, personality of class, Tomlinson and Wormeli's work, student learning profiles, performance assessments, talents, student background, skills to be taught, based on need and level of student, and peer tutors. These represented strategies that illustrate teachers shifting from a teacher centered classroom to a student centered classroom. They also offered engaging opportunities to students.

4. How do you feel differentiated instruction affects student learning and engagement?

All of the interview participants except one stated that "Students prefer differentiation rather than lecture only." One participant stated, “Kids enjoy it. They like the units with choices the most. I give student evaluations to my group and the DI units always come back as the favorite units.” One teacher believed that differentiation teaches content and creates a safe learning environment, “Students learn to believe in each other. They see teachers as people and they feel safe to participate in class.” For students to learn the research says that they must be engaged. “It [differentiation] increases engagement. On my engagement questionnaire students preferred differentiated instruction to direct instruction like lecture and notes.” The general consensus among the teachers who participated in the interview was that differentiation was beneficial to students stating that, “Students think better through a multi-modal approach.” The students enjoyed doing different things in class, working at their own pace and having a

choice whether to work alone or with another. One participant believed that students still prefer the “traditional stuff.” He stated that, “My more advanced students are focused on preparing for college. Many don’t like group work because they get stuck doing the work of others. The majority of these students prefer direct instruction only.”

5. Describe any successes and failures that you have had using differentiated instruction.

Some successful examples used by these teachers include: Role playing, homogeneous and heterogeneous ability groups, formative assessments, a comparison of modern language to Shakespearean English, a marriage project, tiered lessons, development unit where students plan the lesson for different age children, choices in writing letters, poems, or songs, presentations, vocabulary activities and games, five different writing prompts for the Scarlet letter, building or designing Dracula's letter versus an written essay over the novel, literature circles, food web Inspiration project; creating a guide for identifying pests in Agriculture, cut out diagrams of molecules for naming and bonding, tic tac toe grid for Spanish literature where students choose their activities, choice in Spanish Wiki spaces versus translating English ones into Spanish, telling stories in Spanish with using pictures, performance activities that are one on one with the teacher, create a Canterbury Tales bus trip, peer tutoring, cooperative groups, jigsaw, computer based projects and tutorials, creating collages to tell a story, recording a proper phone conversation, identifying a issue in the school and writing a letter to the principal on how to solve it, layered curriculum, and modifying homework to meet the needs of the student. These strategies emphasized a creative, active, and multi-modal learning environment.

6. How do the atmosphere and learning environment differ between a traditional curriculum and one that is differentiated?

Teachers suggested that the learning environment in a differentiated classroom is different than a traditional class that consists of teacher centered lecture and note-taking. “Teachers must be willing to give up control,” says one teacher. Another participant stated that, “The learning environment is fluid, you move, it can be loud. You must be ok with organized chaos and lack of structure.” One teacher described her classroom as student lead, “Let students take the lead but they need approachable teachers. We must shift from teacher centered to student centered classrooms.”

Although giving up control was difficult for some teachers, it is necessary to make the learning environment “more kid friendly and more comfortable. Students must realize that there are no penalties for questions.” A literature teacher emphasized the importance of feeling safe in her class. She says, “Students must feel safe. If they don’t know each other there is not a comfort level for sharing.” A differentiated learning environment also “encourages exploration and inquiry” which required a mutual trust. “Students must trust that they will reach a comfort zone in the lessons…Trust has to be built in. respect must be part of the learning environment. Must let students see the human side of teaching…Teachers must become coaches and be willing to give up control.”

Teaching in a differentiated classroom also required a sense of humor and a spirit of adventure. “A successful DI teacher must be ok with bombing.” One teacher who considers herself a DI teacher said that, “Teachers must have a sense of humor, openness, and be willing to admit success and failures; they need to like students but not come

across as their friend. They have to find that middle ground and be able to say no and yes." To summarize, "Know your kids and let them know you."

Collaboration was also a key component to a successful learning environment. Collaboration occurred between teachers, between the students, and between teachers and students. "More people would do it if we can pull lessons easily. New teachers are overwhelmed. A bank of lessons would benefit everyone." Another emphasized collaboration by saying that, "collaboration with others who teach similar subjects is very important."

7. Is there anything else you would like to share or feel is important?

The teachers recognized the importance of having "passion for what you teach." This is reiterated later in the student interviews. One participant shared that members of her department feel it is easier to differentiate for a small group. But, she stressed that, "Differentiation is more important for larger groups. There are more needs and more levels to keep occupied." There were mixed feeling about the success of the professional learning provided. One participant stated that the, "Majority of teachers decide they are not going to like it beforehand. It overwhelms them and some see it as useless." Another participant stated, "If we continue with differentiation we must teach students what it is and how it works and use student strengths; use instructional focus (advisement) time to explain the concepts (to students). Regarding professional learning, "The administration told me to differentiate but I've taken little from professional learning that I have been able to use. Some ideas are not realistic." In high school, teachers often taught different subjects from year to year. This constant flux seemed to discourage differentiation. "We need continuity in teaching assignments. I would be more willing to plan differentiated

lessons if I knew I could use them from year to year. We also need to be given subjects in our teaching strengths." There were other barriers to encouraging or mandating a differentiated curriculum. "Some teachers don't like change. Some members of the department are unwilling to try new things," and the choices that kids make aren't always helpful." The need for continued support and collaboration as reiterated by one interviewee, who stated, "We need a paradigm shift. We do not teach in isolation" and "...need time to plan and collaborate. If we had more time to work together more teachers would differentiate."As a result "few teachers have truly embraced differentiation. Most want a scripted plan," according to one teacher. However difficult, other teachers have embraced differentiation. "It improves achievement both in test scores and in summative and formative grades. It provides more opportunities for hands-on activities and is geared toward students." One teacher stated that "differentiation allows for students to be successful if they participate."

In an effort to clarify the definition of differentiation among the teachers, they were first asked to describe or define differentiation or differentiated instruction. With all participants recognizing that students learn differently, the definitions of differentiation were categorized into two perspectives: student strengths and weaknesses and ability levels. For example, on participant described differentiation as, "delivering the same content through different methods and products" and another as "teaching to different strengths." With regard to ability levels, one participant described differentiation as, "determining students' needs and specially meeting those needs." Another definition from a participant includes, "giving kids a choice based on strengths, talents, and backgrounds."

Following the decision to mandate that teachers differentiate instruction, professional learning was provided to the teachers within the school and throughout the system. Most professional learning opportunities were facilitated by staff members willing to share ideas and strategies. Many of the participants felt that the professional learning was fragmented and overwhelming. However, the majority of participants felt differentiation was worthwhile and beneficial to the students. Only two participants felt that students did not like differentiated instruction and it was a means to an individualized lesson plan for every student. One participant who teaches social studies felt very conflicted. From his perspective the school was encouraging him to differentiate instruction but the county level administrator wanted"cookie cutter lessons" and "teachers on the same page" each day. Despite the difficulties many teachers have continued to embrace differentiation and the challenges that come with it because they felt it benefits the students.

All interview participants whether favorable toward differentiation or not stressed that for differentiation to be successful, a teacher must know his or her students. Knowing in this sense includes knowing their academic strengths and weaknesses, as well as, their personal strengths and weakness. Some participants utilized learning style inventories, as well as, personal interest inventories. One science teacher used a science content based "get to know you" game to encourage students to become familiar with one another. In American literature, a teacher spent the first week of school establishing classroom protocol and building trust between the teacher and the students and between the students. According to the interview participants the learning environments was incredibly important. It had to be physically and emotionally safe. The teacher had to

have passion for what he or she teaches, be approachable, but yet demand that students respect the teacher and other students. A differentiated learning environment was described by more than one participant as organized chaos. Students worked on different activities at different times or were taught directly. A differentiated classroom was multi-modal in that it should appeal to all learning styles and senses. According to the participants, activities were not limited to the only the visual or auditory. Other senses and learning styles were intentionally targeted, such as kinesthetic activities that target students who were experiential learners.

Aside from knowing students, this environment was created by the task that teachers provided for the students. Based on participants' responses choice was at the heart of differentiation. Many interviewees offered students choices in the products that they created for a given unit. For example, in Spanish one participant gave students a grid of activities and they chose which activities to complete. Students were given the choice of translating a wiki space into Spanish or creating their own wiki in Spanish. She stressed that differentiation allowed students to be successful because they participated in their learning. Activities and the assessments were also designed with students' needs and interests in mind. One math teacher gave students a problem of the day as a warm up activity from the previous day's lesson. Based on their performance, the students then demonstrate mastery with an additional assessment or they went into a small group review. When appropriate, peer tutoring was used because some students feel less intimidated by help from a classmate. This particular teacher also "modifies homework and activities for the special needs students and for the accelerated students" as well. She

stated that not, "all students need to do the same problems or the same number of problems" and relied heavily on daily formative assessments to tell her that.

All the participants mentioned Gardner's MI theory and learning styles as the main foundations they used to differentiated instruction. Half of the participants used some version of a learning style inventory to determine the students' learning styles. Choice was the main component through which teachers differentiate. All the participants gave at least one assignment where the students chose the product they were preparing. The advanced placement (AP) psychology teacher, who participated in this study, epitomized choice through the final exam that was given. The course is divided into 11 units. The students chose three of the 11 units and demonstrate mastery in any manner. The teacher discussed what demonstrating mastery means. However, students are encouraged to be creative. She had them submit a proposal as a form of pre-assessment and formative assessment to help them track their progress. Some products the students created included videos, songs for a senior center, a report on the effects of random acts of kindness, and letters to parents on parenting styles. In health class one participant's differentiated lesson was a simple as having students shake hands to illustrate the effects of multiple sexual partners. Two participants taught health and both agreed that collaboration was a huge part of the success they were experiencing with differentiation. In addition to utilizing choices in the types of assessments for each unit, they also used homogeneous and heterogeneous grouping depending on the assignment and the students' needs, reiterating the need to truly know students. These two colleagues also met to discuss each unit both before and after to reflect on changes that need to be implemented to improve student success.

Not all differentiation was a success story. The majority of interviewees shared experiences where they have had to reteach content material because there were issues with the curriculum design. One participant said that teachers were discouraged from differentiating because they were not comfortable with the perceived chaotic nature of some differentiated activities that they had observed. The AP psychology teacher suggested that teachers must shift from having a "teacher centered classroom to a student centered classroom and some teachers are not comfortable with that." For successful differentiation a teacher must be approachable, have a sense of humor, and be ok with trial and error. In our current education system where accountability is a focus, teachers were discouraged from trying something new. One history teacher that was interviewed expressed frustration and felt he was being asked to do more without the resources. Given his class size and the fact that he teaches in a mobile unit, differentiation is "not realistic; we cannot even move." He felt like he could get the same results from notes, presentations, and discussions which were more conducive to the physical environment.

Regardless of personal preference for or against differentiation, the importance of knowing and understanding students could not be ignored. Understanding students' needs and interest are vital to any educational curriculum if students are to be successful. Strategies for understanding students were formal, like a learning style inventory, or informal through discussions and conversations. Four interview participants shared that they give their own survey at the end of their courses. The students have shared in all four cases that the differentiated units were the favorites. The students also felt most successful during these units because they found them more interesting and engaging.

According to the participants for successful differentiation to continue, a paradigm shift must occur. The following is a discussion of suggestions that participants made. Teachers have to be willing to give up perceived control from a teacher centered classroom to a student centered classroom. Teachers must balance flexibility with content. The administration must present professional learning in small chunks and provide teachers the time to collaborate and plan differentiated units, remembering that "simple is good". Teachers must feel supported and be willing to collaborate with one another. Smaller class sizes would be idea however unlikely. Also, continuity in teaching assignments from year to year also encouraged teachers to plan units and reflect on them. Teachers and students need to become proficient at reflection on success and failure. Above all teachers need to build in time to know their students and create a environment that is promotes student learning while still allows teachers to be approachable for students. Table 35 is a list of some positive and negative outcomes associated with the implementation of differentiation into this high school setting.

Table 35

Outcomes based on Teachers' Responses

Positive Outcomes	Negative Outcomes
Student centered	Teachers feel overwhelmed
Increase student interest	Not enough time for planning
Acknowledges student differences	Not enough time for collaboration
Increase achievement	Not enough continuity in teaching assignments
Multi-modal learning environment	Class size makes differentiation difficult
Encourages Creativity and Critical Thinking	Physical constraints (ex. teaching in mobile unit)
Students given choice	Must be willing to give up perceived control of class
Encourages Reflection	Difficult for students to have responsibility and independence.
Reduces Non-instructional Time	Seen as passing educational trend
Encourages Teacher Collaboration	Logistics and record keeping are difficult
Encourages Student Collaboration	Difficult to focus on all students when there are some with severe needs in class
Reduces Classroom Tension	Moving to next trend before mastering differentiation
Positive and Safe Learning Environment	
Encourages Student Autonomy and Accountability	
Varied and Ongoing Assessment	
Builds trust and Respect	
Student Participation	
Scaffolding	

Student Focus Group Interview Results

Nine students participated in a focus group interview that lasted approximately 45 minutes. The interview was held in the senior lunchroom, and the students volunteered to be part of the interview. The main questions and responses follow.

1. Please share some of the best learning experiences you have had. Think about your most favorite teachers and classes. What are some of the characteristics that they have? What makes them your favorite?

From the perspective of the student a good teacher was one who was well prepared and helped students prepare for tests. “She always gives the information. We do everything in class. She keeps us busy. The second thing is she always has organization. She have plan. She gives a review for the test." This student was a non-native speaker who has lived in

our community for just over a year. "She cares about the student in a sense that she is not he or she is not going to let you fail but not going to give it to you. I disagree with teachers who let students sleep in class; a teacher that pushes student and raises the bar" is a favorite for this participant. Students also preferred teachers who enjoy teaching. One student said he liked a teacher because, " he makes work more enjoyable. He makes us laugh; he compares himself to something we are covering." Student also preferred, "teachers who vary teaching styles, not same thing every time" and "teachers who do something different than notes all the time." One student explained, "I prefer teachers who explain it as opposed to teachers that just say it or they focus on material that is not on the test." Students also appeared to prefer "teachers that use good examples like real life examples."

2. Please share some of the worst learning experiences you have had. Think about your least favorite classes. What are some of the characteristics that they have? What makes them your least favorite?

Students appeared very intuitive. They were sensitive to busy work and teachers who were unhappy in their profession. The participants emphasized that they hated it when teachers "give stupid projects" and when "they say you can come in from help but they are angry all the time." The students also looked for variety when they came for extra help. One student explained a scenario that frustrated her, "When you come for help and they teach the same way as in class and it doesn't help." The students also reported resisting and resented work that they felt wasted their time. For example, "For AP US History, [we were] given a time period to do a newspaper on. We had to pick a time period from the 1840s to present. All you had to do is find 3 articles and 2 ads. We just

had to find them on the Internet and copy and paste. It is not teaching me anything. I learned absolutely nothing from it."

The student participants also felt that for literature they should have some say in what they read, “I think we should at least be able to pick when it does matter. Unless you are passionate, you don't get anything.” Students also appeared very sensitive to being liked or disliked by the teacher and how the teacher approached the students. One student was really put off by a “teacher’s attitude. It is hard to learn if the teacher is really mean. Teachers get a reputation and then you have a negative mindset." This conversation kept returning to need for students to be accepted by their teachers. Showing their intuitiveness the students emphasized that they can tell “teachers that really don't want to be there; you can tell." They provided evidence for this statement when they provided the example, "Like a teacher that tells you, they only teach because they need the money."

However, the students also said that a positive, energetic teacher encouraged them to do well in the classroom. According to students being "upbeat teacher, [is] showing that you care, not just a job.” When students were asked what about a teacher’s attitude encourages them to do well, they overwhelmingly agreed, “Be nice to students.”

3. Are you familiar with the teaching approach of differentiated instruction? Do you prefer a direct only (lecture and notes) to a differentiation curriculum or vice versa, and why?

Students reported that teachers are trying to differentiate the curriculum and for approximately two of their seven it was not working at all. For those teachers who were not attempting to differentiate the instruction the students reported that engagement was

virtually nonexistent. For the teacher who reported in the interview that students preferred direct only instruction, the students gave this description. “In AP US all we do is go in there and three out of the five days we get a lecture. He sits at the computer and presses enter; no one listens; students just talk. Days he doesn’t lecture we just sit around. Tests are impossible. Everyone has failed them. We don’t do anything but take notes. The only project was the Newspaper…it is boring.” Students reportd that taking notes does not help unless you study and most students admit to not studying. Two young ladies reported that in their anatomy class the teacher uses a variety of lessons. One anatomy student said, “In anatomy we take notes in different ways, she uses the board, packets, and we play games, hands-on activities, and Professional Fridays. And, we are assessed in different ways. We are assessed through the chats on ANGEL; we are given projects. ANGEL is the online platform for classes to use as a resource or instructional tool. One participant said, "I like to work on ANGEL with the Dropbox thing. Your teachers can see that you are working, and you can email them if you have problems. Everything is right there."

Another student reported, "Also, with group projects, you can put it all on ANGEL. The person in charge can put it all there and everyone has it. The students preferred variety. One student said, “Our math teacher, we do the same thing every week, nothing on angel. At first I liked it because I knew what we were going to do. But, you get lazy and bored knowing that it is that way all year." Expressing discontent with the same class, another student said, "We sit in back of room, there is a lot of talking; you can't hear; students don't care.” When asked what would make a class like this more engaging, the student reported, “I don't know, we went to another teacher and she had so

much energy. Her personality, our teacher is so monotone. She sets the tone for the class.” The students seemed to believe that more students would do better in the teacher was more interesting from their perspective.

4. What would you like to tell teachers to help them be more effective?

Telling students to study was fruitless from the student perspective. They want to know “for what?” However, the group suggested that if you can relate it to real-world scenarios then students was more engaged, “because if you have never seen them in the real world you don't know why you need to pass this test." The students also wanted their teachers to be approachable. "Teachers should be more personable and mix thing up a little bit." The participants also reported that they do not like to be singled out or compared. They requested, "Don't point out bad students and good students." Students also want variety, "I don't really like the whole daily routine thing. Change up the daily routine." One student also said, "I look forward to coming to school when it is different; we are already told when to eat and stuff. Change is good." The participants want fair grading, but they also do not want the focus to be on just a grade. A student commented on the grading of an art teacher, “"In art she will put in 0 in even though the work is not due for a couple of days.” One reported, “Don't be so focused on a number or a grade for knowing the content. Grades stress me out so much." The students desire timely feedback as well, "...it takes my Government teacher months to grade tests and we take them on scantron and it takes forever to get them back. He should get them back sooner."

As one student stated, "The teacher sets the tone for the class." Students’ perceptions from this interview were categorized in two ways in reference to the teacher, passion and professionalism. Students definitely preferred teachers who are "nice", "have a good

positive attitude", who are high energy and upbeat", and "give positive encouragement but have high expectations." In the words of a student, "teachers who enjoy teaching" or had a passion for teaching. Teachers who were the least effective were the ones who seemed unhappy, angry, or uncaring in the eyes of the student. What differentiates between a positive atmosphere and a negative one was professionalism in practice and in the interactions with students. They preferred classes where they were busy and active. Students wanted meaningful lessons and assignments where they learned. They did not want projects that were just busy work. They wanted their teachers to be organized and have a plan, although the students reported finding it funny when things do not go according to the plan. Real life and real world application improved student engagement. For example, two students shared that their anatomy teacher had professional Fridays where community members that had careers in the science and health gave a presentation to the class. Students wanted a class where the teacher used a variety of activities, strategies, and projects. The students did not want to do the same thing every day. Ironically, they did not want their classes to be super easy; they wanted teachers to challenge them or "raise the bar." These student participants definitely liked to have a choice. For example, one student expressed frustration that they all had to read the same "crappy books in literature." He expressed an interested in having some choices as to what books to read. Another source of student frustration was always being given the same kind of test in a class like always having essay tests in literature or history. Students also liked feeling comfortable enough to come for help outside of class. They also liked personal challenges and incentives. These participants shared that success was a combination of the nature of the student and the tone of the class. One student described,

"If I know a teacher likes me then I will try harder." Students were also very sensitive to inequities in assessments. They wanted equal accountability for everyone whether it was individual work or group work.

What students described as the preferred learning environment was in line with a differentiated classroom. Students wanted an active learning environment where the teacher takes an interest in the students. A direct only approach was boring and unengaging for them. They preferred for "teachers to mix it up." They wanted to have choices in projects, assignments, and assessments when appropriate. Student felt they were most successful in a class where the teacher talked to them and not at them. Teachers who responded to the students' needs were the most successful in the eyes of the student even though it may be a class with challenging content. So in summary, what research describes as differentiation, students interpret as a passion or love of teaching. By practicing teaching in a professional manner a teachers can created a learning environment that encouraged students to be successful.

Conclusions

While the *t test*s performed on the EOCT passing rates before and after the implementation of differentiation resulted in no significant difference there was some evidence that suggests that differentiation has been successful at the high school that differentiated instruction. Changing from a 4 x 4 block to seven 50 minute period had the potential to skew this data. All subject areas showed a decline in passing rates at the end of the year on the new schedule. Since both high schools changed to this schedule and passing rates declined at the end of the year for both schools evidence suggested that the change in schedule may have a greater impact than the teaching approach. The *t test*

performed on the surveys between the teachers at the two schools revealed no significant difference in attitudes toward differentiation. However, if the sample size had been larger, this may not have been the case given that the Sig. value is .077 and the upper limit of the confidence interval is 0.01. There could be a trend that would have been detected had there been more participants. When compared to the interview data this correlates. All but two of the teachers interviewed felt that students preferred and benefited from differentiation. Ironically, the two that felt differentiation was not beneficial to students were males, and very few male teachers participated in the survey. The students in the survey did not appear to have a significant preference for differentiation over direct instruction. However, in the student interviews there were clearly preferences for the learning environment that is found in a differentiated classroom. Students preferred a variety of teaching methods. They wanted teachers to take an interest in them, and in their words, “at least pretend to like them.” They wanted to have choices and be engaged in the class.

Evidence of Quality

In order to create a complete picture of the implementation of differentiation in the high school at the center of this investigation a mixed-method approach was used. As a result there were several sources of data in triangulation. Passing rates and surveys constituted the quantitative component while teacher and student interviews constituted most of the qualitative portions of the research. The surveys created by the researcher were validated by two of the leading experts in the education field, and they are specialist in differentiation, Carol Ann Tomlinson and Rick Wormeli. They have published numerous books on differentiation. When developing the surveys, the researcher had

students and teachers read them to make sure that they could be understood by students and teachers. The Cronbach's alphas revealed that both the teacher and student surveys demonstrated sufficient levels of internal consistency reliability, 82 and .83, respectively. There were some limitations to the study. The sample size of 13 was small for the teachers at the non-differentiation school. Also, when asking for volunteers for interviews, a researcher assumed that those with positive and negative views were equivalent in their desire to participate. A discussion of future implications and results follows in chapter 5.

CHAPTER 5: CONCLUSION

Overview

In an effort to increase student learning and achievement one suburban high school mandated the implementation of differentiated instruction, also called differentiation. The mandate was the result of pressure from failing to make Adequate Yearly Progress as a result of the No Child Left Behind Act. The school administration viewed differentiated instruction as a solution to implementing a rigorous curriculum while improving instruction and student engagement under the assumption that increased engagement improves learning and improved learning increased achievement. In order to implement differentiated instruction the administration used professional learning time to introduce differentiated instruction to its faculty. This study investigates the effectiveness of differentiated instruction, as well as, student and teacher attitudes toward differentiation. The school at the center of this investigation was part of a system that hae adopted Schlecty's (2002) WOW model which strives to provide quality, student centered lessons that engage students in the learning process. In order to implement the Schlecty standards, the administration felt that differentiation would be the best instructional approach due to its focus on standards, student centered quality, and positive learning environment.

To fully investigate the implementation of differentiation, a concurrent, mixed-method approach was used. For the qualitative portion of the investigation, the researcher used a case study approach since the phenomenon if differentiation was central to the investigation. *T test* analysis of test scores and statistical analysis of surveys were used

for the quantitative portion of this investigation. The research questions and hypotheses include:

1. Is there a difference between the passing rates on standardized tests in a suburban area high school before the use of differentiated instruction was mandated and after?

H_0 1- Null Hypothesis: There is no significant difference in the initial passing rates on the EOCT prior to the mandate of differentiation and the passing rates on the EOCT following the mandate of differentiation.

H_A 1- Alternative Hypothesis: There is a significant difference in the initial passing rates on the EOCT prior to the mandate of differentiation and the initial passing rates on the EOCT following the mandate of differentiation.

The variables for Hypothesis 1 in the quantitative portion of the study is the mandating of differentiation as a teaching approach (independent) and the EOCT passing rates (dependent). The dependent variable for Hypothesis 1 is EOCT passing rates prior to and after the implementation of differentiated instruction. A comparison of passing rates was the mechanism used for collecting the quantitative data.

2. Is there a difference between the passing rates on standardized test between a school where differentiation is mandated and where it is not?

H_0 2-Null Hypothesis: There is no statistically significant difference between the initial passing rates among high school students on the EOCT for students who attend a school where differentiation is mandated and those who attend a school where differentiation is not mandated.

H_A 2-Alternative Hypothesis: There is a statistically significant difference between the passing rates among high school students on the EOCT for students who attend a school where differentiation is mandated and those who attend a school where differentiation is not mandated. This investigation compares EOCT passing rates between two schools, one that mandates differentiation be used and the other does not. The independent variable for Hypothesis 2 is the instructional approach and the dependent variable is the resulting passing rates on the EOCT.

3. What strategies, methods, successes, and failures are educators facing when differentiating instruction? Interviews and a survey created by the researcher were used to collect data to answer this research question.

4. What are the students' perceptions regarding differentiated instruction and how does it affect their educational process? Interviews and a likert type survey created by the researcher were used to collect data to answer this question.

Theoretical Framework

Differentiated instruction is one of the current approaches being used to meet the diverse needs of modern students. The idea that students learn best when they construct their own knowledge was a founding principle for many of the constructivist curricular strategies presently used in America's classrooms (Sousa, 2001; Tomlinson, 2001, 2003). However, according to Tomlinson (1999), "Differentiated instruction is not a strategy. It is a total way of thinking about learners, teaching, and learning" (p.6). The idea behind differentiated instruction was that all students have different interests and abilities. Therefore, students learn differently and consequently construct knowledge differently

(Tomlinson & McTighe, 2006; Sprenger, 2003; Tomlinson, 2001). It is these differences that differentiation seeks to use to the student's advantage. According to Tomlinson (1999)

> Public education that accepts all comers is a uniquely American vision. Cultivating schools that effectively, vigorously and consistently address that full range of learning needs in the context of heterogeneity is the goal of differentiation. It is ambitious in its scope, likely not fully possible, confounding in its complexity – and yet no more worthwhile goal may exist for school leaders who believe in public education that provides equity of access and growth in individual excellence for all learners. (p. 6)

Differentiated instruction's core belief includes believing that all students can learn in a comfortable, safe learning environment if they are engaged and an active participant in the learning process (Tomlinson & McTighe, 2006; Tomlinson, 2001).

In order for learning to occur several conditions must be met. These conditions included a focus on content that is applicable and meaningful, a positive learning environment where students felt safe and supported, and instructional strategies that ignites students' desire to learn (Tomlinson & McTighe, 2006; Benson, 2003; Sousa, 2001). When a differentiated curriculum helped students learn and succeed, differentiation was based on sound theoretical principles. One mode of differentiation is through the use of learning styles or modalities. Gardner's (2004) MI theory postulated that learners have different strengths and learned best when material was presented through techniques targeting these modalities. Another premise upon which to differentiate was by using current brain research, BBL. BBL addressed many issues from nutrition to using music and color to improve memory, as well as, to designing lessons that targeted specific regions of the brain. One example was using emotion in the learning

process (Sousa, 2002). According to Wolfe (2006), “Emotion is the primary catalyst in the learning process” (p. 4). Researchers agreed that memory was not stored in one specific region of the brain but spread out based on the functions of the different lobes and that experience literally shaped the brain (Wolfe, 2006).

Gardner (1991, 2004) was one of the most influential psychologists who had impacted the field of education the MI theory. By suggesting that students had learning strengths and weakness the focus of education shifted from the process to the student. Recognizing the individuality of students created a need for teachers to examine what they do in the classroom and why they do it. Understanding that learning is a singular, personal process for the student led to a need to understand how this process works for each student. Although there were individual learning strengths and weakness, emotion, and physiology also played a role in learning.

The 1990s were called the decade of the brain in educational circles (Sousa, 2001). Advances in technology, cognitive science, and educational psychology resulted in a multitude of brain friendly strategies that eventually became known as BBL. Researchers, such as Sousa (2001) and Jensen (2000) suggested strategies that included the use of music, color, graphic organizers, experiential leaning activities, providing proper nutrition and hydration, and more. These strategies and methods were designed to engage students and maximize the learning process. The National Research Council’s (2000) committee on the science of learning integrated the best of neuroscience, psychology, and sociology to determine the fundamental components of lifelong learning.

Learning in any context was affected by brain-function, developmental readiness, and social norms (culture).

Educators must integrate all of these dimensions of learning to help students succeed and create an environment for learning while recognizing that what works for one student is not necessarily fair for another (Wormeli, 2006). Thus equality in the classroom must account for individuality. Differentiation provides an avenue that is fair and equal for all. Wormeli (2006) defines differentiation as, "a collection of best practices strategically employed to maximize students' learning at every turn" (p. 3). Tomlinson (1999), the primary pioneer of differentiation described a differentiated classroom as one that, "provides different avenues to acquiring content, to processing or making sense of ideas, and to developing products so that each student can learn effectively" (p. 1). Differentiation takes the best of all educational practices and incorporates them into their classroom based on the needs of the learners. Some educators and researchers, such as Sprenger (2003) focus on infusing learning styles and brain friendly strategies to differentiate instruction. Regardless of the strategies chosen the response to students' needs is a cornerstone of differentiation.

Interpretations of Findings

End-of-Course Test passing rates were collected from the State Department of Education's Assessment Division. These scores were public domain and were part of the report card for the state, system, and school. The EOCT is a state mandated test that students take after completing required courses. EOCT passing rates for School A, the school that mandates the use of differentiation, were statistically compared before and

after the implementation of differentiation. For the areas of biology and ninth grade literature the null hypothesis is rejected. The null hypothesis failed to be rejected for American literature, algebra I, geometry, and physical science. A significant difference was noted for Biology and Ninth Grade Literature. This could be due to the proficiency of the teachers in these subject areas. One of the teacher leaders for differentiation was a ninth grade literature teacher. The district also encouraged collaboration, and she shared many activities with her colleagues. The implementation of a seven period day could also interfere with the success or lack of success of implementing differentiation with regard to test scores. The seven period day schedule required teachers to adjust pacing of their courses, as well as, individual lessons. The teachers had been teaching on the four by four block schedule where students took four classes a day for 90 minutes each. At the end of the semester the students would receive a new schedule with four new classes. This change in the number of classes that students must manage on a daily and yearly basis could have affected their overall achievement on standardized tests.

EOCT passing rates were also compared between the school mandating differentiation (school A) and another school in the system that does not mandate the use of differentiation (school B). The hypothesis fails to be rejected in all subject areas, ninth grade literature, American literature, algebra I, geometry, biology, and physical science. This lack of significant difference between the passing rates between the two schools could be due to the overall effectiveness of teachers at both schools. Teachers at school B could be differentiating the curriculum as well although not mandated to do so. The

change from a four by four block schedule to a seven period day could affect achievement at both schools as well.

An independent samples *t test* was conducted to determine if there was a significant difference between the teachers from School A and the teachers from School B on their overall attitudes towards differentiated instruction. Several participants had missing data points from the survey. An imputation strategy was the preferred way of dealing with the missing data so the researcher could minimize the exclusion of participants from the analysis. Mean imputation is an effective way of dealing with missing data when the proportion of missing values is small (i.e., less than 20%) (Tabachnick & Fidell, 2007). This process was used for all but one participant who failed to answer 11 (20%) of the 55 items on the survey. The descriptive statistics for each survey item are listed in Appendix B.

The overall (mean composite) attitude scores were standardized, and the resulting z-scores were used to identify outliers. Participants with a z-score greater than $|3|$ were removed. This process revealed one outlier in the data. There were concerns with the small sample sizes in each group and its effect on the assumptions of normality and homogeneity of variance. Thus, a Kolmogorov-Smirnov test was conducted on the attitude scores for each group. Both tests were not significant, suggesting the distribution of the scores did not significantly differ from normality for each group. Levene's test was not significant, suggesting that the two groups had equal variances. The means and standard deviations of overall attitude scores for both groups are listed in Table 28. The *t test* failed to reveal a significant difference in overall attitudes towards differentiated

instruction between the teachers from School A and the teachers from School B, t (62) = -1.80, $p > .05$.

An independent samples *t test* was conducted to determine if there was a significant difference between the students from school A and the students from school B on their overall attitudes towards differentiated instruction. A mean imputation strategy was used again to deal with the missing data points when the proportion of missing data was small. This process was effective for all but 1 student participant who failed to answer 20 (57.1%) of the 35 survey items.

The overall attitude scores were standardized, and the resulting z-scores were used to identify outliers. Participants with a z-score greater than $\left|3\right|$ were removed. This process revealed 1 outlier in the data. A Kolmogorov-Smirnov test was conducted on the attitude scores for each group. Both tests were not significant, suggesting the distribution of scores did not significantly differ from normality for each group. Levene's test was not significant, suggesting that the two groups had equal variances. The *t test* failed to reveal a significant difference in overall attitudes toward differentiated instruction between students from school A and students from school B, t (72) = 1.64, $p > .05$.

One of the most significant findings from the student interviews was the feeling of acceptance that students wanted and needed from their teachers. The students clearly preferred teachers who enjoyed teaching and who enjoyed developing a professional relationship with their students. Time and again the conversation returned to students needing and wanting to be liked by their teachers. Or, at a minimum have a teacher who

liked teaching and not one who shared their dislike for the profession with students. The students' responses also illuminated the benefit of teachers being passionate about what they teach. It appeared that passion was contagious, and if the teacher was enthusiastic about the subject area, students were more likely to be as well. This scenario was congruent with current brain research and cognitive theory.

Wolfe (2001) described the emotional connection to learning. For true learning to occur students must connect on an emotional level in some way. This could be through compassion, genuine interest, a little tension, sadness, and joy. If a teacher shows enthusiasm, students apparently react in kind. If a teacher shows apathy, disdain, or dislike, student respond in kind as well. The need for acceptance is also congruent with current research on the adolescent brain. Success and feeling of self-worth are intricately tied to the feeling of being liked and accepted by both peers and adults. Critical thinking, analysis, and evaluation are facilitated by the last part of the brain to mature. Also, gender, experiences, and genetics all affect the rate at which the brain matures. So, to teach and facilitate these skills an emotionally safe and engaging environment is necessary.

The results from the student surveys revealed no significant difference in attitudes or preference for instruction. Students reported their preference for instruction as differentiated instruction (39.7%); direct only instruction (24.7%), and no preference (34.7%). However, if you combined the students who preferred differentiated instruction with those who reported no preference then a majority of students are open to participating in differentiated instruction. Given that students report that they do better if

a teacher takes an interest in them on a personal level, a differentiated classroom provided more of an opportunity for these students to thrive. A direct only approach provided little opportunity for teachers and students to interact. There were components of differentiated instruction where some teachers and students disagreed. For example, pre assessments, students feel that pre testing was important for the teacher because it illustrates where the students were in relationship to what they needed to know. Yet, a majority of teachers reported not using pre assessments as part of their usual practice.

Even though the school at the center of this investigation mandated the use of differentiated instruction, there was no significant difference in teachers' attitudes between the differentiated instruction school and the control school. This suggested that even though they were given training on differentiation their views were neither more pro differentiation nor con differentiation. However, the sample size was small and the upper limit of the 95% confidence interval was .01 and the sig. value was .77 which suggests that there may have been a trend toward a difference if the sample size had been larger. Another interesting phenomenon was the number of male teachers who took the survey, only 13. Again this number was small. Also, during the teacher interviews the two male teachers had a more negative view of differentiation than their female colleagues. All teachers who participated in the interviews expressed frustration with the district's habit of implementing change after change without understanding the full impact of the original situation.

Recommendations for Further Study

Differences in attitudes toward differentiation between teachers who have had training and those who have not should be pursued using a larger sample size for both groups of teachers. A larger sample size would give this study more power and be a more accurate description of the data. From there researchers could also investigate the effectiveness of the professional learning provided. Also, since the number of males in the study was so few and the interviews suggest that male teachers may have a more negative view of differentiation this is an area that needs further investigation as well. Are male teachers less likely to differentiate instruction? What role does gender play in effective teaching?

Another important area that requires further investigation is the effect of the seven period day on standardized test scores. The raw data on the test scores reveals the one EOCT passing rate available for each subject area is substantially lower in all subject areas. This data should be collected over the next several years and compared to EOCT scores on the four by four block schedule to see if the first year is an outlier or if the trend is toward lower test scores. This fact is significant because part of the rationale presented to the faculty for changing to a seven period day was to improve achievement on standardized tests.

Implications for Social Change

Modern students currently have the world available to them via the internet through cell phones, laptops, and media players. Therefore, there is not only a generation gap between students and teachers based on age but also one based on technology. Most

students are more efficient with technology than their classroom teachers. As a result current students see school, the world, and learning through very different eyes than students 20 years ago. Yet, with so much information available to them students struggle with how to process that information. It is the responsibility of the teacher to bridge the technology and age-based generation gaps in order to educate students. By using professionalism and research-based best practices teachers can accomplish this. Professionalism in the classroom is defined as being well-trained, prepared, and knowledgeable in their content area. Professionalism, at least in the eyes of students, also means having passion for teaching not only content but also passion for teaching students. The students want teachers who enjoy their job and take a genuine interest in them. This helps create the safe learning environment necessary for improving learning and achievement at the high school level. It also makes for happier students and happier students learn better.

Students are perceptive. They can quickly tell if a teacher enjoys his or her job. Current teachers must be able to deal with change as change is inevitable in education from the federal to state to local levels. Educators are at the mercy of so many outside entities that they must roll with the punches and bloom where planted. Students are quick to pick up on discontent, and it carries over into their performance in the classroom. Teachers are also quick to pick up on discord in their school. If they perceive professional learning or changes in their school as a passing trend then they are not engaged in improving their practice. Like students, for a new approach, mandate, or strategy to be effective teachers must take ownership in the learning process.

Open dialogue between students and teachers can help teachers plan effective instruction for their students. It can also make students feel safe, secure, and invested in the learning process. Open dialogue between teachers and the administration can lead to successful implementation of educational approaches and strategies that ultimately help students be successful.

Recommendations for Action

For differentiation to be truly successful dialogue between teachers and the administration must continue. Many teachers expressed that they needed time to collaborate and plan differentiated units by implementing some of the strategies they learned during professional learning time. The school and county administration must recognize that many teachers are trying to better meet the needs of students by implementing differentiation. Survey data suggested that there may be a trend toward a preference for differentiation if there is training and time for teachers to implement what they have learned. The DI school has only focused on differentiation for three years; they need to continue this focus to truly see the effects of differentiation. The faculty changes from year to year as do the resources available to teachers so change, especially improvement is going to take more time. The administration and teachers should work together to allow collaborative time to share ideas. The effects of a seven period day must also be investigated to determine its impact on student achievement.

For effective collaboration and reflection on practice, the staff could use the Japanese Lesson Study Model to improve the practice of differentiation. These collaborative groups are one way of sharing and analyzing relevant data. Another avenue

of sharing information is through community groups on the web based ANGEL Learning platform. Through this venue teachers can blog, submit learning objects, and share in discussion boards. A yearly summary by the professional learning team would also help keep the faculty informed of their progress. This summary could include an analysis of test scores and successful learning experiences from teachers. This should be shared with the faculty, school administration, and district administration.

Reflection

The researcher's role in this study is convoluted. She is a classroom teacher and because of her doctoral studies investigating differentiation, has lead professional learning activities. She has participated as part of the professional learning team and various committee as her job requires. Throughout the three process of researching differentiation and the subsequent investigation into the implementation of differentiation at her school, the researcher admits to preferring the use of differentiation instead of a direct only approach. An inspiration for this research study came from the positive response of students to her differentiated units. The researcher taught some of the interview participants and student survey participants. She is also the colleague of the teacher interview participants. However, the researcher feels respected by both students and teachers so she feels that the interview participants were honest and candid in their responses.

For the researcher the most significant discovery was the incredible need of students to feel accepted and liked by their teachers. While the importance of peer acceptance is well documented in the research, there is little on the effects of the feeling

of acceptance for students from teachers. During the student interviews, the discussion kept returning to the fundamentals of wanting to feel liked by teachers. By far the most effective teachers in the eyes of the students were the teachers who obviously enjoyed their job and enjoyed getting to know their students.

For the researcher this is a paradigm shift to the importance of the affective domain in learning. The importance of emotion is well documented in brain based learning research included in chapter 2 of this study. However, the true impact of this concept can only be realized by hearing it from the students themselves. As a result this is something that the researcher is trying to address more through lessons and professional relationships with students.

Conclusion

Teachers can no longer teach in the isolation of their classroom. Teachers can no longer talk at students. They must have open conversations with their students and educate students on content knowledge and how to learn that knowledge. The United States educational system at all levels prides itself on attempting something no other country does and that is educating everyone. For this reason, the U.S. is often criticized for its rankings compared to other countries, especially in mathematics and science. However, quality cannot be sacrificed for quantity. If we are going to educate everyone, we have to truly recognize what Wormeli (2006) states, “fair is not always equal.” This equivocal approach to education requires educators to embrace the diversity in gender, ability, ethnicity, and physiologically. Students are different and unique and successfully educating them requires acknowledging and embracing these unique differences.

Differentiation provides a map with multiple paths to the destination which, hopefully, is success for all.

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APPENDIX A: SURVEYS

Teacher Survey Questions
For doctoral study entitled: Mandated Implementation of Differentiated Instruction and Effectiveness Examined

This survey was used as part of a research study to determine what strategies and cues that teachers use to plan differentiated lessons, essentially how differentiated instruction is used to meet students' needs. Differentiated instruction is an instructional approach that is student centered and geared toward meeting the various needs of learners by providing multiple learning opportunities, standards-based instruction, and a safe, effective learning environment (Tomlinson, 2001). The survey was developed as part of a doctoral research study done in conjunction with Walden University. I appreciate your time and effort. Your participation is completely voluntary and any data you provide was kept confidential. The results was posted on my webpage. An email with the link and results was sent to participants when the study is completed. Please click on the link below to access the survey. The deadline for completion of the survey is _____, 2008.

References:

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Click on the link below to take the survey.
www.surveymonkey.com

Please choose the best answer that reflects your opinions regarding the statement. The descriptors are below:

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

1. In my opinion all students learn the same.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

2. Students can be taught in the same way to get the same outcome.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

3. I prefer to give students single assignments as opposed to compilation of assignments and activities.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

4. Choices in assignments or activities confuse students.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

5. Mastery of a standard should be attained at the end of the unit or by the deadline.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

6. If students do not meet the standards I have provisions in place to allow students to learn the material.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

7. Students do better if I just tell them what they need to know rather than guide them to their own conclusions.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

8. Only structured lectures and note-taking are effective for instruction.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

9. Individualizing projects and lesson plans takes the responsibility for learning away from the student.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

10. Teaching only one concept at a time as opposed to integrated content is best for student learning.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

11. Standards should be the main focus when planning instruction, student interest is secondary.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

12. Student interest is the primary focus when planning lessons.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

13. Laboratory and hands-on experiences should come with precise instructions, such as those for cook-book type labs, instead of letting students figure out the process, such as those with an inquiry construct.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

14. Students should have input when teachers plan instruction.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

14. Student interest should be incorporated into the standards when planning instruction.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

15. Students learn differently and at different rates from one another.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

16. Students learn differently and at different rates in comparison to one another.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

17. Different learning opportunities should be provided to meet the different needs of students.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

18. A rigorous academic curriculum incorporates student choices.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

19. Enabling students to discover knowledge on their own leads to enhanced learning opportunities.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

20. Critical thinking skills are just as important as content knowledge.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

21. Students work in groups and as individuals in my class depending upon the assignments.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

22. Assessing my students' learning styles and multiple intelligences is important in planning instruction for my students.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

23. I use data from learning style and multiple intelligence inventories or similar instruments to plan instruction.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

24. Offering choices in assignments whenever possible improves student engagement.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

25. Formative assessments are necessary to the learning process.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

26. Summative assessments are necessary to the learning process.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

27. I only use Summative assessments when evaluating student learning.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

28. Pre-testing is necessary for successful lesson planning.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

29. The atmosphere is my classroom is academically rigorous but emotionally safe.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

30. Adjusting the pacing of the course to my students' readiness and needs is integral to the learning process.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

31. Please check the strategies that you use in your class on a regular basis.

_____ web-quests
_____online texts
_____ online lessons

_____ PowerPoint student products
_____ graphic organizers
_____ computer simulations
_____ Laboratory investigations
_____ Hands-on activities
_____ Virtual labs
_____ Blogs or online chats
_____ Curriculum compacting
_____ Rubrics
_____ Authentic assessments
_____ Student presentations
_____ web-based activities
_____ whole-group instruction
_____ Small group instruction
_____ think-pair-share
_____ tiered lesson plans
_____ layered curriculum
_____ Formative assessments
_____ Summative Assessments
_____ Diagnostic assessments
_____ Podcasts

32. I am a teacher who differentiates instruction.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

33. Training on how to differentiate instruction in my classes has been adequate to my needs.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

34. The training/professional learning that I received during early release days in differentiated instruction was helpful to me in planning lessons.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments

35. After professional learning I was motivated to differentiate instruction.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

36. The implementation of differentiated instruction and assessment in our school has benefited students.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

37. The implementation of differentiated instruction and assessment in our school has improved student achievement.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

38. The implementation of differentiated instruction and assessment in our school has motivated students to learn.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

39. I have a favorable opinion of differentiated instruction.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

40. I feel confident I can develop differentiated units that are effective.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

41. A lack of time keeps me from using differentiated instruction as often as I would like.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

42. If I had more time I would use differentiate lessons more often.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

43. I have an adequate understanding of brain-based learning and research.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

44. I use my knowledge of brain-based learning strategies to plan differentiated lessons.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

45. I rarely have to differentiate for students.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

46. Differentiated instruction prepares students well for later high school courses and college.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

47. I believe in making student their own advocate.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

48. It is better to teach students 3 ways to do 1 thing than 1 way to do three things (based Costa's Habits of Mind).

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

49. When it comes to instruction, fair isn't always equal.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

50. When it comes to grading, fair isn't always equal.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

51. I am a consistently fair teacher to all students.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

52. I am a consistently equal teacher to all students.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

53. Giving students more time to work is often helpful for student's success.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

54. Students' responses and /or questions guide the next thing I say in my lesson.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

55. I know when differentiated instruction is effective in my class.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

56. I emphasize formative assessment over summative assessment.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

57. I am willing to adjust my lesson based on what I observe in classroom sessions and assessments.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

58. Please share any information, concerns, or feeling regarding the use of differentiated instruction in your setting.

59. Are there any specific strategies, cues or signals from students that you use to revise your instruction for the next lesson?

Demographic data: Please indicate below.

60. Gender: _____ male _____ female

61. Years Teaching Experience.

_____ 0-3	_____16-19
_____ 4-7	_____ 20-24
_____8-11	_____25-30
_____12-15	_____ more than 30

Student Survey

Attitudes toward Differentiated Learning Opportunities Student Survey

The purpose of this study is to determine which type of instruction, direct only or differentiated, has the most positive impact on student learning. Differentiated instruction is an instructional approach that utilizes many different strategies. In a differentiated classroom, students often have choices in assignments, the standards are high, instruction and learning strategies vary, and assessments are not always traditional pencil / paper tests. The learning environment is comfortable, active, and student centered. Direct only instruction is what has been called the traditional method where the teacher primarily lectures to the class while they take notes and demonstrates labs. Direct instruction is more teacher centered and grades are often based on written assignments and tests; the standards are also high.

The results of the survey was used for a study of the impact of differentiated instruction versus the traditional direct instruction approach. Your participation is completely voluntary. The results was posted on the researcher's website. Directions on how to access the results was emailed when the data has been analyzed. You will complete the following survey online by clicking on the link below. Please complete the survey by _____.

www.surveymonkey.com

Please choose the best answer.

1. I prefer to have choices in assignments in order to demonstrate knowledge of a content area. For example, completing a worksheet paper pencil or completing via computer activity.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

2. In academic classes I like to investigate and discover new things on my own using the teacher as a resource or facilitator.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

3. I like to choose whether or not I can work independent or with a group.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

4. If a teacher gives me a pre-test or quiz at the beginning of a unit to see what I know, it helps me focus on what I need to learn during the unit of instruction.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

5. My teacher's review of my performance on my pre-assessment with me helps me assess my performance.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

6. Allowing me to retest when I do not do well encourages me to relearn the material to improve my performance.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

7. I prefer to take classes in which teachers assess my learning strengths and weaknesses.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

8. I prefer my teacher to discuss my learning styles/strengths with me.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

9. I prefer to take classes where teachers use the learning styles of their students to plan instruction.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

10. I prefer classes where teachers use a variety of strategies to teach lessons and not just do the same thing every class period.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

11. I prefer teachers not use a variety of strategies.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

12. Feeling comfortable enough to ask questions in class helps me to learn better.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

13. I learn better if my teachers take a personal interest in me.

Always	Occasionally	Rarely	Never	
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

14. I prefer to take classes with teachers who understand how students learn.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

15. In general my teachers know how students' learn best.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

16. Students should be taught through different methods to make sure that everyone learns.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

17. I learn best when I can be actively participate in class through projects and hands-on activities and group discussions.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

18. I prefer classes where teachers lecture on content material most of the time.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

19. I prefer to take notes in a lecture type setting than do a project on my own with the teacher acting as a resource.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

20. In science I prefer lab activities with explicit instructions rather than design my on experiments.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

21. I learn best where the regular day to day activities are teacher lecture and practice through worksheets.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

22. Students should only be allowed once chance to take a test.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

23. Retests are highly ethical ways to determine if students learn the material.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

24. I have to be an active participant in class to learn content.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

25. I prefer to take a test rather than complete a project.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

26. It is OK for teachers to do different approaches with different students if students do well.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

27. I learn best when the teacher gives notes to study as the primary instructional tool.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

28. Doing a worksheet for practice on a regular basis helps me learn content effectively.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

29. I prefer highly structured classes where I know what to expect on a daily basis with no deviation from the norm.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

30. I prefer classes to always be quiet.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

31. Active classes where students are working at different paces or on different assignments distract me.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

32. Good lectures engage me in the learning process.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

33. If my teacher take an interest in my learning and knows me on a personal level, I learn more.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

34. I do not need to ask a lot of questions to learn.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

35. For me, an interesting lecture is more effective for learning than a problem-based project.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

36. Which instructional strategy do you prefer most often?

A. Direct Only approach B. Differentiated Approach C. no preference

37. What is your age? 14 15 16 17 18+

38. Gender: Male Female

39. Are there any comments, thoughts, or ideas that you would like to share regarding differentiated instruction, classroom instruction, or activities?

APPENDIX B: SURVEY DATA

Table B1

Descriptive Statistics for Teachers' Responses to Differentiated Instruction Survey

Item	Min.	Max.	M	SD	N
In my opinion all students learn the same.	**1.00**	**4.00**	**1.33**	**0.56**	**65**
Students can be taught in the same way to get the same outcome.	1.00	4.00	1.48	0.69	65
I prefer to give students single assignments as opposed to compilation of assignments and activities.	**1.00**	**5.00**	**2.82**	**1.26**	**65**
Choices in assignments or activities confuse students.	1.00	5.00	2.45	1.00	65
Mastery of a standard should be attained at the end of the unit or by the deadline.	**1.00**	**5.00**	**3.17**	**1.01**	**65**
If students do not meet the standards I have provisions in place to allow students to learn the material.	2.00	5.00	4.02	0.60	65
Students do better if I just tell them what they need to know rather than guide them to their own conclusions.	**1.00**	**5.00**	**2.25**	**1.00**	**65**
Only structured lectures and note-taking are effective for instruction.	1.00	2.00	1.43	0.50	65
Individualizing projects and lesson plans takes the responsibility for learning away from the student.	**1.00**	**5.00**	**2.03**	**0.75**	**65**
Teaching only one concept at a time as opposed to integrated content is best for student learning.	1.00	4.00	2.38	0.84	65

Standards should be the main focus when planning instruction, student interest is secondary.	**1.00**	**5.00**	**2.54**	**0.95**	**65**
Student interest is the primary focus when planning lessons.	1.00	5.00	2.67	0.94	65
Laboratory and hands-on experiences should come with precise instructions, such as those for cook-book type labs, instead of letting students figure out the process, such as those with an inquiry construct.	**1.00**	**5.00**	**2.80**	**0.83**	**65**
Students should have input when teachers plan instruction.	1.00	5.00	3.33	0.79	65
Student interest should be incorporated into the standards when planning instruction.	**1.00**	**5.00**	**3.83**	**0.74**	**65**
Students learn differently and at different rates in comparison to one another.	2.00	5.00	4.57	0.59	65
Different learning opportunities should be provided to meet the different needs of students.	**1.00**	**5.00**	**4.32**	**0.66**	**65**
A rigorous academic curriculum incorporates student choices.	1.00	5.00	3.66	0.99	65
Enabling students to discover knowledge on their own leads to enhanced learning opportunities.	**2.00**	**5.00**	**4.17**	**0.65**	**65**
Critical thinking skills are just as important as content knowledge.	3.00	5.00	4.59	0.55	65
Students work in groups and as individuals in my class depending upon the assignments.	**2.00**	**5.00**	**4.45**	**0.64**	**65**

Assessing my students' learning styles and multiple intelligences is important in planning instruction for my students.	1.00	5.00	3.90	0.86	65
I use data from learning style and multiple intelligence inventories or similar instruments to plan instruction.	**1.00**	**5.00**	**3.24**	**1.17**	**65**
Offering choices in assignments whenever possible improves student engagement.	1.00	5.00	4.11	.66	65
Formative assessments are necessary to the learning process.	**1.00**	**5.00**	**4.33**	**0.69**	**65**
Summative assessments are necessary to the learning process.	2.00	5.00	4.29	0.74	65
I only use Summative assessments when evaluating student learning.	**1.00**	**5.00**	**2.39**	**1.15**	**65**
Pre-testing is necessary for successful lesson planning.	1.00	5.00	3.13	0.96	65
The atmosphere is my classroom is academically rigorous but emotionally safe.	**2.00**	**5.00**	**4.08**	**0.69**	**65**
Adjusting the pacing of the course to my students' readiness and needs is integral to the learning process.	1.00	5.00	4.16	0.79	65
I am a teacher who differentiates instruction.	**1.00**	**5.00**	**3.95**	**0.78**	**65**
Training on how to differentiate instruction in my classes has been adequate to my needs.	1.00	5.00	3.44	0.96	65
The training/professional learning that I received during early release days in differentiated instruction was helpful to me in planning lessons.	**1.00**	**5.00**	**2.84**	**1.03**	**65**
After professional learning I was motivated to differentiate instruction.	1.00	5.00	3.05	1.05	65
The implementation of differentiated instruction and assessment in our school has benefited students.	**1.00**	**5.00**	**3.70**	**0.72**	**65**

The implementation of differentiated instruction and assessment in our school has improved student achievement.	1.00	5.00	3.45	0.78	65
The implementation of differentiated instruction and assessment in our school has motivated students to learn.	**1.00**	**5.00**	**3.39**	**0.82**	**65**
I have a favorable opinion of differentiated instruction.	1.00	5.00	3.95	0.69	65
I feel confident I can develop differentiated units that are effective.	**2.00**	**5.00**	**3.71**	**0.84**	**65**
A lack of time keeps me from using differentiated instruction as often as I would like.	1.00	5.00	4.02	0.94	65
I have an adequate understanding of brain-based learning and research.	**2.00**	**5.00**	**3.43**	**0.98**	**65**
I use my knowledge of brain-based learning strategies to plan differentiated lessons.	1.00	5.00	3.30	0.93	65
I rarely have to differentiate for students.	**1.00**	**5.00**	**2.35**	**0.79**	**65**
Differentiated instruction prepares students well for later high school courses and college.	1.00	5.00	3.31	1.06	65
I believe in making student their own advocate.	**3.00**	**5.00**	**4.25**	**0.56**	**65**
It is better to teach students 3 ways to do 1 thing than 1 way to do three things (based Costa's Habits of Mind).	2.00	5.00	3.80	0.79	65
When it comes to instruction, fair isn't always equal.	**1.00**	**5.00**	**3.95**	**0.80**	**65**
When it comes to grading, fair isn't always equal.	1.00	5.00	3.71	0.90	65
I am a consistently fair teacher to all students.	**2.00**	**5.00**	**4.16**	**0.77**	**65**

I am a consistently equal teacher to all students.	2.00	5.00	3.61	1.04	65
Giving students more time to work is often helpful for student's success.	**1.00**	**5.00**	**3.75**	**0.92**	**65**
Students' responses and /or questions guide the next thing I say in my lesson.	1.00	5.00	4.00	0.66	65
I know when differentiated instruction is effective in my class.	**3.00**	**5.00**	**3.89**	**0.56**	**65**
I emphasize formative assessment over summative assessment.	2.00	5.00	3.28	0.93	65
I am willing to adjust my lesson based on what I observe in classroom sessions and assessments.	**3.00**	**5.00**	**4.33**	**0.50**	**65**

Table B2

Descriptive Statistics for Students' Responses to Differentiated Instruction Survey

Item	Min.	Max.	M	SD	N
I prefer to have choices in assignments in order to demonstrate knowledge of a content area. For example, completing a worksheet paper pencil or completing via computer activity.	**2.00**	**5.00**	**4.20**	**0.75**	**75**
In academic classes I like to investigate and discover new things on my own using the teacher as a resource or facilitator.	1.00	5.00	3.60	0.96	75
I like to choose whether or not I can work independent or with a group.	**1.00**	**5.00**	**4.39**	**0.85**	**75**
If a teacher gives me a pre-test or quiz at the beginning of a unit to see what I know, it helps me focus on what I need to learn during the unit of instruction.	1.00	5.00	3.71	1.17	75
My teacher's review of my performance on my pre-assessment with me helps me assess my performance.	**1.00**	**5.00**	**3.65**	**0.94**	**75**
Allowing me to retest when I do not do well encourages me to relearn the material to improve my performance.	2.00	5.00	4.47	0.74	75
I prefer to take classes in which teachers assess my learning strengths and weaknesses.	**1.00**	**5.00**	**4.09**	**0.81**	**75**
I prefer my teacher to discuss my learning styles/strengths with me.	1.00	5.00	3.77	0.94	75
I prefer to take classes where teachers use the learning styles of their students to plan instruction.	**1.00**	**5.00**	**4.03**	**0.90**	**75**
I prefer classes where teachers use a variety of strategies to teach lessons and not just do the same thing every class period.	1.00	5.00	4.01	1.05	75
I prefer teachers not use a variety of strategies.	**1.00**	**5.00**	**2.57**	**1.20**	**75**
Feeling comfortable enough to ask questions in class	2.00	5.00	4.16	0.84	75

helps me to learn better.					
I learn better if my teachers take a personal interest in me.	**1.00**	**5.00**	**3.72**	**1.13**	**75**
I prefer to take classes with teachers who understand how students learn.	1.00	5.00	4.29	0.85	75
In general my teachers know how students' learn best.	**1.00**	**5.00**	**3.23**	**0.88**	**75**
Students should be taught through different methods to make sure that everyone learns.	2.00	5.00	4.11	0.73	75
I learn best when I can be actively participate in class through projects and hands-on activities and group discussions.	**2.00**	**5.00**	**4.07**	**1.02**	**75**
I prefer classes where teachers lecture on content material most of the time.	1.00	5.00	2.88	1.22	75
I prefer to take notes in a lecture type setting than do a project on my own with the teacher acting as a resource.	**1.00**	**5.00**	**3.05**	**1.33**	**75**
In science I prefer lab activities with explicit instructions rather than design my on experiments.	1.00	5.00	3.83	0.99	75
I learn best where the regular day to day activities are teacher lecture and practice through worksheets.	**1.00**	**5.00**	**2.91**	**1.15**	**75**
Students should only be allowed once chance to take a test.	1.00	5.00	1.85	1.16	75
Retests are highly ethical ways to determine if students learn the material.	**2.00**	**5.00**	**4.04**	**0.85**	**75**
I have to be an active participant in class to learn content.	1.00	5.00	3.56	1.12	75
I prefer to take a test rather than complete a project.	**1.00**	**5.00**	**2.92**	**1.39**	**75**
It is OK for teachers to do different approaches with different students if students do well.	1.00	5.00	3.99	0.86	75

I learn best when the teacher gives notes to study as the primary instructional tool.	**1.00**	**5.00**	**3.48**	**1.13**	**75**
Doing a worksheet for practice on a regular basis helps me learn content effectively.	1.00	5.00	3.49	0.92	75
I prefer highly structured classes where I know what to expect on a daily basis with no deviation from the norm.	**1.00**	**5.00**	**3.18**	**1.11**	**75**
I prefer classes to always be quiet.	1.00	5.00	2.78	1.09	75
Active classes where students are working at different paces or on different assignments distract me.	**1.00**	**5.00**	**2.92**	**1.23**	**75**
Good lectures engage me in the learning process.	1.00	5.00	3.47	1.23	75
If my teacher take an interest in my learning and knows me on a personal level, I learn me.	**2.00**	**5.00**	**3.75**	**0.82**	**75**
I do not need to ask a lot of questions to learn.	1.00	5.00	3.19	1.00	75
For me, an interesting lecture is more effective for learning than a problem-based project.	**1.00**	**5.00**	**3.23**	**1.15**	**75**

Table B3

Descriptive Statistics for School A Teachers' Responses to Differentiated Instruction Survey

Item	Min.	Max.	M	SD	N
In my opinion all students learn the same.	**1.00**	**4.00**	**1.39**	**0.63**	**39**
Students can be taught in the same way to get the same outcome.	1.00	4.00	1.56	0.68	39
I prefer to give students single assignments as opposed to compilation of assignments and activities.	**1.00**	**5.00**	**2.79**	**1.28**	**39**
Choices in assignments or activities confuse students.	1.00	5.00	2.38	1.02	39
Mastery of a standard should be attained at the end of the unit or by the deadline.	**1.00**	**5.00**	**3.18**	**1.00**	**39**
If students do not meet the standards I have provisions in place to allow students to learn the material.	2.00	5.00	3.95	0.56	39
Students do better if I just tell them what they need to know rather than guide them to their own conclusions.	**1.00**	**5.00**	**2.29**	**1.00**	**39**
Only structured lectures and note-taking are effective for instruction.	1.00	2.00	1.46	0.51	39
Individualizing projects and lesson plans takes the responsibility for learning away from the student.	**1.00**	**5.00**	**1.97**	**0.78**	**39**
Teaching only one concept at a time as opposed to integrated content is best for student learning.	1.00	4.00	2.46	0.91	39
Standards should be the main focus when planning instruction, student interest is secondary.	**1.00**	**5.00**	**2.54**	**0.94**	**39**
Student interest is the primary focus when planning lessons.	1.00	5.00	2.63	0.98	39
Laboratory and hands-on experiences should come	**1.00**	**5.00**	**2.74**	**0.85**	**39**

with precise instructions, such as those for cook-book type labs, instead of letting students figure out the process, such as those with an inquiry construct.					
Students should have input when teachers plan instruction.	1.00	4.00	3.28	0.83	39
Student interest should be incorporated into the standards when planning instruction.	**1.00**	**5.00**	**3.72**	**0.83**	**39**
Students learn differently and at different rates in comparison to one another.	2.00	5.00	4.51	0.64	39
Different learning opportunities should be provided to meet the different needs of students.	**1.00**	**5.00**	**4.21**	**0.73**	**39**
A rigorous academic curriculum incorporates student choices.	2.00	5.00	3.72	0.86	39
Enabling students to discover knowledge on their own leads to enhanced learning opportunities.	**3.00**	**5.00**	**4.10**	**0.50**	**39**
Critical thinking skills are just as important as content knowledge.	3.00	5.00	4.51	0.60	39
Students work in groups and as individuals in my class depending upon the assignments.	**4.00**	**5.00**	**4.51**	**0.51**	**39**
Assessing my students' learning styles and multiple intelligences is important in planning instruction for my students.	1.00	5.00	3.71	0.82	39
I use data from learning style and multiple intelligence inventories or similar instruments to plan instruction.	**1.00**	**5.00**	**2.93**	**1.20**	**39**
Offering choices in assignments whenever possible improves student engagement.	1.00	5.00	4.15	0.71	39
Formative assessments are necessary to the learning process.	**1.00**	**5.00**	**4.21**	**0.73**	**39**
Summative assessments are necessary to the learning process.	2.00	5.00	4.30	0.64	39

I only use Summative assessments when evaluating student learning.	**1.00**	**5.00**	**2.41**	**1.07**	**39**
Pre-testing is necessary for successful lesson planning.	1.00	5.00	2.82	1.02	39
The atmosphere is my classroom is academically rigorous but emotionally safe.	**3.00**	**5.00**	**4.16**	**0.63**	**39**
Adjusting the pacing of the course to my students' readiness and needs is integral to the learning process.	1.00	5.00	4.00	0.89	39
I am a teacher who differentiates instruction.	**1.00**	**5.00**	**3.82**	**0.79**	**39**
Training on how to differentiate instruction in my classes has been adequate to my needs.	1.00	5.00	3.06	0.95	39
The training/professional learning that I received during early release days in differentiated instruction was helpful to me in planning lessons.	**1.00**	**5.00**	**2.77**	**1.11**	**39**
After professional learning I was motivated to differentiate instruction.	1.00	5.00	3.00	1.05	39
The implementation of differentiated instruction and assessment in our school has benefited students.	1.00	5.00	3.64	0.81	39
The implementation of differentiated instruction and assessment in our school has improved student achievement.	1.00	5.00	3.28	0.86	39
The implementation of differentiated instruction and assessment in our school has motivated students to learn.	**1.00**	**5.00**	**3.26**	**0.85**	**39**
I have a favorable opinion of differentiated instruction.	1.00	5.00	3.90	0.75	39
I feel confident I can develop differentiated units that are effective.	**2.00**	**5.00**	**3.64**	**0.84**	**39**
A lack of time keeps me from using differentiated instruction as often as I would like.	1.00	5.00	4.23	0.84	39

I have an adequate understanding of brain-based learning and research.	**2.00**	**5.00**	**3.29**	**0.94**	**39**
I use my knowledge of brain-based learning strategies to plan differentiated lessons.	1.00	5.00	3.14	0.92	39
I rarely have to differentiate for students.	**1.00**	**4.00**	**2.47**	**0.82**	**39**
Differentiated instruction prepares students well for later high school courses and college.	1.00	5.00	3.28	1.05	39
I believe in making student their own advocate.	**3.00**	**5.00**	**4.24**	**0.48**	**39**
It is better to teach students 3 ways to do 1 thing than 1 way to do three things (based Costa's Habits of Mind).	2.00	5.00	3.71	0.82	39
When it comes to instruction, fair isn't always equal.	**1.00**	**5.00**	**4.10**	**0.68**	**39**
When it comes to grading, fair isn't always equal.	1.00	5.00	3.79	0.92	39
I am a consistently fair teacher to all students.	**2.00**	**5.00**	**4.18**	**0.72**	**39**
I am a consistently equal teacher to all students.	2.00	5.00	3.45	1.04	39
Giving students more time to work is often helpful for student's success.	**1.00**	**5.00**	**3.63**	**1.01**	**39**
Students' responses and /or questions guide the next thing I say in my lesson.	1.00	5.00	3.90	0.72	39
I know when differentiated instruction is effective in my class.	**3.00**	**5.00**	**3.82**	**0.56**	**39**
I emphasize formative assessment over summative assessment.	2.00	5.00	3.24	0.90	39
I am willing to adjust my lesson based on what I observe in classroom sessions and assessments.	**4.00**	**5.00**	**4.26**	**0.44**	**39**

Table B4

Descriptive Statistics for School B Teachers' Responses to Differentiated Instruction Survey

Item	Min.	Max.	M	SD	N
In my opinion all students learn the same.	**1.00**	**2.00**	**1.23**	**0.43**	**26**
Students can be taught in the same way to get the same outcome.	1.00	4.00	1.35	0.69	26
I prefer to give students single assignments as opposed to compilation of assignments and activities.	**1.00**	**5.00**	**2.85**	**1.26**	**26**
Choices in assignments or activities confuse students.	1.00	4.00	2.54	0.99	26
Mastery of a standard should be attained at the end of the unit or by the deadline.	**1.00**	**4.00**	**3.15**	**1.05**	**26**
If students do not meet the standards I have provisions in place to allow students to learn the material.	3.00	5.00	4.12	0.65	26
Students do better if I just tell them what they need to know rather than guide them to their own conclusions.	**1.00**	**5.00**	**2.19**	**1.02**	**26**
Only structured lectures and note-taking are effective for instruction.	1.00	2.00	1.38	0.50	26
Individualizing projects and lesson plans takes the responsibility for learning away from the student.	**1.00**	**4.00**	**2.12**	**0.71**	**26**
Teaching only one concept at a time as opposed to integrated content is best for student learning.	1.00	4.00	2.27	0.72	26
Standards should be the main focus when planning instruction, student interest is secondary.	**1.00**	**4.00**	**2.54**	**0.99**	**26**
Student interest is the primary focus when planning lessons.	2.00	5.00	2.73	0.87	26
Laboratory and hands-on experiences should come	**2.00**	**4.00**	**2.88**	**0.82**	**26**

with precise instructions, such as those for cook-book type labs, instead of letting students figure out the process, such as those with an inquiry construct.					
Students should have input when teachers plan instruction.	2.00	5.00	3.40	0.75	26
Student interest should be incorporated into the standards when planning instruction.	**3.00**	**5.00**	**4.00**	**0.57**	**26**
Students learn differently and at different rates in comparison to one another.	4.00	5.00	4.65	0.49	26
Different learning opportunities should be provided to meet the different needs of students.	**4.00**	**5.00**	**4.50**	**0.51**	**26**
A rigorous academic curriculum incorporates student choices.	1.00	5.00	3.58	1.17	26
Enabling students to discover knowledge on their own leads to enhanced learning opportunities.	**2.00**	**5.00**	**4.27**	**0.83**	**26**
Critical thinking skills are just as important as content knowledge.	4.00	5.00	4.72	0.45	26
Students work in groups and as individuals in my class depending upon the assignments.	**2.00**	**5.00**	**4.35**	**0.80**	**26**
Assessing my students' learning styles and multiple intelligences is important in planning instruction for my students.	2.00	5.00	4.19	0.85	26
I use data from learning style and multiple intelligence inventories or similar instruments to plan instruction.	**1.00**	**5.00**	**3.70**	**0.96**	**26**
Offering choices in assignments whenever possible improves student engagement.	3.00	5.00	4.04	0.60	26

Formative assessments are necessary to the learning process.	**3.00**	**5.00**	**4.50**	**0.58**	**26**
Summative assessments are necessary to the learning process.	2.00	5.00	4.27	0.87	26
I only use Summative assessments when evaluating student learning.	**1.00**	**5.00**	**2.36**	**1.29**	**26**
Pre-testing is necessary for successful lesson planning.	2.00	5.00	3.58	0.64	26
The atmosphere is my classroom is academically rigorous but emotionally safe.	**2.00**	**5.00**	**3.97**	**0.77**	**26**
Adjusting the pacing of the course to my students' readiness and needs is integral to the learning process.	3.00	5.00	4.39	0.57	26
I am a teacher who differentiates instruction.	**2.00**	**5.00**	**4.15**	**0.73**	**26**
Training on how to differentiate instruction in my classes has been adequate to my needs.	3.00	5.00	4.02	0.67	26
The training/professional learning that I received during early release days in differentiated instruction was helpful to me in planning lessons.	**1.00**	**5.00**	**2.94**	**0.92**	**26**
After professional learning I was motivated to differentiate instruction.	1.00	5.00	3.12	1.07	26
The implementation of differentiated instruction and assessment in our school has benefited students.	**3.00**	**5.00**	**3.78**	**0.57**	**26**
The implementation of differentiated instruction and assessment in our school has improved student achievement.	3.00	5.00	3.70	0.59	26
The implementation of differentiated instruction and assessment in our school has motivated students to learn.	**2.00**	**5.00**	**3.58**	**0.74**	**26**

I have a favorable opinion of differentiated instruction.	3.00	5.00	4.03	0.60	26
I feel confident I can develop differentiated units that are effective.	**2.00**	**5.00**	**3.82**	**0.83**	**26**
A lack of time keeps me from using differentiated instruction as often as I would like.	2.00	5.00	3.69	1.01	26
I have an adequate understanding of brain-based learning and research.	**2.00**	**5.00**	**3.63**	**1.02**	**26**
I use my knowledge of brain-based learning strategies to plan differentiated lessons.	2.00	5.00	3.54	0.90	26
I rarely have to differentiate for students.	**1.00**	**5.00**	**2.17**	**0.73**	**26**
Differentiated instruction prepares students well for later high school courses and college.	2.00	5.00	3.35	1.09	26
I believe in making student their own advocate.	**3.00**	**5.00**	**4.27**	**0.67**	**26**
It is better to teach students 3 ways to do 1 thing than 1 way to do three things (based Costa's Habits of Mind).	2.00	5.00	3.92	0.74	26
When it comes to instruction, fair isn't always equal.	**1.00**	**5.00**	**3.73**	**0.92**	**26**
When it comes to grading, fair isn't always equal.	1.00	5.00	3.58	0.86	26
I am a consistently fair teacher to all students.	**2.00**	**5.00**	**4.12**	**0.86**	**26**
I am a consistently equal teacher to all students.	2.00	5.00	3.85	1.01	26
Giving students more time to work is often helpful for student's success.	**2.00**	**5.00**	**3.92**	**0.74**	**26**
Students' responses and /or questions guide the next thing I say in my lesson.	3.00	5.00	4.15	0.54	26
I know when differentiated instruction is effective in my class.	**3.00**	**5.00**	**4.00**	**0.57**	**26**

I emphasize formative assessment over summative assessment.	2.00	5.00	3.35	0.98	26
I am willing to adjust my lesson based on what I observe in classroom sessions and assessments.	**3.00**	**5.00**	**4.42**	**0.58**	**26**

Table B5

Descriptive Statistics for School A Students' Responses to Differentiated Instruction Survey

Item	Min.	Max.	M	SD	N
I prefer to have choices in assignments in order to demonstrate knowledge of a content area. For example, completing a worksheet paper pencil or completing via computer activity.	**2.00**	**5.00**	**4.23**	**0.78**	**62**
In academic classes I like to investigate and discover new things on my own using the teacher as a resource or facilitator.	1.00	5.00	3.53	0.97	62
I like to choose whether or not I can work independent or with a group.	**1.00**	**5.00**	**4.47**	**0.82**	**62**
If a teacher gives me a pre-test or quiz at the beginning of a unit to see what I know, it helps me focus on what I need to learn during the unit of instruction.	1.00	5.00	3.77	1.12	62
My teacher's review of my performance on my pre-assessment with me helps me assess my performance.	**1.00**	**5.00**	**3.73**	**0.89**	**62**
Allowing me to retest when I do not do well encourages me to relearn the material to improve my performance.	3.00	5.00	4.54	0.69	62
I prefer to take classes in which teachers assess my learning strengths and weaknesses.	**3.00**	**5.00**	**4.15**	**0.74**	**62**
I prefer my teacher to discuss my learning styles/strengths with me.	2.00	5.00	3.82	0.90	62
I prefer to take classes where teachers use the learning styles of their students to plan instruction.	**2.00**	**5.00**	**4.11**	**0.81**	**62**
I prefer classes where teachers use a variety of strategies to teach lessons and not just do the same thing every class period.	2.00	5.00	4.21	0.85	62
I prefer teachers not use a variety of strategies.	**1.00**	**5.00**	**2.44**	**1.15**	**62**
Feeling comfortable enough to ask questions in class helps me to learn better.	2.00	5.00	4.21	0.83	62

I learn better if my teachers take a personal interest in me.	**1.00**	**5.00**	**3.79**	**1.10**	**62**
I prefer to take classes with teachers who understand how students learn.	2.00	5.00	4.36	0.79	62
In general my teachers know how students' learn best.	**1.00**	**5.00**	**3.25**	**0.92**	**62**
Students should be taught through different methods to make sure that everyone learns.	2.00	5.00	4.10	0.76	62
I learn best when I can be actively participate in class through projects and hands-on activities and group discussions.	**2.00**	**5.00**	**4.11**	**1.01**	**62**
I prefer classes where teachers lecture on content material most of the time.	1.00	5.00	2.93	1.19	62
I prefer to take notes in a lecture type setting than do a project on my own with the teacher acting as a resource.	**1.00**	**5.00**	**3.10**	**1.31**	**62**
In science I prefer lab activities with explicit instructions rather than design my on experiments.	2.00	5.00	3.87	0.98	62
I learn best where the regular day to day activities are teacher lecture and practice through worksheets.	**1.00**	**5.00**	**2.95**	**1.15**	**62**
Students should only be allowed once chance to take a test.	1.00	5.00	1.82	1.17	62
Retests are highly ethical ways to determine if students learn the material.	**2.00**	**5.00**	**4.11**	**0.87**	**62**
I have to be an active participant in class to learn content.	1.00	5.00	3.63	1.13	62
I prefer to take a test rather than complete a project.	**1.00**	**5.00**	**2.95**	**1.37**	**62**
It is OK for teachers to do different approaches with different students if students do well.	1.00	5.00	3.95	.89	62
I learn best when the teacher gives notes to study as the primary instructional tool.	**1.00**	**5.00**	**3.53**	**1.11**	**62**

Doing a worksheet for practice on a regular basis helps me learn content effectively.	1.00	5.00	3.52	0.90	62
I prefer highly structured classes where I know what to expect on a daily basis with no deviation from the norm.	**1.00**	**5.00**	**3.18**	**1.18**	**62**
I prefer classes to always be quiet.	1.00	5.00	2.72	1.13	62
Active classes where students are working at different paces or on different assignments distract me.	**1.00**	**5.00**	**2.95**	**1.23**	**62**
Good lectures engage me in the learning process.	1.00	5.00	3.48	1.25	62
If my teacher take an interest in my learning and knows me on a personal level, I learn me.	**2.00**	**5.00**	**3.81**	**0.81**	**62**
I do not need to ask a lot of questions to learn.	1.00	5.00	3.24	1.00	62
For me, an interesting lecture is more effective for learning than a problem-based project.	**1.00**	**5.00**	**3.23**	**1.14**	**62**

Table B6

Descriptive Statistics for School B Students' Responses to Differentiated Instruction Survey

Item	Min.	Max.	M	SD	N
I prefer to have choices in assignments in order to demonstrate knowledge of a content area. For example, completing a worksheet paper pencil or completing via computer activity.	**3.00**	**5.00**	**4.08**	**0.64**	**13**
In academic classes I like to investigate and discover new things on my own using the teacher as a resource or facilitator.	2.00	5.00	3.92	0.86	13
I like to choose whether or not I can work independent or with a group.	**2.00**	**5.00**	**4.00**	**0.91**	**13**
If a teacher gives me a pre-test or quiz at the beginning of a unit to see what I know, it helps me focus on what I need to learn during the unit of instruction.	1.00	5.00	3.38	1.39	13
My teacher's review of my performance on my pre-assessment with me helps me assess my performance.	**1.00**	**4.00**	**3.31**	**1.11**	**13**
Allowing me to retest when I do not do well encourages me to relearn the material to improve my performance.	2.00	5.00	4.15	0.90	13
I prefer to take classes in which teachers assess my learning strengths and weaknesses.	**1.00**	**5.00**	**3.85**	**1.07**	**13**
I prefer my teacher to discuss my learning styles/strengths with me.	1.00	5.00	3.54	1.13	13
I prefer to take classes where teachers use the learning styles of their students to plan instruction.	**1.00**	**5.00**	**3.62**	**1.19**	**13**
I prefer classes where teachers use a variety of strategies to teach lessons and not just do the same thing every class period.	1.00	5.00	3.08	1.38	13
I prefer teachers not use a variety of strategies.	**1.00**	**5.00**	**3.15**	**1.28**	**13**

Feeling comfortable enough to ask questions in class helps me to learn better.	3.00	5.00	3.92	0.86	13
I learn better if my teachers take a personal interest in me.	**1.00**	**5.00**	**3.38**	**1.26**	**13**
I prefer to take classes with teachers who understand how students learn.	1.00	5.00	3.95	1.04	13
In general my teachers know how students' learn best.	**2.00**	**4.00**	**3.15**	**0.69**	**13**
Students should be taught through different methods to make sure that everyone learns.	3.00	5.00	4.15	0.55	13
I learn best when I can be actively participate in class through projects and hands-on activities and group discussions.	**2.00**	**5.00**	**3.85**	**1.07**	**13**
I prefer classes where teachers lecture on content material most of the time.	1.00	5.00	2.62	1.39	13
I prefer to take notes in a lecture type setting than do a project on my own with the teacher acting as a resource.	**1.00**	**5.00**	**2.85**	**1.46**	**13**
In science I prefer lab activities with explicit instructions rather than design my on experiments.	1.00	5.00	3.62	1.04	13
I learn best where the regular day to day activities are teacher lecture and practice through worksheets.	**1.00**	**4.00**	**2.69**	**1.18**	**13**
Students should only be allowed once chance to take a test.	1.00	4.00	2.00	1.15	13
Retests are highly ethical ways to determine if students learn the material.	**3.00**	**5.00**	**3.70**	**0.63**	**13**
I have to be an active participant in class to learn content.	2.00	5.00	3.23	1.01	13
I prefer to take a test rather than complete a project.	**1.00**	**5.00**	**2.77**	**1.54**	**13**

It is OK for teachers to do different approaches with different students if students do well.	3.00	5.00	4.15	0.69	13
I learn best when the teacher gives notes to study as the primary instructional tool.	**1.00**	**5.00**	**3.23**	**1.24**	**13**
Doing a worksheet for practice on a regular basis helps me learn content effectively.	1.00	5.00	3.38	1.04	13
I prefer highly structured classes where I know what to expect on a daily basis with no deviation from the norm.	**2.00**	**4.00**	**3.17**	**0.69**	**13**
I prefer classes to always be quiet.	1.00	4.00	3.06	0.87	13
Active classes where students are working at different paces or on different assignments distract me.	**1.00**	**4.00**	**2.76**	**1.23**	**13**
Good lectures engage me in the learning process.	1.00	5.00	3.38	1.19	13
If my teacher take an interest in my learning and knows me on a personal level, I learn me.	**2.00**	**5.00**	**3.46**	**0.88**	**13**
I do not need to ask a lot of questions to learn.	1.00	4.00	2.92	0.95	13
For me, an interesting lecture is more effective for learning than a problem-based project.	**1.00**	**5.00**	**3.23**	**1.24**	**13**

APPENDIX C: CURRICULUM VITAE

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Summary Statement: My professional goal is to transition into adult and higher education from my position as a teacher in secondary science education. Training teachers, especially science teachers, requires dedication and discipline, both of which I possess. Personally, I plan to continue my pursuit of life-long learning.

Education:
2006 to Present Ed.D. in Teacher Leadership, Walden University, Minneapolis, MN
Dissertation: Mandated Differentiation Effectiveness Examined
GPA: 4.0/4.0

1997-1998 M.A.T. Secondary Science Piedmont College, Demorest, GA
Capstone: Teaching Science through Literature
GPA: 4.0/4.0

1990-1994 B.S. in Biology, North Georgia College, Dahlonega, GA
Minor: Chemistry
GPA: 3.65/4.0; Cum Laude

Certifications:
Broad-Field Science, 1998; Gifted In-Field Endorsement, 2001; Teacher Support Specialist, 2004; National Board Certification, 2005

Professional Affiliations:
National Science Teachers Association; Georgia Science Teachers Association; Association for Supervision and Curriculum Development; Professional Association of Georgia Educators

Employment History:

Science Instructor and Department Head *August, 2005-Present*

Serve as Department Chair. Teach variety of Science classes to include Biology, Physical Science, and Chemistry. Act as the Gifted Facilitator/Co-teacher for the Science Department. Serve as a member of the Leadership Team and Textbook Adoption committee. Assist with the development of Benchmark Tests. Teach professional development on differentiation.
Department Chair responsibilities include: maintaining the Science budget; scheduling classes; training middle school teachers on class recommendation requirements; mentoring teachers.

South Hall Middle School, Gainesville, GA *October, 2004 to June, 2005*
Taught 8th grade Earth Science and Reading in the Content Area classes

Gordon Central High School, Calhoun, GA *August, 2002 to October, 2004*

August, 1998 to June, 2000
Taught various levels Physical Science, Biology, Environmental Science, Chemistry, and Anatomy classes. Secured a grant and facilitated the development of an outdoor classroom. Sponsored the Environmental Club

East Hall High School, Gainesville, GA *August, 2000 to June, 2002*
Taught various levels of Biology, Physical Science, and Anatomy; Served as Student Support Team Coordinator

Brenau Academy, Gainesville, GA *August, 1995 to June, 1998*
Taught Physical Science, Biology, Chemistry, and Anatomy. Served as Environmental Club Sponsor; Coached varsity volleyball and tennis. Coached intramural flag football and basketball. Served as a advisor and activities coordinator for weekend field trips.

Relevant Experience:
Hidden Lake Academy, Dahlonega, GA January, 1995 to July, 1995
Blue Ridge Outdoor Education Center, Toccoa, GA March, 1994 to December, 1994

Professional Learning:
Assessment for Learning, Forsyth County Board of Education
Georgia's Coastal Ecology, MAREX, Skidaway Island Institute
National Science Teachers Association Conference, Nashville, TN
Differentiation for All Abilities, Rick Wormeli, Atlanta Georgia

Chemical Safety Summit, Forsyth County Board of Education
Explore Learning Gizmo Training, Forsyth County Board of Education

Computer Skills:
Microsoft Office Suite
ANGEL Online Learning Platform
e-College Online Learning Platform