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Differentiated Instruction in a Standards-Based Middle School Science Classroom

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COLLEGE OF EDUCATION

This is to certify that the doctoral study by

Marsha Hogan

has been found to be complete and satisfactory in all respects,
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2014

Abstract

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MA, Fort Valley State University, 1995

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Middle schools in Georgia and all over the United States face unique obstacles for enhancing the academic accomplishment of an increasingly diverse group of learners. Under pressure to implement innovative, research-based teaching practices to overcome these challenges, many schools and teachers adopt differentiated instruction (DI), a teaching approach designed to accommodate different learning styles and levels of ability. This study was grounded in Howard Gardner's multiple intelligences and Lev Vygotsky's zone of proximal development (ZPD) theory. The research questions investigated in this study were designed (1) to explore the perceptions of science teachers regarding how they apply DI and (2) what obstacles they encountered in their application of DI methods. The data collected were analyzed using occurring themes through individual interviews, observations, and artifacts from 5 regular education science teachers and 2 special service teachers who implemented DI in their classroom. Findings of the study revealed that the teachers experienced successes and difficulties in implementing DI strategies in science. They addressed these difficulties by changing their lessons to coincide with available materials or resources and applying low-preparation DI strategies to meet the needs of each student. Data from this study informed social change by assisting teachers in providing enhanced instruction which promotes student engagement and academic success through the grades. In turn, empowers students to graduate from high school prepared for advanced learning, which leads to productive careers.

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Dedication

I wish to dedicate this educational endeavor to my husband, Hubert; my daughters, Marlaetrice and Matiecea; my sister, Anissa Brown; and my mother, Brenda Fitzgerald. They supported me with love, patience, and understanding as I completed this doctoral program of work. In addition, I want to thank my science colleagues who helped me by providing insightful information about using differentiated instruction to improve student achievement in the middle grades.

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Section 1: Introduction to the Study

Background

Pressure on U.S. educators to be accountable for improvements in student performance has increased (Guilfoyle, 2006). This focus on student performance is in response to evidence provided by international studies that indicate that American students are lagging behind many other countries in academic achievements. Achievement in science education is an area of particular concern. The National Assessment of Educational Progress (NAEP) science exam results documented that Grade 4 students made progress in science (Wenglinsky & Silverstein, 2007), Grade 8 students stayed the same, and Grade 12 students' progress declined over time (Mullis, Martin, Foy, & Arora, 2012).

Furthermore, the focus on improving academic achievement among America's school children intensified after President George W. Bush signed the No Child Left Behind Act (NCLB) in 2001 (Mayers, 2006). NCLB offers educators in schools across the United States the opportunity to ensure that all learners receive appropriate education to succeed academically. In addition, NCLB requires educators in all schools to establish systems to measure students' adequate yearly progress (AYP). Equally, educators in schools are required (a) to show sustainable evidence that the educational practices in schools enable every student to improve academically and (b) to measure the progress of the school and student achievement annually (Georgia Department of Education [GADOE], 2009).

At the same time, teachers and policymakers are facing unprecedented challenges of educating an increasingly diverse student population with wide-ranging learning abilities and needs. These challenges make it difficult for educators in many schools to meet this stringent government requirement for accountability and for continual improvements in student performance (Beecher & Sweeney, 2008).

Additionally, the educational system during the 1800s served America's industrial age. Those teaching methods, where children were passive recipients of information, are inappropriate to equip children to succeed in this knowledge- and skills-based economy (Yatvin, 2004, 2007). If teachers continue to use traditional pedagogical methods to educate students, it is highly unlikely that academic performance levels will improve. It is imperative that decision makers in school districts put into practice new strategies, including instructional techniques, teaching methods, and lesson delivery, to meet the education challenges in the 21st century.

Therefore, many educators and policymakers are turning to new pedagogical strategies intended to ensure mastery of learning for all students (Guilfoyle, 2006). Some observers have noted improvements in the educational setting because of these strategies (Bowerman, 2005; Corley, 2005). Nevertheless, developments have been piecemeal. Educators are still debating how to create quality Grade K–12 education in a world dominated by science and technology (Hersh, 2009; Trefil & O'Brien-Trefil, 2009).

Educators in some states, including Georgia, have implemented a standards-based curriculum that includes an explicit requirement for schools and instructors to practice research-based methods and theories in order to improve student learning. Content-area

teachers are responsible for the information they provide in their own classrooms. The use of research-based teaching methods places considerable pressure on teachers to maintain awareness and demonstrate the ability to use proven instructional methods. The demands on teachers and students increases considerably as learners progress from lower to higher grades (Mastropieri et al., 2006). Educators seem burdened in heterogeneous science classrooms, which include a diversity of students (Johnson, 2006).

To address the issue of increasing academic achievement among students, educators in schools are encouraging teachers to address varied student needs via the use of differentiated instruction (DI), a form of instruction that is supported by learning theories such as multiple intelligences (MI), zone of proximal development (ZPD), and learning style (Graham, 2009; Hall, Strangman, & Meyer, 2003, 2009; Tomlinson, 2006). DI addresses both individual learning styles and multiple intelligences. DI is a pedagogical method with the possibility of meeting the NCLB expectations (Tomlinson, 2008) by helping learners connect with various degrees of advancement (Rock, Gregg, Ellis, & Gable, 2008; Tomlinson, 2006). DI involves modifying pace, kinds of instruction, and tasks to meet every learner's academic needs by using strategies such as cooperative learning, flexible groups, and tiered instruction (Erwin, 2004; Tomlinson, 2006). Many leading education researchers have expressed the belief that DI enables teachers to improve student academic performance in content areas (Darling-Hammond & Brandsford, 2006; Hersh, 2009; Trefil & O'Brien-Trefil, 2009). Relatively few empirical studies and little qualitative research have been conducted to explore the genuine utilization of DI at the classroom level; as a result, little guidance, information,

or best practices are available for teachers on how to use DI instructional techniques, particularly within science education.

Problem Statement

Within science teaching, no single successful instructional strategy has been established and implemented in schools in the United States (Landrum & McDuffie, 2010). Often recommendations identify DI as a research-based teaching method, which suggests an array of learning choices intended to interest students' various learning profiles and readiness levels (Tomlinson, 2004b). DI enables teachers to accomplish the task of helping all students perform at the top of their academic ability (Benjamin, 2006; Hall, 2002; Heacox, 2003; Keck & Kinney, 2005; Tomlinson, 2004a). This study explored the perceptions of teachers who were in need of different strategies to meet the learning needs of students. Moreover, teachers repeatedly use familiar instructions to address learning problems, instead of using research-based strategies (Zionts, Shellady, & Zionts, 2006). In the county where this study took place, students were not meeting AYP (GADOE, 2009); therefore, the science teachers at the school site had to shift from traditional instructional delivery practices and explore alternate instructional strategies to aid in enhancing science comprehension in Grades 6–8.

Researchers suggest that teachers have qualms about and face difficulties that hinder them from implementing DI in their classrooms (Brighton, Hertberg, Moon, Tomlinson, & Callahan, 2005; Edwards, Carr, & Siegel, 2006). Multiple studies have been conducted since the 1990s on the use of DI strategies for academic achievement (Levy, 2008; Rock et al., 2008; Tomlinson, 2009, 2010; Yatvin, 2004). These studies

presented evidence on the positive and negative aspects of DI, provided reasons to use DI, and identified barriers in teacher utilization of DI. However, none of these studies provided a picture of teachers' personal perspectives and utilization of DI strategies in a poor-performing rural middle school science class. Therefore, it was necessary to perform a phenomenological study to examine teachers' perceptions and knowledge of employing DI methods as an alternative for meeting the educational needs of middle school learners (Hall et al., 2003, 2009).

Educational researchers often use quantitative methods to investigate the impact of different types of teaching strategies on the academic performance of students. However, it could not be determined from the available quantitative research whether the lack of an impact was due to weaknesses of the strategy itself, teachers' inadequate knowledge of the techniques, misperceptions of DI strategies, or failure to implement DI effectively due to lack of training (Creswell, 2008). Therefore, in this qualitative study I explored the perceptions of middle school science teachers relative to using DI as an instructional strategy.

Standards-based methods of assessing student performance, based on annual assessments, may be inadequate for demonstrating the true impact of teaching methods, including DI. Clymer and William (2007) suggested it is vital to observe a wider range of factors, such as changes in student behavior, motivation, and cooperative work behaviors, because these factors could be associated with longer term academic achievement, though not reflected in yearly tests.

Purpose of the Study

The purpose of this study was to examine the perceptions of middle school science teachers about implementing DI strategies in a rural middle school in Georgia. The goal was to recognize themes associated with the teachers' perceptions about executing DI with unconstructive and constructive aspects of this method and reasons the teachers adopted or did not adopt DI strategies. The school site has provided professional learning training in varied instructional methodologies, including DI, since 2004 for all staff members in an effort to improve student achievement. I used a qualitative phenomenological study to examine the perceptions and teaching methodologies of seven participants. Research questions addressed the positive attributes and the challenges of this instructional method.

The sample for this study included five regular education science teachers and two special service teachers at a rural middle school in Georgia. The science teachers participated because they had a common interest in improving science instruction, knowledge, concepts, and skills to enhance academic achievement in science as measured by state standardized test scores. In addition, the selected teachers had 2 years of summer training in DI, in addition to professional learning training every quarter, provided by university professors and other professional development specialists. Initially, this study generated insight into the perceived benefits and weaknesses of DI as an instructional method from science teachers' perspectives. Secondly, in this study I examined teachers' awareness of DI in classroom instruction as a strategy to enhance students' academic achievement.

Conceptual Framework

The conceptual framework included established theories of learning, such as MI (Gardner, 1993, 2006) and ZPD theory (Vygotsky, 1978, 1934/1987), which have demonstrated the potential benefits of DI in improving academic performance. The conceptual framework for the study assumed that children learn well in various ways and with varying degrees of structure (Tomlinson, 2010), and that educators have a responsibility toward both society and the individual (Dewey, 1938/2001) for implementing teaching strategies that are tailored to individual learning styles and academic abilities.

Two main theories underpin this study and the use of DI. MI recognizes the different types of human intelligence that influence how learners become interested and how they connect learning to the real world. ZPD is a concept developed to describe and explain the difference between what learners are able to achieve independently or with assistance (Vygotsky, 1978, 1934/1987). To implement DI in a mixed-ability classroom, teachers should understand and use these concepts in their work (Sprenger, 2003, 2008). For this study, these theories identified the types of issues needed to answer the research questions. These theories framed the design of the data collection instruments and guided the investigation.

Nature of the Study

In this qualitative, phenomenological study I applied in-depth interviews and observations of teachers in their classrooms. Creswell and Maietta (2002) defined a *phenomenological study* as “one that tells the significance of lived experiences

surrounding a concept or a phenomenon" (p. 151). The reason for this type of research is to appreciate the phenomenon from the firsthand perceptions and articulated challenges of educators directly involved in it. This approach combined the MI and ZPD theories as a perspective through which to examine the teachers' accomplishments and trials.

This study applied in-depth interviews with five regular education science teachers and two special service teachers at a middle school, trained between 2008 and 2010, who self-reported as using DI strategies weekly in their classrooms since the beginning of the 2011–2012 school term. I interviewed teachers, reviewed lesson plans, observed the teachers, and compiled a checklist to determine the instructional strategies the teachers incorporated weekly.

The teachers chosen for this study participated in book studies and special science workshops taught by university professors and professional development specialists. The training was ongoing semiannually during grade-level planning time or after school during monthly department meetings. The interviews explored the teachers' understanding and personal perceptions of using DI. Additionally, the interviews addressed the specific challenges and difficulties encountered, how those challenges and difficulties were resolved, and how teachers perceived the effect of these teaching methods on various categories of students. The combined data generated from the interviews and other documentation allowed me to analyze the findings by using the process of data aggregation. The interviews, observations, and lesson plan reviews generated themes to answer the research questions. Detailed discussion of the methodology is provided in Section 3.

Study Objective and Research Questions

The objective of this research was to generate information and develop meaningful guidance when using DI in middle school science teaching, particularly in Grades 6–8. The study addressed two main research questions:

RQ1: What are the reported experiences of science teachers, annually trained in DI strategies, regarding their implementation of DI strategies at a rural southeast Georgia middle school?

RQ2: What strengths and difficulties do science teachers trained in DI strategies report regarding their implementation of DI, and what do they say they do to address the identified difficulties?

Answers to the two research questions emerged through a phenomenological design. Data from semistructured in-person interviews, observations, and lesson plan reviews generated answers to the research questions. Teachers participated in individual interviews after school or during their planning times. Tape recorders captured the interview responses of each of the participants.

Research Study Site

The research study site, in addition to the school system, failed to achieve AYP from 2004 through 2012 (GADOE, 2009). Beecher and Sweeney (2008) contended that if DI were implemented on a consistent basis, students would improve academic performance and achievement. Diverse learners, with an array of academic levels and experiential backgrounds, make up most science classrooms in the study site. This diversity makes it arduous to address the academic demands of every learner with one

teaching strategy. During the years of failed AYP, educators made efforts to enhance science instruction, and science teachers implemented DI on an individual basis. However, no overall school strategy for DI was used. Anecdotally, the evidence suggested that lack of training and fear of the unknown prevented teachers from adopting DI more extensively.

The total enrollment of students at the school for the 2011–2012 school year was 566. Of these students, 88% were economically disadvantaged and qualified to receive a free/reduced price lunch. Twenty-four percent had a disability, and 6% qualified as English language learners. Within the school, students ranged in academic ability from gifted to special service students. Teachers in this study participated in at least one workshop or instructional training on DI annually for 3 years or more. Therefore, the teachers who met this criterion had the capability to participate in the study.

Definition of Terms

The terms used in this study have many interpretations; however, for this study, the following definitions apply.

Adequate yearly progress (AYP): A stipulation in NCLB that requires schools to demonstrate an annual increase in student achievement (GADOE, 2009).

Anchor activities: Activities that students work on when they finish assigned classwork or have down time (Gregory & Chapman, 2006; Walpole & McKenna, 2007).

Differentiated instruction (DI), differentiation: Terms used interchangeably to describe the process teachers use to improve learning by tailoring instruction and assessment to learners' individual needs, in order to increase students' progress by

meeting and assisting learners on their level (Sprenger, 2008; Tomlinson, 2001, 2004a, 2004b). Useful implementation of DI in classrooms demands following the differentiated instructional process through use of tools and strategies such as classroom climate, learner variances, adjusting assignments, instructional ideas, and curriculum methods (Gregory & Chapman, 2006).

Flexible grouping: An educational method that acknowledges discrete differences by using various grouping strategies. The method matches learners with tasks based on comparable interests, readiness levels, or particular skills (Bundoc, 2007; Tomlinson, 2001).

Jigsaw: A cooperative learning technique that enables students to become experts on a given topic once they participate in a home group (Souvignier & Kronenberger, 2007).

Multiple intelligences: Different cognitive abilities that help students connect learning with the real world (Gardner, 1993).

Regular education teachers: Teachers who are expert in a content area such as math, social studies, science, or English (GADOE, 2009).

Special service teachers: Teachers who are trained to work with students with learning disabilities or behavior disabilities (GADOE, 2009).

Teacher training: Policies and procedures designed to equip someone to become a teacher with the necessary knowledge, attitudes, behaviors, and skills required to perform tasks successfully in classrooms, schools, and communities (Harris & Sass, 2011).

Tiered activities: A pedagogical method that offers tasks on multiple complex levels (Tomlinson, 2010; Tomlinson & Edison, 2003).

Zone of proximal development (ZPD): Area existing between what learners can accomplish alone and what they can accomplish with assistance (Vygotsky, 1978, 1934/1987).

Assumptions and Limitations

Assumptions

The main assumption was that the research participants were using their training in DI strategies in the classroom. This idea was based on my familiarity with the teachers selected to take part in the study and previous informal discussions relating to the use of DI. Another assumption was that the information provided by participants during the interviews was an accurate and truthful account of their perceptions of using DI in the classroom. For the reason that the teachers and I were acquaintances and colleagues, it was important that teachers were candid and accurate in their responses to the interview questions. Efforts to ensure accuracy included guaranteeing that my dual role as the study investigator as well as a teacher at the study site would not influence the research outcomes. Finally, this study added to the body of literature on understanding DI and its usefulness for improving teacher success in the classroom.

Limitations

Some limitations to this study were present. First, the participants in the study worked together and knew each other for 3 or more years. Therefore, teacher discussions and exposure to DI training could have had an impact on their perceptions. Second, this

study included an examination of a small sample of participants, but the in-depth semistructured interview process allowed thorough responses to emerge. Third, the school district was predominantly made up of African American, low-income students, representing one of the lowest performing schools in the district. As a result, the generalizability of the study was limited to other similar schools in the districts. Finally, the focus of the study was not on the quality of differentiation but on the teachers' perceptions of DI. Teachers could perceive differentiation as a simple process but might not understand the difficulty of DI in a more diverse setting.

A limitation of the study was that, due to preexisting knowledge of and familiarity with the research participants, achievement of 100% objectivity might not be possible. On the other hand, my own experiences as a teacher were likely to represent a strength in relation to the study, enabling me to identify the types of issues and classroom learning situations that need to be investigated and to quickly gain a good grasp of points being made by the research participants.

Scope and Delimitations

Scope

The scope of this study included a small sample of science teachers in Grades 6–8 at a rural middle school in Georgia. The study did not include other middle school teachers or students in the district. No other teaching or management staff participated in the study. The results are available to other practitioners and researchers, though the study's direct applicability to all teachers teaching science in Georgia and beyond its borders is limited. However, as in the case of most qualitative research, it was impossible

for the findings to generalize to other teachers at the study site or to teachers or schools in other locations.

Delimitations

The delimitations of this study involved additional reduction of the scope in relation to the time involved, resources allocated, and location of the study. One of the delimitations was that the participants in the study were science teachers at a middle school in a rural area. A second delimitation was the period in which the data collection process occurred, within one 9-week grading period. Third, given that I was the sole investigator, to limit time and expenses, the study took place at the school where I worked. Finally, the study portrayed the perceptions and practices of teachers who faced similar situations but had different teaching experiences, attitudes, and characteristics.

Significance of the Study

The emphasis on standards-based instruction leaves little time for teachers to provide relevant instruction to engage and motivate students (Luft, Brown, & Sutherin, 2007). To fulfill NCLB obligations, school administrators focus on improving teacher instruction by concentrating on the diverse needs of learners. The phenomenological method was most effective to examine teachers' perceptions and practices of implementing DI and the perceived benefits and weaknesses that enabled teachers to support or reject the method. More generally, the study broadened the understanding of how teachers use DI to influence instructional practices. The findings were of particular importance for the school and its teachers in this study. The findings provided valuable feedback on using DI within science education in the school.

Implications for Social Change

In this study, I proposed to promote positive social change by creating a better understanding of implementing DI, by identifying its benefits and drawbacks as well as strategies used to implement DI in the classroom. Moreover, the social implications developed from the findings include improvement of pedagogical strategies that promote student engagement and motivation for learning to empower students to succeed through the grades. Success in school, in turn, empowers students to graduate from high school prepared for advanced learning that leads to productive careers and ultimately thriving lifestyles. In addition, results from this study provided other educators some tools and insights into navigating DI in all content-area classrooms. Moreover, the teachers were able to use alternate methods to provide instruction that (a) served a larger diversity of students at one time, (b) provided instruction at the level of understanding for each student, and (c) enabled teachers to feel less stressed about working outside their comfort zone. I attempted to preserve the mission of Walden University by extending the field of learning awareness and ultimately helping to bring about beneficial changes. Walden University's (2006) motto is "that ideas and actions are applied to facilitate individuality to advance learning throughout the community" (p. 4). This beneficial change could result in a better society.

Summary

In this study, I investigated the firsthand experiences of a group of science teachers using DI at a school in rural Georgia. The findings revealed teachers' perceived benefits and difficulties of using DI, to make recommendations for best practice guidance

and other support in the use of this instructional method. In this way, the findings contributed to the future success of educational reforms necessary for the improvement of American students' educational endeavors, ensuring students are prepared more adequately for modern-day life situations.

Section 2 provides the findings of a thorough literature review of DI and associated issues. Section 3 provides the methodology, including the collection of data and the data analysis techniques applied in the study. Section 4 provides the results of the study. Finally, Section 5 provides a summary of the study, the findings, and a discussion of the wider significance of the study. Recommendations for future study on the application of DI also are included in Section 5.

Section 2: Literature Review

Overview

This section provides an overview of the relevant literature on DI, based on science modification in the United States. First, the literature review draws on existing findings that highlight the need for improvements in science education in the nation and explains why the adoption of new approaches to teaching is so important in this context. I used findings of previous research to discuss the meaning of DI, explain relevant learning theories that led to the development of the DI approach, discuss the ways in which DI applies in practice, and identify what previous researchers stated about the effectiveness of DI.

In order to locate relevant material for the review of literature, many database searches occurred at Galileo, Walden University, Macon State College, and Fort Valley State University, using Academic Search Premiere, Galileo, and EBSCOhost. Descriptors such as *differentiated instruction*, *science achievement*, teacher perceptions, math achievement, differentiated, qualitative study, and *best practices pedagogy* produced literature published between 2005 and 2013. The search topics were useful, based on their connectivity to the study to present the reader with a variety of viewpoints in considering the use of DI and science achievement.

RQ1: What are the reported experiences of science teachers, annually trained in DI strategies, regarding their implementation of DI strategies at a rural southeast Georgia middle school?

RQ2: What strengths and difficulties do science teachers, trained in DI strategies, report regarding their implementation of DI and what do they say they do to address identified difficulties?

The Need for Science Education Reform

Educators in American public schools face grave challenges. The lack of alignment to standards and the time needed by teachers to adapt materials are barriers that led to teacher resistance in implementing games in instruction during the NCLB reform (Deubel, 2002, 2009). The United States lags behind other countries in academic achievements, especially in the area of science education (Hersh, 2009).

In a major effort to improve education in America, President George W. Bush signed NCLB into law in 2001 (Mayers, 2006). NCLB mandated each state to ensure that all of its children receive educational instruction, enabling them to succeed academically. NCLB required educators in school districts to establish systems to measure students' yearly progress. Educators in schools are required to show firm evidence that their educational practices enable every student to improve academically, and to measure their progress and achievement annually (GADOE, 2009). Federal legislation has authorized states to provide standards in every content area to show that all students have achieved AYP goals (GADOE, 2009). In the area of science education, many states have arranged and modified standards to match the National Science Education Standards (Johnson, 2006).

The Trends in International Mathematics and Science Study (TIMSS) offers consistent and timely data on the mathematics and science achievement of U.S. students

in Grades 4 and 8 in comparison to the achievement of students in other countries. Data from the TIMSS study from 1995, 1999, 2003, 2007, and 2011 showed that students in Georgia are behind in science and math. The 2007 TIMSS is the fourth comparison of mathematics and science achievement evaluated since 1995 by the International Association for the Evaluation of Educational Achievement, an international organization of national research institutions and government research agencies (Mullis et al., 2012). In 2007, 36 countries participated at Grade 4 and 48 countries at Grade 8 (Mullis et. al).

Despite efforts to make improvements in academic performance through NCLB and other educational reforms, the gains were very limited in 2003 and 2004. Results from the TIMSS and the NAEP indicated that the performance levels of U.S. science students were not meeting international standards (Schmidt, 2008; Wang & Zhu, 2003). However, the United States leads the world in hands-on science improvement (Livingston, 2006).

In the NAEP science exams, Grade 4 students were the only age group found to have made any progress (Wenglinsky & Silverstein, 2007). The progress of eighth grade students remained stagnant, while Grade 12 student progress declined over time (Livingston, 2006; Schmidt, 2008). In 2005, the average score for Grade 8 students in Georgia was 144 out of a possible 300. Similar to the scores from 1996 and 2000, students in Georgia scored lower than students across the nation, with a score of 147 (Schmidt, 2008). A mere 25% of students in Georgia performed at or above the NAEP mediocre level in 2005. This percentage was no different from 2000 when 23% passed.

The image of the American educational system that developed from the statistics is that the United States lacks a balanced and meticulous science curriculum that is appropriate for all students (Schmidt, McKnight, Cogan, Jakwerth, & Houang, 1999). This statistic seemed inevitable, given that science teachers in approximately 16,000 school districts implemented their own science curricula and required resources to meet the respective state standard (Schmidt et al., 1999; Valverde, Bianchi, Wolfe, Schmidt, & Houang, 2003). Moreover, the collection of subjects taught at certain grade levels in the United States is what the district, state, or teachers deem important.

New Approaches to Teaching Science

Various factors contribute to the problem of unsatisfactory science scores in the United States, among which are failures to address different learning styles (or multiple intelligences), poor reading comprehension skills, and emotional conditions (Sternberg, 2006). Problems relating to the educational system itself and the teaching methods employed are evident. The educational system in use in the early 1900's served an industrial population in America. The dominant teaching method includes students as passive recipients of information. Such a method is unlikely to equip students to succeed in a knowledge- and skills-based economy (McCoy & Radar, 2007; Yatvin, 2004). Teachers need to empower students to work collaboratively, to make their own decisions, to sort through information for meaning, and to apply complex concepts in daily life situations.

In response, educators and policymakers are turning to new pedagogical strategies intended to ensure mastery of learning for all students (Brann, Gray, Piety, & Silver-

Pacuilla, 2010; Guilfoyle, 2006) and to generate the types of skills needed for life in the 21st century. The pedagogical changes are making gradual improvements to the educational setting (Corley, 2005). However, there is no real consensus as to which educational approaches work best. Theories about how learning occurs, and the most appropriate content and pedagogical strategies to maximize learning, were issues of debate in the educational arena for years (Burton, 2000). Educators have reexamined pedagogical strategies over time, while changing curricula and assessment techniques (Brooks, 2004), but developments have been gradual, and there has been no agreement among educators about how to create quality Grade K–12 education in a world dominated by science and technology (Hersh, 2009; Trefil & O'Brien-Trefil, 2009).

Within this context, schools and teachers all over the United States face the challenge of determining which instructional approaches to employ for the benefit of every learner in all areas of the curriculum. Teachers struggle to implement classroom practices that support their ideas on helpful teaching, while they try to equip students with the knowledge necessary to pass state tests (Brighton, 2002). After trying DI practices, teachers abandoned the use of DI for test practices. Teachers are also facing unprecedented challenges of educating an increasingly diverse student population with wide-ranging learning abilities and needs (Beecher & Sweeney, 2008; Johnson, 2006).

Teaching practices are fundamental to improving academic performance in the United States; research proves there is a correlation between science achievement, teacher preparation, and instructional strategies (Wenglinsky & Silverstein, 2007). Instructional materials, instructional practices, and the classroom environment must

promote a learning sequence that allows sufficient time for students to explore concepts in depth, to build conceptual understanding, and to represent their understanding in various formats (Bybee & Van Scotter, 2007).

Teaching methods that are proven effective are best practices (K. M. Anderson, 2007; Daniels & Bizar, 2005). The use of best practices in teaching allows meaningful ways for students to explore content and excel in their learning and academic performance. For example, the provision of positive feedback by teachers is a form of educational best practice that engages learners' learning styles and helps guide the learning process (Daniels & Bizar, 2005). Other examples of best practice in science education relate to methods of questioning students and responding to students' answers in the classroom. Adjusting questions is a technique used in education settings in elementary, middle, and secondary schools. The teacher introduces a situation that involves the agenda and learning objectives. These objectives require the synthesis of ideas.

Findings by R. D. Anderson (2002) and Aikenhead (2006) indicated that questioning techniques increased student achievement more than traditional instruction. Brooks (2004) and Colburn (2004) contended that teachers should ask questions that encourage further investigation in order to promote learning. In traditional classrooms, teachers accept one-word answers and do not require elaboration or group feedback. Instead of asking students to name Newton's laws of motion, teachers should aim to assess conceptual understanding by asking for examples and explanations of each law. Teachers can convey that many acceptable answers are available for one question rather

than just *yes* and *no* answers. For example, teachers can use comments or questions such as "I did not think of it that way," "How did you arrive at that conclusion?" or "That is creative; can you explain further?" This type of positive feedback and exploration of students' understanding creates a nurturing and safe environment that assures the students that their own independent thinking is encouraged. In addition, this type of feedback from the teacher removes the student's fear of making mistakes (Brooks, 2004).

In accordance with findings by B. Clark (2002) and Koch (2009), children acquire knowledge more expeditiously when learning activities relate to everyday experiences. The National Science Education Standards call for educational pedagogy that promotes students to own their learning and to concentrate on meaningful, real-life situations via student-centered and inquiry-based experiences (Johnson, 2006, p. 150). Daniels and Bizar (2005) argued that by constructing tasks that provide opportunities for learners to choose and communicate independently, students have an improved chance to achieve academically. Educators have begun to stress that education should allow children to learn by following their interests (Yatvin, 2004). Moreover, an increasing amount of research indicates that the provision of a variety of opportunities and methods of learning is one best practice approach to increasing student achievement (Tomlinson, 2003, 2006).

In other countries, the approach to science education is different from that used in the United States. Roth et al. (2006) examined instructional procedures in Australia, the Czech Republic, Japan, the Netherlands, and the United States. The 1999 TIMSS assessment results showed that four countries outperformed the United States in science. It was determined that although many of the instructional strategies were similar in all

five countries, there were two main distinctions between the United States and the other countries: The advanced countries had their own definite plan for teaching science, while the United States used a variety of different approaches. Second, each of the more advanced countries used an approach that included methods for engaging learners with only science concepts. In the United States, content was found to play a diminished role or no role at all (Roth et al., 2006; Roth & Garnier, 2007), with lessons instead centered on engaging students in a variety of activities (Roth & Garnier, 2007, p. 16). To date, there is little evidence that the approaches to science education are having a positive impact on academic performance in the United States. In other words, these approaches do not represent best practice (Johnson, 2006).

Differentiated Instruction

Overview and History

The justification for a different educational paradigm in the United States relates to numerous factors, including a growing diversity within the student population and research about multiple intelligences and psychology. The approach that has emerged with the most potential for improving academic performance levels is DI (Yatvin, 2004). Many leading education researchers have expressed the expectation that DI could enable teachers to improve student academic performance in all content areas (Darling-Hammond & Brandsford, 2006; Gredler, 2005). DI is regarded as a teaching method with the possibility of meeting NCLB expectations (Tomlinson, 2008) by enticing learners with many learning modules on different levels (Rock et al., 2008; Tomlinson, 2008).

In previous years, there have been concerted attempts in the United States to provide instruction that was modified to the learning needs of different groups of students (Yatvin, 2004). True DI, however, originated in the 1960s on a small scale, with practices such as shorter spelling lists, homework projects with extra credit, projects with varying difficulty levels, and fun activities, including puzzles "for students with different levels of academic ability" (Yatvin, 2004, p. 7). With the modification of curriculum, legislations such as the Individuals with Disabilities Education Act (2004), and the addition of inclusionary practices, educators began to adapt and adopt instructional methods to aid with teaching diverse learners. Educators, teachers, and parents began to understand that children's abilities and interests develop at different times and in different directions. By the 1980s, new educational theories, such as social and cognitive learning theories and MI theories, were influencing policies of curriculum and instruction and contributing to the increased adoption of DI (Bredo, 2000; Cosentino, 2012; Hall, 2002).

Research Supporting Differentiated Instruction

In DI, teachers observe the needs of individual students and recognize that effective learning begins at the student's academic stage of ability and provides challenges for learning to develop (Tomlinson, 2006). Differentiation occurs when teachers acknowledge that in order for effective learning to transpire, a strategy that enhances the potential of all students at their place of academic learning and promote academic growth must be employed (Fahey, 2000; McTighe & Brown, 2005). DI is not individualized instruction; rather, it emphasizes learning from the student's viewpoint

(Rock et al., 2008). DI is a strategy that many teachers already execute to ensure that all learners are successful academically.

Teachers who utilize differentiation thus realize that learners differ in important ways and that they need teaching methods that are on the readiness or interest level of the students to help them become engaged in effective learning. To differentiate instruction is to recognize and accommodate learners on their own academic levels (Hall, 2002). When using DI, teachers vary instruction and let students select their learning style while completing tasks. The method involves modifying the pace, kinds of instruction, and tasks, meeting each student's academic needs by using methods like cooperative learning, flexible groups, and tiering (Erwin, 2004; Tomlinson, 2006, 2009). Differentiation provides all students with the chance to perform and to develop their own strengths (George, 2005; Tomlinson, 2001; Walpole & McKenna, 2007). When using DI, teachers improve learning by balancing instruction with students' characteristics to create assessments that are challenging and appropriate for the students. The advantage of the DI method is that it gives every student access to similar lessons by tailoring delivery to the students' needs (Hall et al., 2003; Lawrence-Brown, 2004). Whole-group and small-group lessons are used when appropriate, while accommodations to the lesson are made by providing for different learning styles (Ghazi, Shahzada, Gilani, Shabbir, & Rashid, 2011; Lawrence-Brown, 2004).

Theoretical Basis for Differentiated Instruction

The theoretical basis for DI lies mainly in Gardner's (2006) MI theory and Vygotsky's (1978) ZPD theory. When teachers apply these theories in combination to

develop instructional methodologies, the result is likely to be DI. The ensuing topics delve more deeply into the theories that guided this study.

Multiple Intelligences Theory

The MI theory, introduced by Gardner in 1983, supports the use of DI as a way of drawing on students' strengths. Although originally created to improve understanding of brain-damaged students, teachers who use MI are able to determine the mental, physical, and social strengths of all students (Gardner, 1993, 2006). The theory subsequently developed the principles, format, and constituent elements of DI (Tomlinson & Allan, 2000). MI theory argues that it is important to portray a person's talent in terms of individual cognitive capacities (Moran, Kornhaber, & Gardner, 2006). The MI theory has a foundation for students to learn content and demonstrate how they learned the material (Armstrong, 2001, 2009; Gardner, 2006). Using MI theory, teachers can give assignments that allow the students to draw heavily on the form of intelligence that causes learning to be most meaningful for them and easily understood.

Vygotsky's Zone of Proximal Development Theory

DI is a collection of learning theories and instructional practices. Vygotsky's cognitive approach to learning supports DI (Dodge, 2009; Tomlinson & Allan, 2000). The ZPD is the area between what learners accomplish on their own and what they accomplish with assistance (Vygotsky, 1978, 1934/1987). ZPD is the area where learning occurs. The goal of the instructor is to give instructions to learners on their level of understanding. Specifically, instruction should occur between the lower threshold of development and the upper threshold represented by the problems the child can complete

with assistance (Vygotsky, 1934/1987). According to Tomlinson and Allan (2000) and Tomlinson (2010), ZPD supports DI because it highlights the importance of the role of the teacher pushing the child into the ZPD, coaching for success so the learner can manage alone, and promoting independent thinking. The teacher is responsible for each student's ZPD (Tomlinson, 2006) by means of an instructional strategy called *scaffolding* in which the teacher develops tasks to build on prior knowledge.

The Differentiated Classroom

Tomlinson (2001, 2006) contended that a differentiated classroom is proactive and student centered. A DI classroom promotes challenging activities, and struggling students normally get extra support to help them develop skills that enable them to do tasks independently. Typically, differentiated classroom instruction addresses comprehension of concepts instead of the material covered. Different grouping styles are paramount, and formative assessments of student readiness and comprehension level are part of the curriculum. Teachers regard themselves as facilitators and students as explorers. Students set goals and assessments for themselves, based on their own level of development (VanSciver, 2005). The teacher plans positive hands-on instruction that enables learners to become interested and engaged in the lesson. Children are the center of all decision making in the classroom.

Tomlinson (2004a, 2009) observed that a differentiated classroom blends different types of group instruction and is organic. Sometimes it is more effective to have small-group instruction, individual instruction, or whole-class instruction, depending on the task. For instance, a lesson could begin as a whole-group lesson, break down into small

groups, or individuals could work alone. In this way, classroom diversity is an asset as it allows for the contribution of multiple perspectives, multiple ideas, and different ways to find solutions to problems. The key characteristics of DI identified by Tomlinson (1995) include the following: "(a) plan with hands-on activities; (b) value learning; (c) built on evaluation; (d) use assorted methods to deliver the lesson; and (e) vary instruction" (p. 5).

The instructor's duty in a DI classroom is to offer rigorous instruction and challenging activities that focus on significant learning. The teacher must know what is important in the subject matter and be knowledgeable and creative when dealing with differences in students. In addition, the teacher must adjust the presentation of the lesson to relate to the students' readiness levels and interests. Rubrics displayed and group work are the focus of learning rather than the teacher's lectures. Formative assessments record the progress of the students along with the goals and the assignments (Tomlinson, 2005).

Chang (1996) and Rock et al. (2008) identified several methods of DI: (a) hands-on activities, (b) cooperative group, and (c) technology. As Rock et al. explained, the particular importance of integrating technology into learning "is a way to differentiate instruction for a child's learning situations, and the combination of technology makes it meaningful and creative for students in an active learning environment" (as cited in Chang, 1996, p. 39).

Unlike the traditional educational setting, in DI, the students and teacher are collaborators in the learning process. Some characteristics of DI are more student-focused than others. Learners decide how they want to learn. Students have the opportunity to select topics to study in depth and engage actively in their own learning. Students learn

best when they make connections between the curriculum and their interests or life experiences (Landrum & McDuffie, 2010; Levine, 2003; McAdamis, 2001; Tomlinson, 2004b). In differentiated classrooms, children are engaged in an environment in which they perform the same activities as children in a nondifferentiated classroom. However, in differentiated classrooms, students have options guided by their interests and readiness for a particular task (Tobin & McInnes, 2007).

Central to DI is the flexibility to draw on different methods and techniques in order to acknowledge the needs of individual learners and different learning situations. There is no single correct way to apply DI. Educational researchers generally concur that applying many methods for student engagement and success is the key to promoting student achievement (Gregory & Hammerman, 2008). Research has revealed that teachers who regularly use a range of teaching and organizational strategies throughout the classroom are more likely to connect what needs to be learned with more students who need to learn the content (Tomlinson, 2006). What is common to most DI techniques, though, is the use of manipulatives to offer children real-life learning experiences. Meaningful activities foster true understanding without useless memorization of facts and names (Gregory & Hammerman, 2008).

Within science education, lessons are differentiated to permit students to discover areas of interest, expand research skills, and obtain instruction on separate science and inquiry skills (Gregory & Hammerman, 2008). Science students, it is argued, should have multiple and varied opportunities to collect, sort, categorize, observe, use science tools and instruments, and take notes to perform a task (Dodge, 2009; Gregory & Hammerman,

2008; Haurv, 2002). Hands-on activities help develop science process skills and promote achievement of learning, which involves applying the knowledge to everyday situations.

A wide range of DI strategies is available for application in the science classroom. Many of these strategies are effective as teachers practice DI. These strategies draw on the key findings of relevant empirical research regarding their use.

Differentiated Instructional Strategies

A number of researchers have investigated teachers' actual use of various DI strategies and techniques. For example, in a 1-year study in a California school district, the classroom inclusion practices of five teachers from two middle schools were examined (Carolan & Guinn, 2007). The teachers were observed and interviewed about their beliefs and routines. In this example of DI, the factors found to be common to differentiated classrooms were that the teachers (a) offered personalized scaffolding, (b) used flexible groups, (c) designed classrooms in which differences existed, and (d) had relevant expertise.

Tiered Activities

Teachers acknowledge the academic potential of learners by applying tiered activities. Tiered activities can work with any concept teachers teach or reinforce. The benefit of this method is that the whole class masters the same topic, but individuals choose activities on their level with the teacher's assistance (Brimijoin, 2005; Garnett, 2010; Willard-Holt, 2003). Tiering starts with a heterogeneous, whole-group lesson. Smaller groups are formed based on interest. The unit is tiered through assignments, materials, or assessments that reflect the student's ability level (Levy, 2008).

Teachers tier assignments by making small adjustments to teaching content within the same lesson in order to challenge students appropriately, according to their level of ability. Forsten, Grant, and Hollas (2002) and Rock et al. (2008) recommended that before starting to tier activities at the conclusion of the lesson, the key ideas and skills all learners should understand must be identified. Then teachers should choose reading materials matched to the learners' reading levels on the same topic.

Tiered activities focus on preparing students for different levels of difficulty of a task within the same lesson topic (King-Shaver, 2008; Kobelin, 2009; Tomlinson, 2001). This form of DI mainly assigns tasks at the learner's level and acknowledges student interest (Tomlinson, 1999, 2009). These tasks comprise investigations that are suitable for learners and take into account their prior knowledge (Tomlinson, 2001, 2008). The modification of activities in this way aids in understanding of the concept taught while ensuring that every student is challenged (King-Shaver, 2008; Tomlinson, 1999; Tomlinson & Edison, 2003). Writing in content areas is beneficial and can take the form of tiered assignments. For instance, in an earth science class, learners operating below grade level may write about places using the latitude lines as references, while students on grade level might write about places without using latitude lines (Tomlinson & Edison, 2003).

A number of researchers have investigated the use of tiered activities in the classroom. Tobin and McInnes (2008), for example, investigated the DI strategies of two teachers in one school district. Both teachers were experienced, imaginative teachers who went beyond the call of duty for their students and were accommodating, especially to

special needs students. After reading a book, "Margot's" students were offered choices about how they would respond to text. Margot used tiered activities and created methods to restrict below-grade-level readers to making responses, which related closely to the text. Students completed individualized questions to guide them in completing the assignments with the appropriate complexity level. Margot provided clear scaffolding directions and monitored the students' understanding of the products. Moreover, she facilitated their answers to many choices, taking account of their appropriate levels (Tobin & McInnes, 2007).

Other studies have contributed to an increased understanding of how tiered activities can apply most effectively in the classroom, but have also revealed outstanding gaps in understanding. For example, Brimijoin (2005) conducted a case study of a fifth-grade classroom in which the teacher developed assignments at various tiers to challenge all students as well as a task for all students based on key learning goals that met the range of learning needs for the entire class. Brimijoin concluded that in using tiered assignments, varying journal prompts for each tier helped to solicit student responses if the questions were adjusted to students' ability levels.

Stager (2007) observed the productiveness of DI on tiered activities in improving student learning using fractions. Students in homogeneous groups received instruction, then completed activities on their level in the groups. Every student made important gains, according to the test results, but not all students mastered the concept. Stager concluded that more study is necessary to understand how DI can assist mastery learning by all students.

Flexible Groups

In DI classrooms, learners need practice in engaging mutually to learn in group situations. Flexible groups apply when assessments identify a group of learners having comparable needs, interests, or preferences (Heacox, 2003; van Garderen & Whittaker, 2006). This DI method grants teachers the opportunity to match children by their readiness level (Tomlinson, 2004a, 2004b, 2010). In addition, it allows learners to interact with different peers in different groups. In flexible grouping, the composition of groups varies depending on the specific learning objective and activity. Teachers assign students to groups based on certain characteristics to complete a lab or tasks in which learners must collaborate to finish an assignment. Groups might be organized, for example, by task, motivational level, interest, learning style, ability level, or randomly (Gregory & Hammerman, 2008; Tomlinson, 2004a, 2004b, 2006). Typically, each member of a group has a role. For example, a student who writes well might become the recorder, while a good speaker may present the group results to the class (K. M. Anderson, 2007; Willard-Holt, 2003). Teachers who utilize flexible grouping use different organizational methods for instruction. For example, a middle school physical science class might illustrate and describe the movement of particles in solids, liquids, and gases. In group work, the students may write a story depicting the movement of particles in one of the states of matter.

Castle, Deniz, Baker, and Tortora (2005) examined the impact of flexible grouping on student learning over a 5-year period. Their results demonstrated that the percentage of students maintaining mastery increased from 10% to 57%. The teachers in

the study credited the use of flexible grouping on learning to (a) focused lessons related to learning needs, (b) the ability to keep the students attentive, and (c) improved student confidence. The conclusions supported the application of flexible grouping to increase student learning without the harmful effects of ability grouping (Castle et al., 2005).

Jigsaw

Jigsaw is a type of peer learning normally used in the context of cooperative learning. Cooperative learning is a strategy in which peers acquire knowledge and skills through active learning and support to improve their understanding of a subject (Topping, 2005). Educators generally concur that cooperative learning is the most effective way to teach math and science (Prince, 2004; Souvignier & Kronenberger, 2007). Within cooperative learning, jigsaw is a technique whereby instruction can be differentiated, allowing students to be introduced to new material and to maintain responsibility for the concept according to their ability levels. In this technique, the class forms groups known as *home groups* and each member receives a subtopic. Next, each home group divides into research groups in which students become experts on a part of the overall topic. Later, they return to the home group with information to share with that group (Gregory & Chapman, 2006). Slavin, Hurley, and Chamberlain (2003) theorized that cooperative learning is an effective instructional strategy because the responsibility for learning is borne by teams of students and not just the teacher. Moreover, this gives the teacher more time to assist individual students and small groups of students.

Souvignier and Kronenberger (2007) examined the effects of the cooperative learning method jigsaw on elementary students. Nine third-grade classes from three

elementary schools made up three divisions: standard jigsaw, jigsaw with extra questioning training, and teacher-guided instruction. Three math results and one science result provided the data for analysis. In Math 1, the results were similar to each other in all three groups, while in Math 2, the teacher-guided group performed better than the jigsaw groups. The Math 3 results demonstrated that the jigsaw group with questioning outperformed the teacher-guided and standard jigsaw groups. In science, the results revealed that the students benefited from more teacher-guided instruction. Achievement gains were small using jigsaw methods because the teachers could not intervene with the groups; thus, the authors concluded that restricting the role of the teacher was a disadvantage when using the jigsaw method. They recommended that teachers attend to all groups and not allow the students to work alone (Souvignier & Kronenberger, 2007).

Anchor Activities

Anchor activities are review activities of past concepts that are carried out independently when students complete assignments early. Anchor activities occur when students can complete the assignments with little or no supervision, such as journal writing, which provides time for the teacher to work directly with other students (Tomlinson, 2004a, 2004b). Teachers use anchor activities to deal with *ragged time*, when students finish assignments at different times, to tutor individual students, and offer ongoing activities that relate to the topic studied.

In a study by Tomlinson (1995), an elementary teacher employed a differentiated unit studying the concept of extinction as an anchor activity. The class explored two meanings of extinction: extinction from natural causes, and extinction from fabricated

changes to the environment. One group of students used dinosaurs to examine extinction and the other group compared dinosaur extinction to rain forest depletion. The dinosaur group's task was less complex and focused on one element, while the rain forest group's task was more abstract and focused on many elements. Both groups demonstrated a comprehension of extinction but arrived at the understanding through different ways.

Brimijoin (2005) studied the use of anchor activities in a Grade 5 science classroom. The teacher-selected activities were intended to reinforce or enrich content knowledge while the teacher worked with other students, and students had to be accountable for their own work. The results showed that 74% of the Grade 5 students passed their science assessment when anchor activities were a part of the instructional presentation (Brimijoin, 2005).

Impact on Student Achievement

A number of empirical research studies have demonstrated that DI influences academic achievement in practice (Dodge, 2009; Tomlinson & Jarvis, 2006). In general, researchers identified favorable practices of DI that enhanced student learning progress (e.g., Christensen, 2007). The nature of the research questions that were the focus of these studies has often required the use of quantitative methods, although some mixed-method studies combined quantitative measurements of the impact of DI on achievement with data generated from in-depth teacher interviews.

In a research study by Connor, Morrison, and Katch (2004) and a follow-up study by Connor, Morrison, Fishman, Schatschneider, and Underwood (2007), the researchers connected teachers' pedagogical methods to learners' achievement. Instruction was either

explicit or implicit and tabulated as either teacher- or child-centered. Growth was evident for the students who were below level on their vocabulary skills when explicit instruction occurred, and growth increased for those who started the year with advanced skills when implicit instruction was the method used. The results revealed that students learned more when the strategies were in accordance with the students' needs. In another study, Connor, Morrison, and Petrella (2004) investigated the correlation of instruction and achievement of third graders, and found evidence that DI was more effective in promoting learning than one-size-fits-all instruction.

A number of other studies have revealed evidence of the effectiveness of DI in improving the academic performance of students. For example, the literature supports the effectiveness of DI as a method for students with learning disabilities. Tieso (2005) affirmed that students with learning issues who received DI displayed better achievement in mathematics than the students who received regular instruction. Baumgartner, Lipowski, and Rush (2003) noticed similar positive gains in reading among students with learning issues, in their study on an urban middle school's switch to DI methods. In a similar study, Cusumano and Mueller (2007) reported that the students in a school district in California displayed remarkable growth in reading and mathematics state assessments following a switch to a DI model. This change required the schools to reorganize grouping practices and reallocate fiscal resources. Moallem (2007) discovered that, based on teaching and pedagogical styles, a student's desire to learn depend on the circumstances and the content delivery, a finding that further supports the use of DI.

Empirical research has also revealed, however, that despite the strong theoretical justification for DI, its use is limited and that, where used, its potential for improving academic performance is limited. For example, a study by Westberg, Archambault, Dobyns, and Slavin (1993) revealed that teachers did not use DI often, if DI occurred. Ten years later, Westberg and Daoust (2003) stated matching conclusions that teachers were not employing DI in the middle school educational setting to any degree. Bundoc (2007) revealed that the present manner in which DI occurs is not perfect. Additionally, Lee and Olszewski-Kubilius (2006) observed that DI was applied in advanced placement courses. Even when DI was the instructional model, teachers relied solely on the textbook that was adopted for instruction. Overall, however, empirical research on the use of DI is limited, and there are significant information gaps in this area.

Student and Teacher Results of Differentiated Instruction

Various studies have investigated the results and perceptions of using DI from the perspectives of teachers and students, using both quantitative and qualitative methods. In a study by Drain (2008), the frequency of teacher use of DI strategies was infrequent: once per month for the first two subgroups of activities studied and a few times a month for the third subgroup. No significant demographic difference was evident between teachers who applied DI methods and those who did not. When they examined the specific strategies used by these teachers, the researchers found that unsupported strategies most often were present. These strategies were used equally frequently with gifted and nongifted students, demonstrating no differentiation on those strategies. The results of the study indicated that the teachers differentiated more often for gifted

students than for nongifted students, especially in terms of offering challenges, and in reading and written assignments. However, the differences were negligible. Even though the use of DI strategies in the aforementioned areas was significant, the frequency of differentiation was limited or performed only occasionally. Items in the *Challenge and Choice* and *Reading and Written Assignments* subgroups occurred once a month or less. Items in the *Curriculum Modifications* subgroup occurred occasionally. No differentiation strategies occurred more frequently than a few times per month.

Sondergeld and Schultz (2008) performed an in-school study on DI and science standards while teaching a 3-week unit about simple machines. The DI strategy used was tiering in a Grade 3 mixed-ability classroom that included 13 remedial reading or math students, two gifted students, and 11 average-ability students. The teachers reported that the process of differentiating lessons was laborious and involved more planning. However, a positive finding was that learning shifted from the teacher to the students and retention of content increased. The science teachers in the study suggested that in using DI, it was best to begin with a comfortable topic and with a small unit. The study involved only one DI strategy, in contrast to the present study, which examined the use of four DI strategies.

Mastropieri et al. (2006) performed a quantitative study with 13 Grade 8 science classes. The intervention took place over a 12-week period with student pretest and posttest and surveys concerning students' and teachers' attitudes regarding the use of DI. Teachers stated that they enjoyed using the DI materials because they felt them to be beneficial to all students, especially students who were struggling in science.

Pierce and Adams (2004) were concerned with changing teacher attitudes. They presented data from a study and discussed variables that correlate with teachers' attitudes toward academically diverse students. The study included two groups: (a) 95 tenured teachers from five schools participated in a Jacob K. Javits Gifted Programming grant, and (b) 85 preservice teachers participated in full-day Saturday workshops on using DI strategies. Results from the self-report Survey of Practices with Students of Varying Needs showed no significant differences between the responses of student teachers and qualified teachers.

The attitudes of both groups appeared to be moderately positive in that all of the teachers were involved, to some degree, with gifted education coursework or workshops. The predisposition of those who enrolled in such courses and workshops could define participants as a special group as opposed to a randomly selected group of preservice or in-service teachers. The most pertinent results from the study lie in the fact that teachers in gifted education and DI workshops reported positive attitudes about DI, thus supporting the idea that additional educational opportunities in DI correlated with academic success and DI (Friend, 2008; Rash & Miller, 2000; Rubenzer & Twaite, 1979; Starko & Schack, 1989).

A study by Stetson, Stetson, and Anderson (2007) that included 48 elementary educators was performed after teachers had studied Diane Heacox's book *Differentiating Instruction in the Regular Classroom: How to Reach and Teach All Learners, Grades 3–12* and subsequently experimented with using DI. The teachers differentiated their lessons based on learning styles and interests, and were asked to report on the greatest

benefits and biggest problems associated with DI. Insights that all teachers shared included the difficulties of finding creative tasks for all students. Overall, however, the teachers saw the benefits for the students as outweighing the challenges of using DI. Findings showed that the students demonstrated mastery learning when they had choices of how they wanted to learn.

In a study regarding teacher attitudes and learning by Netterville (2002), teachers were consistent in their views about the use of DI. All concurred that the obstacles to using DI included lack of time, development, and administrative support. Moreover, most of the teachers agreed that students need instruction on their own learning level and expressed the view that the use of DI could have an impact on academic performance. In summarizing their findings, the researchers reported that, according to the teachers in their studies, DI is an effective way to boost academic achievement in the learning environment and that for numerous students, this type of instruction is necessary.

Methodology

The educational arena has been busy with ideas on how to improve instruction for students' academic success. Science scores in America have been a concern since the 1970s (Holloway, 2000; Kroeger & Kouche, 2006). In this study, I examined teachers' results with the use of DI strategies in middle school science classrooms. Moreover, I collected data regarding teachers' perceptions of DI strategies, obstacles, and outcomes of the use of DI strategies on academic achievement in science classes. Although Mastropieri et al. (2006) performed a study with 13 Grade 8 science classes; they did not use Grades 6 and 7 science classes and did not reveal specific attitudes and experiences

regarding the use of DI. A quantitative approach was inappropriate because it required comparison through test scores with numerical data. The present study focused on the instructional approach of DI from the teachers' perspectives.

Phenomenology is one of five qualitative research approaches, including "case studies, ethnography, grounded theory and narrative" (Creswell, 2003, pp. 14–15). A phenomenological study uses a limited number of people for in-depth interviews and conversations, and observations to investigate and understand the experiences of the research participants. In addition, a phenomenological study examines how participants make sense of experiences from their own viewpoints (Creswell, 2007; Merriam, 2009). Qualitative methods, including in-depth interviews and observations, are strategies used to collect the data. The key task of phenomenology study is to explain ways in which people in specific surroundings understand, justify, and perform daily activities (Miles & Huberman, 1994). Moreover, this type of research calls for the data analysis written in words instead of numbers. A phenomenological approach explores the attitudes and events of people, and then relates the data collected to clarify the events. Surveys and lengthy interviews are typically the methods used to collect the data.

For this study, I investigated how science teachers perceived the use of DI in a heterogeneous classroom. A phenomenological design was used to uncover events and their meanings through lived occurrences (Creswell & Maietta, 2002). I did not use a case study or ethnographic study because these two methods would have been less effective in addressing the research questions. For instance, although a case study is interested in single individuals or communities such as science teachers (Creswell, 2007) and an

ethnography study investigates the understanding of an individual's lived experiences, these two methods concentrate on the sociocultural analysis of a specific group (Merriam, 2009). The focal point of the present study was teachers' perceptions of DI and the real-life application of DI procedures. In this way, the study generated data on teachers' perspectives of using DI strategies in the content area of middle school science, an area often neglected in previous research. Moreover, I gathered data on strategies used successfully in a middle school that had low science achievement and low motivation among students on three grade levels.

Barriers to the Adoption of Differentiated Instruction

In using DI, teachers become change agents in their classrooms (Beecher & Sweeney, 2008; Brighton, 2002). Implementing educational reforms occurred to empower teachers to have a major impact on academic performance levels in the United States. However, changing instructional practices is not easy (Drapeau, 2004; Johnson, 2006). There are number of specific barriers to the adoption of DI by teachers and schools, which becomes clear when reading the literature in this area.

As Gess-Newsome (2001) and K. M. Anderson (2007) emphasized, change requires choosing to give up familiar practices for new and uncertain practices. The change might also provoke resistance from parents of gifted students who are apprehensive because, after mastering grade-level content, some students shut down and no more learning occurs. Some educators and teachers view differentiation as an instructional strategy that has become another educational fad, and are therefore reluctant to invest time and effort into learning the new techniques.

There are also practical barriers to the adoption of DI. Teachers and educators are hesitant to employ these new methods because of lack of time, resources, and administrative support (Garnett, 2010; Hootstein, 1998). Kanevsky (2011) highlighted the fact that asking teachers to differentiate has many implications in terms of time, classroom management, and grading, which many schools and teachers are unable or reluctant to address. In particular, as Tomlinson (2001, 2004a, 2009) and Hall et al. (2003) pointed out, differentiation takes time, and it is necessary for teachers to be patient in implementing and using these strategies. The main issue with using DI, according to Corley (2005), is time. Corley mentioned the planning time needed to measure learners' readiness levels is vigorous due to the -organizing of questions and key concepts. Additionally, the teacher's role has changed. This is a difficult routine to change because teachers have become accustomed to being the givers of information, and in DI classrooms, teachers share the responsibility of learning with the students.

When using DI, teachers must also be highly sensitive to cultural and racial differences, which influence learning (Tomlinson, 2004a, 2009). Few teachers are able to incorporate instructional methods that allow students to draw from their personal experiences because doing so is a complex process. Therefore, the reluctance of some teachers to invest the time needed to become experts on the use of DI and to move from their traditional teaching comfort zone might represent significant barriers to the use of this teaching strategy.

Prerequisites for Successful Differentiated Instruction Implementation

Wenglinsky and Silverstein (2007) identified teacher training as the most essential step in improving science education in the United States, whether by workshops, staff development classes, or other training methods. One reason struggling learners do not perform well is ineffective instruction from teachers (Scherer, 2006). There is also a need for key stakeholders, including teachers, school administrators, and parents, to find a common ground for instruction and to support changes, which requires considerable time and effort (Moran et al., 2006).

Much knowledge is available about what ensures the success of DI by studying the findings of previous case study research. For example, Pettig (2000) conducted a 5-year study of teachers guided to restructure their classrooms to fit the needs, interests, and abilities of their students. Practices that were found to lead to success were collaboration among the teachers, alignment of objectives, use of preassessments, planned flexible groupings, encouragement of student responsibility, and provision of choice. Moreover, the findings indicated that with small, distinct steps and learning from their own mistakes, the teachers were able to differentiate their classrooms successfully. Pettig identified low-preparation differentiation activities for teachers and students who are beginning to be comfortable with differentiating instruction, and high-preparation activities for teachers and students who are comfortable and have experience with differentiation.

Contribution to the Literature

Much information exists about how to differentiate instruction and how DI affects a number of emotional patterns (e.g., K. Clark, 2010) and people's perceptions of DI (e.g., Goodnough, 2010). However, given the long-standing appeal of DI, there is limited research about the effectiveness of DI (Cosentino, 2012; Hall, 2002). Overall, the research evidence relating to DI is patchy. A strong theoretical basis for the DI approach is available, but there are considerable information gaps relating to its use in practice and little clear guidance on best practice in this area that can help to inform the content of teacher training courses and material. In particular, there have been relatively few in-depth qualitative studies of teachers' experiences of implementing DI in the classroom, and hardly any phenomenological studies. Phenomenological study is concerned with explaining the ways people in specific surroundings understand, justify, and perform their daily activities (Miles & Huberman, 1994).

Summary

In this section, I drew on a review of literature to explain why changes in instruction and, in particular, the application of DI were important to the success of the educational reforms that are now crucial for the United States, more specifically, the study site. This section provided a description of the conceptual basis of DI, its application in classrooms, and a summary of the key findings from empirical research to highlight the potential of DI and barriers to its extensive adoption in U.S. schools. The literature review demonstrated that although a considerable number of empirical studies investigated various aspects of DI, including the impact on student performance and

teacher perceptions of this teaching method, the literature in this area was limited overall and there were few in-depth qualitative studies on teachers' perceptions of DI, especially in the middle school context and in low-performing schools. The present study addressed this lack of research and information gap. Section 3 presents in more detail the research methods used in the study.

Section 3: Research Method

Introduction

Educators are accountable for improvements in student performance (Guilfoyle, 2006), especially because it is evident that America is trailing other countries in academic achievements, particularly in the area of science. The NAEP science exam displayed results that indicated that in most grade levels, the academic progress in science was stagnant or had declined (Wenglinsky & Silverstein, 2007).

The objective of this study was to investigate teachers' perceptions of using DI in science teaching in Georgia, to provide a clear understanding of the perceived benefits and weaknesses of this instructional method from the perspectives of the participants, and to identify any difficulties they experienced in the use of DI. Secondly, I examined teachers' awareness and perceptions of a number of specific DI techniques to help illuminate differences in their effectiveness or ease of use. Many studies use immeasurable methods for teaching different subject contents, but the perspectives and occurrences of the teachers participating in this study require~~s~~ more study. A quantitative study was inappropriate because an extensive descriptive method was necessary for this study.

This study examined middle school science teachers' perceptions of DI. Teachers at the school site completed professional learning training during the summers of 2008 and 2009 and during professional learning days during the 2010–2011 school term to get the training they needed to implement DI, using research-based strategies to increase student achievement. This investigation enabled the teachers to understand the need to

increase student academic success in classrooms, regardless of their diversity. In addition, beginning in 2012, science became one of the areas that students had to pass to meet the NCLB mandates. Furthermore, beginning in 2007, the science scores at the study site plummeted.

Methodological Approach

This research was a qualitative study based on in-depth interviews, observations, and artifacts. The study occurred within the phenomenological research tradition. The objective of this type of study is to examine a phenomenon from the firsthand experiences of the participants. This approach is in contrast to the positivist research tradition, which assumes that the forms of scientific inquiry used in relation to the natural world apply to the social world. From a positivist perspective, researchers study social phenomena by using purely quantitative methods to look for cause-and-effect relationships, patterns, and regularities among variables (Denscombe, 2003; Smith & Flowers, 2009). However, phenomenological researchers contend that knowing a social phenomenon requires studying the phenomenon as perceived and experienced by the social actors who are involved directly in creating their own reality (Leedy & Ormrod, 2005; Merriam, 2009; Nixon, Hagen, & Peters, 2011).

This methodological approach generally uses qualitative research methods such as in-depth interviews and conversations to investigate completely and use the knowledge of the research subjects and the sense they make of the phenomenon (Creswell, 2007, 2008). The research method entails the centrality of the researcher as a data-gathering and data-analyzing instrument (Hatch, 2002; Marshall & Rossman, 2007). The study used this

approach because it was necessary to understand the perceptions of teachers using DI, in order to understand more fully its impact on students as well as the specific challenges faced by teachers in its use.

Qualitative research studies are of particular value when researchers investigate a social concept or phenomenon about which limited knowledge exists. In addition, when it is necessary to identify key factors about information needed to provide a knowledge base, qualitative research is valuable. The main drawback of qualitative research is that, generally, it includes small samples of research participants because of the high cost and time involved in in-depth data collection and analysis. As a result, the findings do not apply to the wider population from which the sample is drawn, and it is not possible to apply statistical methods to test research hypotheses about cause-and-effect relationships. The sample size is not a weakness of the qualitative research method because its purpose is to generate in-depth understanding of a social phenomenon rather than to provide data from which statistical inferences occur.

The present study explored teachers' utilization of DI in teaching science in Grades 6–8, using a phenomenological approach. Secondly, this study was conducted to provide better insight of the perceived benefits and weaknesses of this instructional method from a teacher's perspective. Finally, this study examined teachers' awareness of the need to eliminate differences in classroom instruction. As such, this phenomenological study focused on advancing awareness of how teachers view the use of DI to assist learners to develop a knowledgeable appreciation of science content. The main research questions addressed the objective of the study.

Research Design

The research was a phenomenological study that applied data collection strategies, including semistructured, in-person interviews with five regular education science teachers and two special service teachers at the study site, observations, and the use of artifacts (lesson plans). The research participants and I were teachers in the school who had professional rapport with each other. Documentary evidence supported the qualitative interview-based findings.

I explored the teachers' understandings and personal viewpoints about using DI, the specific challenges or difficulties they encountered, and the manner in which they addressed these challenges through interviews. The teachers also gave their perceptions of the impact of DI methods on various categories of students. Semistructured interviews facilitated comparison of the experiences of different research participants, but also provided the flexibility necessary to vary the order in which the questions were asked to seek further information or clarification of points made or to introduce further lines of questioning (Denzin & Lincoln, 2003). The interviews took place at the school; hence, the setting was familiar and comfortable to the participants and fostered frank and truthful responses to the questions.

Denscombe (2003) noted that face-to-face interviews provide the researcher with some ability to validate information on the spot and compared it with other data collection methods such as self-completion questionnaires, it is often easy to tell from a respondent's body language and tone of voice whether he or she is giving truthful responses. On the other hand, a drawback is that responses may sway toward what the

interviewee thinks the researcher wants him or her to say, and it can be difficult for the researcher to conceal in informal conversation any preconceived ideas he or she may have about the issues being examined. These types of factors are called *interviewer effect*. To avoid the risk of bias in the research, it is vital for the researcher to be impartial and to communicate passively at all times (Denscombe, 2003). Moreover, avoiding bias was vital in this study because I was a coworker of the research participants. I was a member of the faculty in the school, and my own awareness of the subject area was strength in this qualitative research (Bresler & Stake, 2006). Conversely, threat to objectivity and neutrality existed. In this research study, my dual role as the study investigator as well as a teacher at the study site had minimal influence on the research outcomes.

In this study, I used interviews primarily to examine teachers' awareness and perspectives of a number of specific DI methods taken from Tomlinson's (2003) list of high- and low-preparation differentiated strategies. Additionally, I used topics and issues arising from the individual interviews, observations, and collection of the artifacts to contrast and compare the experiences of participants.

Some limited use was made of documentary evidence, such as lesson plans, in exploring teachers' utilization of DI strategies weekly. The participants were asked to bring to their interviews any written documents that they felt could assist them in explaining how DI influenced instruction and learning in the classroom setting. The use of many different data collection methods is called *triangulation*. Triangulation helped to produce a broader knowledge of the social concepts studied and to validate the findings

by helping to overcome the methodological weaknesses that the use of single methods of data collection inevitably entails.

Research Questions

The primary goal of the study was to generate information for use in developing best practice guidance on the application of DI in middle school science teaching. The study was guided by two main research questions that addressed the information needed for the study to achieve its primary objective:

RQ1: What are the reported experiences of science teachers, annually trained in DI strategies, regarding their implementation of DI strategies at a rural southeast Georgia middle school?

RQ2: What strengths and difficulties do science teachers, who trained in DI strategies, report regarding their implementation of DI and what do they say they do to address identified difficulties?

Research Participants

To secure a sample of science teachers to participate in the study, I first approached the school principal with a request to conduct the research. The school principal directed me to the new superintendent for approval (see Appendices A and B). Having obtained verbal and written permission to conduct the study, I used purposive sampling methods to select science teachers from one middle school. Purposive sampling applies when a researcher needs to identify individuals with specific experiences or characteristics to provide the most valuable data, and already has some personal knowledge of people who meet these criteria (Denscombe, 2003; Onwuegbuzie &

Collins, 2007). As Denzin and Lincoln (2003) noted, it is appropriate to use purposive sampling when suitable individuals are available and there is no need to represent a wider population.

Giorgi (2008) recommended a small sample in a phenomenology study because of the time-consuming data collection procedures and analysis involved. The sample in this study included five middle school regular education science teachers and two special service science teachers who taught Grades 6–8. In phenomenological studies, samples are small because the data collection phase is long and tedious (Creswell, 2008). This small sample included common interest of the participants to improve science comprehension and knowledge by willingly applying DI strategies weekly. The participants noted the DI strategies used weekly in their lesson plan books. The participants also had access to and knowledge about DI to offer details of the experience (Creswell, 2008; Groenewald, 2004).

The participants represented certain conditions to assure validity of the results. The first criterion was that they should apply the use of DI in the classroom. The second criterion was self-directed participation (Creswell, 2003, 2008; Merriam, 1997). A purposively selected sample provides important data to answer the research questions (Creswell, 2007; Moustakas, 1994). Using this selection process, produced viewpoints on the use of DI that were based on awareness and understanding of its use (Erlandson, Harris, Skipper, & Allen, 1993). The five selected research participants were all full-time certified Grade 4–8 teachers with a specialization in teaching science. The regular education teachers in the study participated in the two summer workshops that lasted 4

weeks each and the quarterly instructional training during 2008–2010. The two special service teachers participated in the quarterly training only.

The method for establishing an effective researcher–participant relationship was an initial contact letter sent via e-mail (Appendix C). The initial contact informed the participants of the intent of the study, their role in the study, the benefits the study would provide for them, and a consent form to sign in order to participate in the study (Appendix D). In order to protect the identity of the participants, each participant was assigned a number and asked to sign a waiver form of acknowledgment of participation in the study. I gave assurances of confidentiality, answered questions about the study, and scheduled dates and times for interviews. Each of the participants was interviewed and allocated a reference number for use in the fieldwork notes and analysis. Teachers who taught science participated in the interview process.

Data Collection and Quality Control

This study involved interviews, observations, and the collection of artifacts. An interview guide (Appendix E) consisted of several open-ended questions asked of the respondents, along with follow-up probes to use as necessary to help the interviewer collect relevant information. For developing the interview guide, relevant questions emerged from the literature review, with consideration given to the information gaps in this area. Observations of teachers enacting DI strategies offered further insights about how verbal attitudes (interviews) verified teachers' behaviors in the classrooms. An analysis of the instructional lesson plans served as a method to help validate the perspectives of the teachers.

I asked administrators at one middle school to allow interviews to be conducted with the science teachers, after the Institutional Review Board (IRB) approval by Walden University (07-27-12-0045569) and the return of the consent forms. Permission forms were distributed and participants were assigned a reference number after signing the consent forms. The participants returned signed consent forms within 1 week, and interviews took place within a 2-week period.

After the IRB approval, participants received consent forms and the interviews occurred as scheduled. The following interview questions guided the data collection process:

1. Describe your philosophy and viewpoint of teaching relative to your work in the classroom, especially with working with students and understanding DI strategies.
2. What changes have you made in your classroom setting since implementing DI? Describe (a) the physical setting (seating arrangement, wall decor, etc.); and (b) classroom climate (teacher–student interactions, student–student interactions, classroom management, etc.).
3. What do you know about differentiated instruction? What do you see as the possible benefits of differentiated instruction? How do you differentiate instruction? When you differentiate, do you do it always, or only under certain circumstances?
4. What do you perceive were the challenges while implementing DI (during lessons, planning lessons, etc.)?

5. What specific DI strategies did you use to work with the students in your classroom? Which ones did you consider effective for student learning? Which ones would you exclude?
6. How are teachers accountable for DI? What could administrators provide teachers to help them differentiate instruction?
7. What is your general feeling of DI as an everyday methodical strategy for your classrooms?

I recorded the interviews with permission from the participants, to guarantee precise transcription for analysis purposes, and recorded full field notes as an inspection of the data collection stages. To help ensure the quality of data obtained from the in-depth interviews, I used descriptions, member checking, and an external auditor. Descriptions were applied as a control method to communicate the results of the study (Creswell, 2003, 2007). Using a detailed method to create the consistency of the study helps to ensure the accuracy of the results (Creswell, 2008). Member checking was used for feedback to determine that data interpretation was accurate (Lincoln & Guba, 1985). The interview questions provided information to assist in gaining data about the participants' utilization and perceptions of DI as a pedagogical method. I recorded the interviews first, and then I carefully transcribed the recordings (Giorgi, 1985).

Data Analysis and Presentation

The interview data, observation data, and artifacts were analyzed using content analysis, or what Burnard (1991) referred to as *thematic analysis*. Thematic analysis first involves reading the transcripts to identify key categories and subcategories relevant to

the research questions, and then rereading and coding material from all the transcripts against these themes in an attempt to answer the research questions. Thematic analysis identified relevant categories in the interview transcripts so that an in-depth description could emerge from the participants' viewpoints (Giorgi, 2008). The findings were presented by research question and key theme, with verbatim quotes used to illustrate key points. During this process of reducing data, the topic summaries occurred through documentation to identify categories related to the literature and the experiences regarding DI (Berg, 2004; Giorgi, 2008). Finally, a synthesis of research findings produced documentation needed to develop a set of recommendations for best practice guidelines regarding the use of DI.

The most important methodology was to collect data on observable behaviors and to analyze these data in order to identify important themes and findings that were relevant to the research questions and the objectives of the study. I collected and evaluated the data over a 9-week period. The written descriptions formed a summary of participants' perceptions of DI (Giorgi, 2008). Key themes from the data formed the findings from the study.

Researcher's Role

As the only researcher in this study, I had two roles. The first role was conducting the research, and the second role related to teaching science. I was responsible for all tasks related to initiating the study as well as collecting and analyzing the data, including introducing the study to participants (teachers), distributing and collecting permission forms, and performing all interview-related activities. I conducted and audiotaped the

interviews, and then transcribed, coded, and analyzed the data for similarities, consensus, and themes. In addition, I reviewed and recorded teachers' perceptions about their readiness to apply DI techniques in the classroom. As a public educator, I have taught science for 17 years. This professional background made it easy for me to understand the advancing beliefs of education in making provisions for diverse levels of learners. The study allowed me to pursue an interest in increasing awareness and knowledge of an instructional method that offers benefits for all learners.

As the researcher in this project, I had prior professional affiliation with the participants. This association empowered me to help facilitate a genuine portrayal of instructional methods as they occurred in the classroom. The association facilitated the research process, including the collection of data from face-to-face interviews, observations, and artifacts such as lesson plans. I was responsible for distributing the findings to the stakeholders. I examined various DI strategies in a standards-based classroom in five science classroom settings and employed various DI strategies in one room. I designed and conducted interviews, observations, and collected artifacts (lesson plans) and coded and tabulated results to generate the data needed to answer the research questions.

Validity and Reliability

Good research designs should meet high levels of reliability and validity, two important methodological concepts. Originally created for quantitative research, these concepts are equally appropriate for qualitative studies, though less easily measured. To establish validity of an instrument, researchers check to see if the instrument really

measures what it is supposed to measure (Salkind, 2003). In quantitative research instruments such as attitudinal scales included in structured questionnaires, validity is measured through statistical procedures, comparing the results with those achieved from other research instruments.

Validity

In qualitative research, the validity of a research instrument, such as an interview guide or topic guide, evaluates results by assessing whether the results reflect the key issues or research questions as identified in the literature review and capture information relating to these issues or questions. When designing qualitative research instruments, therefore, it is important to have a good familiarity with the subject matter and with previous relevant research. Where possible, qualitative research instruments derive from previous studies and are modified as necessary, also facilitating comparison of the results with those of previous research. In the case of the present study, I attempted to maximize validity by conducting a comprehensive literature review, adapting questions from previous research in this area, and taking care to design a high-quality instrument that was likely to generate the information needed to answer the research questions.

To establish the authenticity and validity of the interview questions, prior to the main interviews, I asked an expert panel for feedback. This occurred after a faculty meeting. A varied group of educators evaluated the interview questions. Two participants were in the process of completing their doctoral programs and one had a doctoral degree. Three regular education teachers and two special service teachers provided feedback. Six reviews were returned from the panel of eight who reviewed and evaluated the questions.

The interview questions took 12–20 minutes to complete. No aid was necessary to complete the interview questions. The educators read the questions to determine if any were unclear and to offer any ideas that might aid in collecting related information. From the feedback provided, I determined that the interview questions correlated with the research questions.

The validity of an overall research design is improved by incorporating a number of different methods of data collection in a process of triangulation (Glaser & Strauss, 1967). The use of documentary evidence also helps to verify the information provided by individual research participants. Additionally, I planned debriefing sessions for the participants to verify the key findings of the study. Peer debriefing, member checking, and other forms of respondent validation are common methods of enhancing a study's validity (Bresler & Stake, 2006; Lincoln & Guba, 1985).

Lincoln and Guba (1985) and Creswell (2007) listed several methods for validating a research study: long-term and repeated observations, explaining researcher bias, improving the work, triangulation, peer review, member checking, using full descriptions, debriefing, and external audits. At least two of these methods were applied in the present study to ensure validity of the research data. In this study, four methods validated the quality of the study: member checking, debriefing, triangulation, and clarification of researcher bias. Member checking provided each participant the opportunity to review his or her interview transcript to check for errors along with my interpretations of the participant's meaning to ensure the true meaning of the data. While analyzing the data, it was helpful to schedule conferences with the participant to review

the interview, artifacts, and observational notes to explain the perceptions of the participant about how he or she used the documents. As a result, debriefing was an ongoing process of ensuring validity by correcting misperceptions or deceptions.

Another method used for validating the study was explaining researcher bias. Even though I knew the teachers participating in this study, we did not work in a classroom coteaching setting. Contacts with the participants were limited to science cadre meetings. As a teacher in the building, I was an observer in the back of the room, taking notes over the presentation of the lesson, student and teacher interactions, as well as student behaviors.

Triangulation was the final method used for validation. According to Yin (2009), qualitative research studies request the use of triangulation. Triangulation is a method to cross-check data from multiple sources to search for regularities in the research (Creswell, 2008). The sources of data in this study were interviews, observations, and artifacts (lesson plans).

Reliability

Reliability is another concept that relates mainly to quantitative research, and refers to the ability to make the findings from a sample known to a wider population, and to ensure that, if replicated, the study would produce the same results (Joppe, 2006; Rossi, Lipsey, & Freeman, 2004). Although there is no requirement in qualitative research to produce findings to generalize to a wider population, the principle of replication remains important. Qualitative researchers must ensure that they keep comprehensive and thorough records of their data collection and analysis procedures so

that it is feasible for someone else to assess whether the research findings are reasonable and can be defended (Morse, Barrett, Mayan, Olsen, & Spiers, 2002), even if a different researcher might not have arrived at exactly the same conclusions. In the case of this study, I kept detailed fieldwork notes and a full record of analysis procedures.

Ethics

When conducting social research, it is essential to maintain high standards of ethics and particularly to respect the rights of the research participants (Denscombe, 2003). Some of the key ethical issues in research include ensuring that participants took part voluntarily and knew the purpose of the study and the use of the findings. Participants also need assurance of confidentiality about the information they provide and assurance of their personal anonymity. In order to guarantee that the study met the requirement of informed voluntary consent, I briefed potential research participants in relation to the objective of the study, what their role was, that no remuneration or other reward applied, and that they had the right to withdraw at any stage or refuse to answer any questions.

In the case of this study, there were particular ethical challenges relating to anonymity and confidentiality because the research participants and I were coworkers. As a result, it was essential to ensure not only that neither personal details nor comments attributed to individuals were present in the research results but that all participants respected the confidentiality of others in the study. To preserve anonymity, the participants were referred to only by pseudonym in the research results. Additionally, no students' names were revealed in the study.

Summary

In this section, I explained the research approach and design for the study and how this strategy is appropriate in the context of this research objective. An interview guide consisted of a number of open questions to be asked of all participants, along with follow-up probes. Data were gathered, analyzed, and tabulated with the appropriate statistical analysis. Finally, the section provided an explanation of how the study met high standards of reliability, validity, and ethics. The following section presents the research results.

Section 4: Results

Introduction

The purpose of this phenomenological study was to examine the perceptions of science teachers in Grades 6–8 regarding differentiated instructional strategies, DI implementation in the classroom, and reasons teachers might apply DI strategies regularly. Patton (2002) suggested a phenomenological study shows how an individual experiences a phenomenon—how they perceive it, explain it, reflect about it, judge it, and make sense of it while talking about it with others (p. 104). In this study, the participants had the opportunity to discuss pedagogical strategies through their own individual lens. In addition, the participants included their definition of DI, elaborated on previous trainings, their practices with DI, and frequency of its use. Through training in DI, individual interviews, lesson plans, and classroom observations, I was able to investigate the phenomenon of DI as perceived and practiced by the teachers and as carried out by them in the classroom. For this section, I analyzed the findings from the interviews, observations, and artifacts (lesson plans) of seven participants, five science teachers and two special service teachers who cotaught science. All participants discussed their perceptions of DI and its usage in the classroom.

Generation, Gathering, and Recording of Data

The following procedures represent the data collection process for this study. After obtaining letters of consent from the school principal and district superintendent and obtaining IRB approval from Walden University, an invitation to participate in the study went out to 10 teachers via e-mail. Five regular education and two special service

teachers responded. Once the teachers agreed to participate in the study by returning their consent forms (Appendix D), the interviews were scheduled. After conducting the individual interviews and classroom observations, a review of artifacts (lesson plans) occurred.

The process of data collection involved interview questions. The interview questions had two objectives: to identify the participants' experiences with DI and their perceptions of DI strategies. I used purposive sampling, a method used to identify individuals with specific experiences or characteristics to provide the most valuable data. I had some personal knowledge of people who met these criteria (Denscombe, 2003; Onwuegbuzie & Collins, 2007).

Systems of Keeping Track of Data and Emerging Understandings

In conducting the interviews, I met individually with the seven participants for 30–45 minutes. The interviews provided the participants the opportunity to share their opinions about the DI strategies. The interviews occurred in a private room in the media center during August 2012 over a 4-day period. Predetermined interview questions (Appendix E) generated from the research questions guided the interview process. The questions focused on the use of various DI strategies, obstacles with the use of DI, and success with the use of DI in middle school science classrooms. The participants had the opportunity to ask questions. Each recorded interview was labeled with the respective participant's pseudonym in order to maintain confidentiality and entered into a Microsoft Word document. Participants were coded so as to identify their grade and science level.

Member checking established reliability and validity. Member checking, according to Lincoln and Guba (1985), permits the researcher to acquire credibility of the research. Each participant had the opportunity to review his or her transcript to verify reliability and validity of the research through e-mail correspondence. Member checking occurred through the e-mail correspondence.

Upon completion of the interview process, classroom observations, lesson plan reviews, and transcription of the data, a follow-up question was developed based on the research questions and purpose of the study. The participants received the follow-up question via e-mail and in person. The follow-up question inquired about the effectiveness of the DI strategy used with the lessons taught. This process occurred over a period of 10 days. Participants provided their responses in person. The interview information was stored at my residence in a secure location. I will keep all materials and data associated with the study locked in a file cabinet in my home for 5 years after the acceptance of the study, after which I will destroy all evidence by shredding all documents associated with the study.

Participant Profiles

Five science teachers and two special service teachers agreed to participate in this study based on purposeful criteria. The teachers taught or cotaught science at the middle school. Each teacher had been teaching science for at least 1 year and was trained in the doctrines of DI through college courses, professional development, or summer institute workshops. The school district required all math and science teachers to take DI classes. Pseudonyms identified the teachers. Table 1 lists the participants' profiles.

Table 1

Participant Profiles

Pseudonym	Gender	Years of teaching experience	Subject taught	Current degree
Lynn	F	29	Earth science	Bachelor's
Zo	M	4	Earth science	Bachelor's
Cassie	F	6	Life science	Specialist
Roe	F	21	Physical science	Specialist
Vint	M	2	Physical science	Bachelor's
Cam	F	3	Special service physical science	Bachelor's
Kita	F	5	Special service life/earth science	Master's

Individual Description of Participants

The following is a brief description of each participant.

Lynn. Lynn was a 29-year veteran teacher who had taught mostly science in her career. She had also taught reading, English, and social studies. She had taken the summer institute trainings and workshops required by the district.

Zo. Zo was a fourth-year teacher who taught reading, science, and social studies and was a paraprofessional at the research site. Although he was familiar with DI, he participated only in the workshops.

Cassie. Cassie had taught science for 15 of her 18 teaching years. All but two of her science teaching years were in life science. She taught earth science 2 years and was the in-school suspension teacher for 2 years. Cassie participated in the 2-year summer institutes, but like Lynn, stated that the institute was about science content, not DI

strategies. While obtaining her specialist degree, she became familiar with strategies classified as DI strategies.

Vint. Vint, a second-year teacher, received most of his training in DI from his college classes. He did not participate in the 2-year summer training because he was employed at another school. Vint was knowledgeable about DI and its strategies.

Roe. Roe had been teaching 19 years, mostly science in elementary schools. She taught sixth- and eighth-grade science. Roe did not attend the summer trainings because she was teaching on the elementary level and the training was for middle school and high school teachers. She did, however, participate in the workshops offered during the school year.

Cam and Kita. Cam and Kita were the special service teachers whose content areas changed at the end of the previous year. Cam and Kita were new to coteaching science and did not attend any of the summer trainings. Cam was a third-year teacher with previous English and social studies experience in coteaching at the middle school level. Kita was a Georgia Teacher Alternative Preparation Program teacher with 5 years of experience. She cotaught in English classes with 1 year in a science class.

Trainings

The trainings occurred during two summer sessions in 2009 and 2010 and during school trainings and workshops. The participants attended 2 weeks of training conducted at a state university. They also voluntarily attended professional development sessions once a month for 1 hour during the school year. The curriculum for the trainings included a variety of materials on science and the application of DI strategies such as flexible

grouping, jigsaw, think-pair-share, learning stations, student choice, and tier products. All participants received professional learning unit credit. The workshops during the academic school year consisted of book studies that asked the faculty to apply some of the DI strategies and report about the progress of the lesson.

Evidence of Quality

To ensure quality during the data collection process, I triangulated data obtained from the teacher interviews, lesson plans, and observations. During the research and interview process, several themes were identified from the comments of the participants during the interviews. Lesson plans and observations had examples of similar themes. The interviews were audio recorded and transcribed for accuracy. I transcribed all of the interviews, observations, and lesson plans (see Tables 2–5) to record the meaning, which I converted to themes. I identified frequent and recurring themes, which I explained under each principle. Through meticulous analysis of the developing themes, I ensured that appropriate and careful conclusions resulted from the data.

A peer examiner reviewed the interview transcripts and observational field notes. The peer examiner is an established educational consultant with years of experience in reviewing and editing proposals, theses, and dissertations for doctoral students. In addition, she has experience as a peer reviewer with various organizations, including the National Science Foundation, U.S. Office of Education, and school districts throughout Georgia. She has expertise in qualitative, quantitative, and mixed methodologies as well as form and style guidelines of the American Psychological Association and the Modern Language Association. Students from various universities, including Capella, have used

the service of this peer examiner. As a Capella visiting scholar for the past 12 years, this peer examiner has assisted many students to ensure evidence of quality in their doctoral research process. In addition to this peer examiner, credibility, transferability, dependability, and confirmability also provided evidence of quality, described as follows.

Trustworthiness: Credibility, Transferability, Dependability, and Confirmability

Credibility, transferability, dependability, and confirmability were applied in this research to strengthen trustworthiness of the research process. Each of these elements enabled me to increase the trustworthiness of this research. A description of how each of these elements strengthened the findings of this study follows.

Credibility

I used revelatory, explanatory, and informational insights (an interpretive approach) to interpret the participants' responses and offered their accounts, reports, details, and explanations verbatim without changes in the meaning or intent of graphic responses. With each participant, member checking verified accuracy of the transcript. Member checking enabled me to determine the accuracy, precision, or correctness of the findings. This process occurred through taking the draft of the final report to participants and determining whether they felt that the findings relative to their responses were accurate. Rich, thick descriptions in the findings represented the exact comments from the participants.

I thoroughly addressed the field notes from the observations. Analysis occurred through a process designed to keep a record of procedures, reflections, and analysis of emergent themes. In the meantime, I avoided biases through self-reflection, openness,

transparency, and honest narrative, which worked well with participants. A detailed, systematic examination and interpretation of the data enabled me to identify categories, patterns, themes, and meaning.

In addition, I applied bracketing to eliminate possible preconceptions. An epoche approach also was applied while I was conducting the research, meaning that I bracketed prior knowledge and experiences related to the phenomenon under investigation. Bracketing ensured prior knowledge of DI remained confined, which resulted in prior knowledge becoming useless in the study. I viewed participant statements with equal value. Therefore, in this study, transferability of the research findings could begin to close gaps in the literature about DI by describing this instructional process in light of the participants' lived experience in changing from traditional instructional practices to the implementation of DI in the classroom. Discussion of the lived experience has the ability to unfold new truths on the influence of DI instruction on the achievement of students in the regular education classroom (Groenewald, 2004).

Transferability

My aim in conducting this study was to contribute to the body of knowledge relative to the use and value of DI as an instructional method to enhance student learning and inform decision making from educational researchers who have expressed the expectation that DI could enable teachers to improve student academic performance in all content areas (Darling-Hammond & Brandsford, 2006; Gredler, 2005; Rock et al., 2008). Given the long-standing appeal of DI but limited research about the effectiveness of DI (Cosentino, 2012; Hall, 2002), this phenomenological study adds to the literature by

explaining the ways participants in one specific school understand, justify, and perform daily activities related to DI, which might offer insights to instructors in similar locations.

Dependability

During the data analysis process, I identified the similarities in the participant responses to determine what they considered germane to the use of DI in the instructional process. I noted specific ideas the participants offered and I recorded verbatim their responses to determine how teachers met the challenges they faced in implementing DI in their classrooms. I read and reread the interpretations to ensure reliability from the triangulated data.

Confirmability

To address confirmability, I checked and rechecked the data as I conducted the participant interviews. I labeled the steps I used in conducting the study in order that other researchers could follow the same procedures, confirmed or corroborated the results, and documented the procedures for reviewing the results and member checking the data throughout the study. Creating an audit trail makes external review possible, which also provides an opportunity for other researchers to repeat the steps of this study. In addition, I used the audit trail and included detailed descriptions of the data gathering process. Trustworthiness in qualitative research supports the argument that the findings of the inquiry are worth others' considerations. This researcher gave attention to credibility, transferability, dependability, and confirmability; therefore, the trustworthiness of this study became stronger.

Findings

Interviews

This study examined middle school teachers' experiences relative to the implementation of DI strategies in science classrooms. Seven teachers were interviewed before the observations were conducted. I asked the participants seven interview questions. The interview responses were audio recorded and transcribed. All transcripts provided the documentation for meaningful themes from triangulation with the results from observations and lesson plans.

Units of Analysis

The purpose of this study was to examine perceptions and experiences of middle school science teachers using DI strategies. Research Question 1 investigated the experiences of science teachers, annually trained in DI strategies, regarding their implementation of DI strategies at a rural southeast Georgia middle school. The research questions examined science teachers' experiences regarding their implementation of DI strategies, including their strengths and difficulties, and how they addressed the difficulties. The units of analysis from the interviews included (a) philosophy of teaching, (b) classroom setting changes since implementing DI, (c) knowledge of DI, (d) implementation challenges, (e) DI strategies used, (f) instructional accountability, and (g) perception of DI as a an instructional method. Each unit was described with specific themes. These themes were common among the majority of the participants during both the interview process and the observational process. Dominant themes from interviews by unit of analysis were as follows:

- Philosophy of teaching: Meeting individual needs; using DI strategies.
- Classroom setting changes: Rearrangement of learning environment; student work and words posted.
- Knowledge of DI: Limited knowledge of DI.
- Challenges of DI: Addressing individual differences; preparing students for Criteria Referenced Competency Test (CRCT).
- Accountability measures: Student achievement.
- Perceptions of DI: Challenges and difficult to implement.

Philosophy of teaching. Interview Question 1 asked, "Describe your philosophy and viewpoint of teaching as it connects to your work in the classroom, especially with working with students and understanding DI strategies." The teachers had various teaching philosophies on teaching and learning. Their philosophical themes were meeting individual needs and using DI strategies.

Cam. Cam reported that her philosophy and viewpoint of teaching connected directly to her work in the classroom. Working with students and understanding DI strategies "means tailoring instruction to meet the individual needs of my students," Cam stated.

Cassie. Cassie identified her learning style as "old school," but she was moving toward problem-based learning. She believed that "DI is based on the aspect that learning is diversified in the classroom and teachers are flexible in the approach to teaching."

Lynn. As a teacher with multiple areas of responsibilities, including science as well as English language arts/reading, math, and social studies, Lynn believed that the

goal of DI is "to meet the learners where they are on their level." Thus, her philosophy of instruction was similar to Cam's and Cassie's.

Kita. In describing her philosophy and viewpoint of teaching, Kita explained that DI should be in all classrooms because no two students have identical abilities, experiences, and needs. She added that DI helps all students to succeed in learning regardless of their ability level.

Zo. The difficulty of providing DI was paramount in Zo's interview response. In particular, Zo said, "Tailoring instruction to each student's learning style is very tedious but can help students be successful."

Vint. In explaining his philosophy, Vint believed that "responsibility educates, and the teacher has responsibility to teach students to the best of their knowledge." However, relative to DI strategies, Vint said, "My philosophy is to put students first. I aim to incorporate many avenues of reaching the holistic mind of the student."

Roe. Roe indicated that she perceived DI to be an exceptional way of teaching. "DI far surpasses the usual way of teaching and gives every child an equal opportunity to excel," Roe explained.

Classroom setting changes. Interview Question 2 asked, "What changes have you made in your classroom setting since implementing DI? Describe the (a) physical setting (seating arrangement, wall decor, etc.). (b) classroom climate (teacher–student interactions, student–student interactions, classroom management, etc.)." Due to implementation of DI, the participants' ways of thinking brought about a change in the

arrangement of their learning environments. Themes identified with classroom setting changes were rearrangement of learning environment and student work and words posted.

Cam. Cam identified one change as setting the tone to ensure that each student feels welcomed and everyone is a contributor within this atmosphere. The second change was that everyone understands that respect is the key to learning. The third change was providing an environment of safety. The fourth change was that each student was aware of the expectation of growth in regard to every individual who comprises the class. Cam added,

> Having stated these foundational requirements, the seating arrangement may range from small group—four desks situated to encourage discussion—to amphitheater seating—an arch of seats that focus upon the speakers, teachers, students, or guest speakers. In addition, the walls include content words, student samples, and motivational quotes—textual format—by role models from various occupations and age-appropriate reflections.

Cassie. Cassie explained that the major changes she made included having a word wall, posting students' work, and arranging desks in rows.

Lynn. Lynn described her change as arranging desks in groups with the middle open so the teacher can visit each group and students can present projects**.** Also, Lynn posts students' work along with the task.

Zo. Zo explained that his change was minimal: The desks are arranged in rows, but are easy to move if he wants to place a student with a partner.

Vint. The seating arrangement of Vint's classroom is ever-changing, as it is pertinent to be flexible with grouping when implementing DI strategies. He explained, "I have a word wall that is changed based upon the standard we are working on, as well as the standards posted to assure the students are engaged from every angle of view."

Knowledge of DI. Interview Question 3 asked, "What do you know about differentiated instruction? What do you see as the possible benefits of differentiated instruction? How do you differentiate instruction? When you differentiate, do you do it always, or only under certain circumstances?" During the initial interviews and the postinterview commentary, all of the participants revealed their lack of knowledge and experience with DI. One theme identified with this unit of analysis was limited knowledge of DI. All participants expressed a need to further their knowledge of DI and the use of DI activities.

Cam. Cam explained, that DI involves a plethora of "opportunities to assist in my proactive response to students' needs as defined by their abilities, learning styles, and interests." He added,

> My aspiration is to provide challenge and success for all learners. The benefit of differentiation can create a form-fitting school for students and an inclination of teaching that is more stimulating and fulfilling. The key components of differentiation are tiered assignments, graphic organizers, curriculum compacting, and independent studies. In stating such, these essentials filtered through four classroom elements based on student readiness, interest, or learning profile. These aspects include content, the process, the products, and the learning environment.

> Differentiation, in that it is a complex approach to teaching, is one that I explore, demonstrate, and exercise on a daily basis.

Cassie. Cassie supported the use of DI in the classroom and explained that it provides the opportunity for all students to learn:. "Based on the materials that I have been studying, I understand that differentiating instructions consist of meeting the learner's needs."

Lynn. To Lynn, DI involves redirecting or remediating a student who is having problems with the same concepts as the other students and finding a different way to relay the information. DI becomes time consuming, and accurate record keeping is necessary for proper data collection.

Kita. Kita described DI as a method that "allows the students to use different options in acquiring content; hence, expresses what they learned. DI helps the students to succeed and feel comfortable about learning. I differentiate every day with all students if the need arises."

Zo. In describing his understanding of DI, Zo said, "It is a way for teachers to tweak their lessons to fit the different needs of their students. Although it can be time consuming, I feel that it is very necessary to differentiate instruction in the classroom."

Vint. The benefits of DI are numerous; therefore, participants identified varied benefits. Vint said,

> The one [benefit] I typically enjoy is learning in the classroom. Engagement increases when I am using various strategies to teach a standard as well. I use flexible grouping, peer-to-peer tutoring, graphic organizers, and leveled questions

> as strategies for DI. It has become second nature to differentiate instruction. Every lesson will have some form of differentiation incorporated to involve all students.

Roe. Roe suggested that using DI in the classroom makes it easier to teach. She said, "For me and the learner, DI is how to meet the needs of diverse students and be able to teach effectively, teach them better."

Implementation challenges. Interview Question 4 asked, "What do you perceive were the challenges while you were implementing DI (during lessons, planning lessons, etc.)?" The intent of this question was to determine the teachers' perceptions of their own experiences with DI. This question allowed the participants to reflect on the ways they apply DI. Themes identified regarding DI implementation were addressing individual differences and preparing students for standardized tests. All of the participants stated that planning DI lessons and using DI was tedious work and that applying DI effectively was time consuming.

Cam. With the implementation of DI, current and sometimes continuous struggle centers on several factors. Cam identified the following factors: "(a) pacing of the whole (curriculum/instruction, varied learning resources, small-group tasks), (b) assigning students to groups, (c) honoring on-task behavior, and (d) giving my students as much responsibility for their learning as possible." Cam added,

> In light of planning lessons, the issues I continue to confront is being clear on the key concepts and generalizations or principles that give meaning and structure to the topic, chapter, unit, or lesson planned. As a third-year teacher, I remain a student of the content. I have not yet achieved mastery, and certain areas given are

> more of a challenge than others are. Imagine creating invigorating instruction and activities and yet trying to understand just what you are to teach!

Cassie. Based on her experiences, Cassie found that teaching students on different instructional levels was very complicated and frustrating because "the instructional level is too high or too low" for all learners. The challenges that Cassie encountered during the implementation of DI are lack of class participation, lack of motivation, class disruptions, and lack of accountability.

Lynn. Lynn also found it challenging to implement DI. She said, "It can be very challenging. However, when it comes down to that one test—CRCT—the information being tested is not differentiated. Differentiating instruction requires a great deal of planning, research/data, and organized classroom management—with assistance done ideally."

Kita. "Teachers have to be well prepared by knowing the content in implementing DI," Kita explained. She added, "Lessons must be designed on multiple levels. Multiple intelligences should be used to provide various ways of learning."

Zo. Zo described his experiences in teaching learners who are on different instructional levels as challenging at times. He explained,

> With mastering the standard as the main goal, having students at different levels can make it difficult for everyone to reach the goal. Some students may need the foundation/basics, while others may be able to do the work with no problems. One specific barrier I have encountered while initiating the DI was that the

student that needed the help wanted the tutor to do the work for them instead of showing them how to do it.

Vint. Vint did not identify a challenge in implementing DI. Instead, he identified varied types of grouping patterns and levels of questioning strategies, which suggested that he was meeting some difficult challenges. He said, "I use flexible grouping, peer-to-peer tutoring, graphic organizers, and level questions as strategies for DI."

Roe. DI seemed to be a challenging experience for teachers and students. Roe explained, "It is difficult for the teacher and the learner—everything [DI strategies and planning time], but mostly time consuming in planning and implementing any new strategy."

DI strategies used. Interview Question 5 asked, "What specific DI strategies did you use to work with the students in your classroom? Which ones did you consider effective for student learning? Which ones would you exclude?" The purpose of this interview question was to learn which strategies the participants applied and the effectiveness of those strategies. Strategies commonly used by all participants were cooperative groups and graphic organizers.

Cam. Specific strategies that Cam used are tiered teaching (basic tiered activity, tiered by challenge level, tiered by complexity) and scaffolding (modeling, reteaching/extending learning, use of manipulatives, use of study guides, use of organizers). Cam reiterated, "Thus far, I consider both [strategies] to be productive for student learning and would not disallow either option."

Lynn. Lynn identified a wide range of strategies she used in the implementation of DI. Some of the strategies included graphic organizers, visualization, word games, cooperative learning, individualized instruction, Internet research, and giving students a choice in assignments.

Kita. Specific strategies that Kita used were tiered teaching, think-pair-share, anchor activities, cooperative groups, songs, and graphic organizers. She considered graphic organizers, think-pair-share, and anchor activities the most successful.

Zo. The strategies Zo used included partners/groups, using manipulatives, making/labeling diagrams, drawing pictures, journaling, color-coding topics, and organizers. Zo said, "I have comfortably used cooperative groups, with the group leaders helping by tutoring group members."

Roe. Strategies Roe identified included "peer tutoring, flexible groups, graphic organizers. The most successful ones were flexible groups and graphic organizers."

Instructional accountability. Interview Question 6 asked, "How are teachers held accountable, if at all, to differentiate instruction? What could administrators provide teachers to help them differentiate instruction?" With the educational accountability measures, teachers, students, parents, and administrators are all held responsible. Themes identified were student achievement and personal and parental expectations. The participants noticed an increase in student production in work and engagement.

Cam. Cam believed that teachers are accountable for DI first by their own expectations and committing to variance of learning among their students. Secondly, general education teachers and special service teachers must allow for collaboration and

cohesiveness in the delivery of content/standards to all students. Parental involvement is another key for aiding in accountability. Parents engage by asking probing questions directed toward the collaborative teacher, such as "How are you finding out about what my child already knows and can already do?" "What kind of information would you like me to provide as you learn more about my child?" and "How is my child growing in this subject area?"

> Administrators can greatly assist in this world of differentiation by providing support in a myriad of ways: constructive feedback because of observations, professional development—classes, pairing with seasoned and/or knowledgeable teachers on this topic, webinars—and inquiring with current students taught about their perception of the class. Are they eager to attend class, and if so, why or why not?

Cassie and Lynn. Cassie and Lynn had similar ideas of accountability in that both referenced the CRCT as an accountability measure. For example, Cassie said, "The students who exceed or meet the state standard on the CRCT standardized test, and the number who pass the class, are used to provide accountability data." Lynn, on the other hand, said, "Students' success on the state standardized test [can be used as an accountability measure], and how many students fail the class."

Kita. Kita indicated that teachers are responsible for differentiation by their own standards and expectations. They commit to modification of learning for their students.

Zo. Zo reiterated the same accountability measure as Cassie and Lynn, the state-mandated standardized test, the CRCT, by measuring the number of students who fail or pass the test.

Vint. Teachers are accountable due to the need to educate all students. Vint stated,

> This generation of students does not learn from one approach. It is a necessity to differentiate for learning to occur. Administrators need to be on the front line with the teachers in providing the ammunition of sorts to help in implementation.

Perception of DI as an instructional method. The postobservation question asked, "How effective was the DI strategy used for student learning in the lesson taught (challenges/or success)?" The underlying theme about perception of DI was the challenges and difficulty to implement. All participants concurred that DI is a strategy that will aid in all students being successful; however, all of the participants stated issues with applying DI every day or weekly.

Cam. As one who implements DI, Cam believed that the DI approach is a valuable teaching method. He explained,

> Although this method has its challenges, to say the least, I have witnessed with my students growth, understanding, a strong desire to learn, and a way to build them upward when others have minimized their abilities, based on how they learn. I have yet to master this strategy, and remain encouraged to keep my face like flint in my daily efforts to provide modifications and the tailoring of content for all my students with a variant way of learning.

Cassie. The reflections Cassie provided suggested that she had positive and negative perceptions of DI. Cassie said,

> DI was very time consuming with the planning and implementing activities. Some strategies did not go as planned, and I had to revamp in the middle of the class. I think that DI is very useful because it allows me the opportunity to give students multiple options in learning the concept.

Lynn. In her personal evaluation, Lynn had some concerns about her success in implementing DI. She said,

> I have tried to do DI, but not often enough to have the full grasp of the method for it to be helpful for my students. It was hard work and took time for me to plan and help the students to research and complete the choice board tasks, but it was worth the learning the students showed.

Zo. Zo was concerned about the students who did not progress as quickly as other students. Zo said,

> I will have to use different strategies and manipulatives for those that did not get it [the concept]. It is by law that these students receive specific accommodations in the classroom setting. I would like to add that I feel that accommodating all students all the time is hard work and time consuming.

Vint. Vint considered DI as the only way to reach out and provide a quality education to the generation of students in school today. He explained, "Working toward educating the student requires attacking every avenue possible, even if it takes time."

Analysis of Interviews and Observations

Interviews investigated how teachers perceived DI strategies and applying DI strategies. Observations investigated how teachers applied DI strategies in the classroom setting. Themes began to appear during the interview process to answer the research questions. These themes were common among the majority of the participants during both the interview process and the observational process. To gather information from the observations, the interview questions determined the effectiveness of the DI strategy used for student learning in the lesson taught (challenges/or successes). Even though participants used different descriptive words, the dominant themes that emerged from the interviews and observations were as follows:

- DI strategies were challenging.
- DI strategies were difficult to implement.
- Meeting individual needs.
- Limited knowledge of DI.
- Student achievement.
- Perceptions of DI.

Sample responses to the postobservation question follow:

Cam. Cam stated that implementing DI was very strenuous and time consuming. He said, “I had to plan and carry it out effectively. I had a few kinks during the stations, but with all the interactions between the students and me, it was okay. I will know what to expect next time.”

Kita. Kita cotaught with Zo and Cassie. Each teacher indicated that implementing DI was challenging and strenuous.

Zo. Zo explained that DI strategies used for student learning in the lesson were successful but very challenging.

Vint. The DI strategy used helped Vint in facilitating learning for the students at all ability levels. Vint explained,

> I was able to differentiate how my below-level learners grasped the material by paying attention to their individual learning styles as well as being more succinct in the information needed from them. For my above-level learners, I added more depth to the content necessary for the project. Differentiation was also noticeable in the deliverables required from the students. The specific challenges I faced only included making sure the below-level learners were able to grasp the minimal amount of content necessary to reach proficiency.

Roe. Roe stated, "The stations worked well with the coteacher assisting me." In the other classes, there were a few issues due to some management problems, but the students displayed learning when the products were completed.

Table 2 provides units of analysis of teaching and DI strategies. Table 3 provides the DI planned and observed activities.

Table 2

Units of Analysis

Unit of analysis	Emergent themes	Discrepant cases
Philosophy of teaching	• Meeting individual needs • Pacing instruction • Changes in classroom setting • Using DI strategies	
Knowledge of DI	Limited knowledge of DI	
Challenges of DI	• Meeting state standards • Addressing individual differences • Preparing students for CRCT	Planning time
DI strategies used	• Tiered teaching, scaffolding • Graphic organizers, technology • Cooperative groups	
Accountability measures	• Personal/parental expectations • Student achievement	
Perceptions of DI	Challenging and difficult to implement	

Table 3
Planned and Observed Differentiated Instruction Activities

	Planned DI		Observed DI	
Teacher	Activity 1	Activity 2	Observed activity 1	Observed activity 2
Vint	Flexible grouping	Graphic organizers	Graphic organizers and flexible grouping	Graphic organizers and flexible grouping
Lynn	Graphic organizers and choice board	Graphic organizers and MI task	Graphic organizers and choice board	Graphic organizers and MI task
Roe	Flexible grouping	Graphic organizers	Flexible grouping	Flexible grouping and graphic organizers
Cassie	Peer tutoring	Flexible grouping	Independent notes/ textbook	Graphic organizers
Zo	Ticket out the door	Graphic organizers and flexible grouping	Read aloud and ticket out the door	Graphic organizers

Analysis of Lesson Plans

Planning for DI included constructing knowledgeable choices about the learning environment, which include instructional time, content, materials, supplementary resources, instructional strategies, and evaluation procedures (Cook, Tankersley, & Landrum, 2009). All teachers at the study site were required to turn in lesson plans weekly. A plethora of strategies were noted during the interviews; however, most of the strategies were low-preparation DI strategies. Table 4 provides the themes that emerged. The dominant themes emerging from an analysis of the lesson plans were

- Graphic organizers.
- Flexible groups.
- Guided practice.

Table 4

Lesson Plan Documents

Strategy	*N*	Participants
Graphic organizers	7	All
Flexible groups	5	Lynn, Vint, Roe, Cam, Kita
Guided practice	4	Cassie, Zo, Cam, Kita
Leveled questions	1	Vint
Preassessment	2	Cassie, Cam
Multiple intelligences	1	Lynn

Summary of Themes by Research Question

The participants in this study used the trainings and book study information to try new pedagogical strategies. Even though DI has affected the educational arena for many years and has a long history, it is incorrect to believe that experienced teachers understand the concepts or structures of DI. DI strategies applied in this study, along with other DI strategies, according to the participants, continue to be a part of classroom experiences. Moreover, the participants implemented different DI strategies to meet the learning needs of their students.

Research Question 1

Research Question 1 asked, What are the reported experiences of science teachers, annually trained in DI strategies, regarding their implementation of DI strategies at a rural southeast Georgia middle school? To answer this question, the teachers

explained how often they applied DI strategies and identified experiences they had in applying these strategies. The teachers were asked about their knowledge and understanding of DI strategies. Emergent themes from interviews and observations showed that teachers experienced success with DI by applying flexible grouping, a low-preparation strategy, graphic organizers, leveled questions, and other DI strategies, with different levels of success.

Graphic organizers and flexible groups. The grade-level teachers collaborated both with each other and with the special service teachers. I observed small-group and whole-group activities as they used graphic organizers. All seven participants applied graphic organizers daily. In the classes with the special service teacher and the general education teacher, the students created their own graphic organizers. The teachers facilitated and gave feedback about the graphic organizers to ensure the students understood the material. Five participants applied flexible groups. Two classrooms were the cotaught groups.

Lynn used flexible groups without a coteacher. The groups separated into no more than four students, and the teachers floated among the different groups. The teachers provided instructions and assisted the various groups, while the other groups worked independently. All of the participants concurred that starting with low-preparation DI strategies was effective with the students and comfortable for the teachers.

Benefits for all students. There was excitement and interaction between students and teachers. All participants shared success stories of student motivation, engagement, and success, relative to applying DI strategies. While observing five of the classes, I

noticed excitement with learning and participation. The teachers did not lecture or give notes to the entire class. The students did the work by using the 5 E's learning cycle, which includes engagement, exploration, explanation, elaboration, and evaluation. After engaging in learning, the students explored the lesson with hands-on activities. Students explained their understanding of the concept and process. Some groups were able to elaborate on the assignment.

Research Question 2

Research Question 2 asked, What strengths and difficulties do science teachers trained in DI strategies report regarding their implementation of DI, and what do they say they do to address the identified difficulties? To answer this question, the teachers identified obstacles such as availability of resources, inadequate planning, and staff development. To solve these issues, the teachers reported that they changed the lesson to concur with the available materials or resources and applied low-preparation DI strategies to meet the needs of students (see Table 5).

Table 5

Strengths and Difficulties

Teacher	Strengths	Difficulties
Vint	• More acceptable to change • Flexibility	Little practice
Lynn	Using same strategy until teachers and students are experts	Not enough time in class to plan for or use DI

Roe	Practicing different strategies	Planning and executing DI strategies
Cassie	Multiple options for teachers and students	Varied academic levels of students
Zo	Changing lessons to fit learning of each class	No hands-on experience with DI before study
Kita	Several ways to teach	Designing multiple-level lessons
Cam	Tailor instruction to each student	Time consuming and strenuous

DI application difficulties. Participants mentioned several obstacles that produced challenges for practicing DI daily. Some dominant challenges were (a) availability of resources, (b) inadequate planning, and (c) staff development training. Sometimes the teachers could obtain access to the technology room or have enough computers to complete assignments such as online tests or labs. In addition, the teachers collaborated on their grade level and taught the same concept. It was laborious to use or share science equipment when needed. In addition, grade-level meetings, parent conferences, and workshops made it difficult to plan or plan together some weeks. Participants agreed that DI takes time and sufficient planning. Four participants reported that most of their DI planning occurred at home after countless hours of planning and preparation. Participants concluded that more staff development on the use and application of DI strategies was necessary.

Summary

The purpose of this study was to examine the perceptions of middle school science teachers about implementing DI strategies and reasons teachers might or might not adopt DI in a rural middle school. The data obtained from the interviews, observations, and lesson plans revealed how each participant perceived the effectiveness

of DI strategies and their experiences with these strategies in their classroom. Based on the interviews, observations, and lesson plans, themes emerged regarding the application of science instruction the teachers implemented in their teaching practices. Middle school teachers share many common perceptions toward effective instructional strategies such as DI, and have many attitudes that conflict. Teachers' responses differed; however, underlying their responses was the commonly theme that all children learn differently and teachers must utilize the students' strengths to improve learning. A few teachers reflected on their preparation to teach heterogeneous-ability students, while others appreciated the opportunity, believing they were able and ready.

This phenomenological study allowed for a comprehensive analysis of two research questions. The results of the study showed that middle school science teachers had similar and different perceptions on the practice and efficacy of DI strategies. The seven teachers offered valid and trustworthy data to support the themes and findings in Section 4. An explanation of the findings, implications for social change, and recommendations for further study are provided in Section 5.

Section 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this phenomenological study was to examine the perceptions of science teachers regarding DI strategies. Additionally, I investigated participants' definitions and understanding of DI, prior workshops and trainings, and frequency of implications of DI strategies. Multiple sources of evidence were applied in the triangulation of the data to establish validity and reliability. The questions guiding this research about the perceptions of science teachers in regard to DI understanding, training, and implementation were as follows:

RQ1.What are the reported experiences of science teachers, annually trained in DI strategies, regarding their implementation of DI strategies at a rural southeast Georgia middle school?

RQ2. What strengths and difficulties do science teachers trained in DI strategies report regarding their implementation of DI, and what do they say they do to address identified difficulties?

Data collection for this study involved the DI trainings, the interview sessions, the 9 weeks of observations in the classrooms of the seven participants, and the lesson plan records. The interview guide contained seven main questions and one postobservation question regarding the participants' trainings, perceptions, prior and current use of DI, and stories about their experiences.

Organization of Section

To address the research questions, interviews, lesson plans, and observations represented data from seven middle school science teachers from a public school in southeast Georgia. Section 1 presented the problem, purpose for exploring teacher perceptions of DI, and a background of the approach. Section 2 provided the literature review of the research surrounding the approach. Section 3 contained an explanation of the methodology used to collect, code, and analyze the data. Section 4 presented an analysis of the findings from the data collected. Section 5 presents a discussion and interpretation of the results provided in Section 4. More specifically, Section 5 summarizes the research study, including interpretations of findings, implications for social change, recommendations for action, recommendations for further study, reflections, and conclusions.

Discussion

A phenomenological method was appropriate for this study for numerous reasons (Moustakas, 1994). First, by conducting interviews with a small sample, stronger themes from each unit of analysis emerged. A phenomenological method portrayed the perceptions and explanations of a specific occurrence. The purpose of this study was to describe how teachers perceived the pedagogical strategy of DI.

Multiple sources of evidence included interviews, lesson plans, and observations used to triangulate the data for validity and reliability. After completing and listening to the interviews, I triangulated the results from the data, along with the lesson plans and observations to identify common themes. DI strategies represent a way to meet the

learning needs of all students (Rock et al., 2008). Seven teachers' perceptions of DI implementation were revealed through interviews, observations, and lesson plans. The data generated themes to answer the two research questions. The following discussion explains the seven participants' responses in connection to the two research questions.

Research Question 1

Research Question 1 asked, What are the reported experiences of science teachers, annually trained in DI strategies, regarding their implementation of DI strategies at a rural southeast Georgia middle school? A conclusion was that middle school science teachers practiced DI differently and in various levels. DI encourages mastery of learning for all students, not just gifted and talented or special service students (Rock et al., 2008).

Participants concurred that additional training was necessary in applying DI strategies so that teachers will feel more comfortable with using the high-preparation strategies. The participants used verbal and written feedback to encourage and motivate their students to participate in class. The participants noticed that consistent feedback and student-focused lessons aided in the learning and participation in class. In addition, once the students engaged in learning and became expert in a DI strategy, they wanted to explore more DI strategies that would engage their interest in the science topics.

The participants agreed that the DI strategies should be a part of the learning activities every other day, if not daily, to produce a classroom with a nurturing climate that is conducive to learning and teaching. The process of developing teacher–student and student–student relationships is demanding but necessary for constructing trust, respect, and confidence in the learning arena.

Philosophy of teaching. All of the participants in this study had at least 1 year experience of teaching science. Four of the participants completed the summer trainings both years. All of the participants completed the in-service workshops and book studies. The trainings, book studies, and in-service workshops may or may not have always involved DI application. Sometimes the sessions involved discussion of implementation. This gap in previous knowledge or training in differentiated instructional strategies was obvious from the interviews and observations with the participants. All of the participants implied that they had heard of the term *differentiated instruction*, but they had not applied the strategies often enough to be experts. The fact that teachers may have had no or little experience in implementing DI and/or training in differentiated instructional strategies is an important finding in this study.

Classroom setting changes and DI strategies used. The teachers in this study reported the use of DI in the classroom had positive outcomes on their teaching styles and students. Scigliano and Hipsky (2010) suggested that teachers who seek to apply DI focus on the student's interest, readiness, and learning profile to plan instruction. The participants indicated that lesson planning was challenging and lengthy. All of the participants employed DI strategies, but most of the strategies involved low preparation. Participants decided that as retention of material increased, student engagement increased and resulted in better student collaboration and communication. Many of the participants implied that in their past practices, they had used pedagogical strategies known as differentiated strategies.

Research Question 2

Research Question 2 asked, What strengths and difficulties do science teachers trained in DI strategies report regarding their implementation of DI and what do they say they do to address identified difficulties?

Student outcomes. Regarding the use of DI in the classrooms, the teachers in this study reported the use of DI in the classroom had positive effects on their students. According to most teachers, learning science became fun, which aligns with Sondergeld and Schultz (2008); moreover, positive findings showed that learning shifted from the teacher to the students with student retention of the content increasing. Although the study was only 9 weeks in duration, some of the participants stated that academic performance increased due to student engagement and improved comprehension levels. The participants indicated that as the students became more involved and the benefits became evident throughout the classroom, the experience for the teachers and students was positive. The majority of the participants stated that their students enjoyed the DI strategies that were implemented.

Implementation and perceived challenges. The issues to implementing DI instructional strategies experienced by the participants were not many. Some of the problems are similar to what Kanevsky (2011) discussed. The seven participants cited issues in terms of time, classroom management, and use of the DI strategies. The participants indicated that extra time was necessary to prepare lessons that included DI. Since the DI methods were new, additional time was necessary in evaluating how the methods would be included in the lessons. Moreover, the participants were not

comfortable at first in using some of the DI methods; therefore, all of the participants began with low-preparation DI methods. In addition, they identified success with one DI strategy before venturing to other DI strategies. This unmanageable task led some of the participants to not use the methods as regularly as they otherwise would have because of the extra time required. Other issues cited by all of the participants were classroom management, student behavior, and noise level. DI methods involve student-centered tasks such as cooperative learning and peer work. Five of the participants reported that adjusting to the classroom noise level was a big issue. Adjusting to the noise level and confusion was challenging for some participants, as noticed throughout the classroom observations.

Implications for Positive Social Change

With the educational system recommending equal and fair chances for all students to succeed, public schools must provide opportunities in which all students can be successful with rigorous programs. Many educators find it excessively challenging to provide excellence for all students (Daggett, 2008; Ordover, 2012). A vision of DI is to empower teachers to teach on various grade levels to culturally diverse students in a heterogeneous classroom. DI is a challenging strategy that aids in equal educational opportunities for all.

This study results revealed various perceptions from teachers in a middle school with a variety of student cultures and backgrounds. The study revealed two main challenges the teachers faced in relation to using DI: the understanding of DI and the daily implementation of DI. The results of the study verified many of these challenges

were from the lack of understanding DI and that more professional development and practice is needed. The findings from this study showed that in heterogeneous science classrooms, the teachers accepted and implemented science strategies that were effective in helping the students with achievement.

Many teachers are reluctant to change; moreover, making vital modifications to teaching style is difficult for some people (Drapeau, 2004). As the teachers in this study disclosed lack of DI knowledge and understanding, it seems sensible to conclude that more workshops, book studies, or trainings to address these issues are needed. If lack of knowledge is more of a personal barrier to not wanting to learn, then it is clear that the school culture and the way in which teachers describe themselves and perceive their teaching style are the heart of the problem.

Social change may occur through the recommendations of this study by assisting teachers in providing enhanced instruction to students, hence effecting assessment outcomes. Moreover, the social implications developed from the findings include improvement of pedagogical strategies that promote student engagement and motivation for learning to empower students to be successful.

This phenomenological study provided an example in which teachers were able to modify traditional pedagogical strategies and conditions that are found in most heterogeneous middle schools by implementing strategies that appealed to the students' learning styles and academic success. Other middle schools and school districts could benefit from these advantages, hence cultivating teachers' ability to use different instructional strategies to raise academic achievement for all students.

Recommendations for Action

This phenomenological study examined teachers' perceptions of DI training and implementation in science classrooms. The participants had limited knowledge of DI and its methods. Based on the findings from the interviews, observations, and lesson plans, the following recommendations apply to school districts, administrators, and teachers.

The results of this qualitative study were sent to the superintendent of the county, the school principal, and the assistant principal. These results will aid in communicating how science teachers currently use DI from the trainings and book studies. Moreover, the data will help to determine the need for further professional development as it relates to high-preparation DI strategies and planning successful lessons with all teachers. The results were sent to participating teachers and other teachers so that varying perspectives about the understanding and implementation of DI and can help gain a better understanding of various teacher perspectives. I will share the results of this study with the community at a local board meeting and at the parent–teacher organization of the research site.

Recommendations for Further Study

This study could serve as a topic for researchers who are avid differentiators who can observe classrooms for effective DI practices so they would be able to instruct teachers on how to implement DI.

1. A similar study could investigate DI at the elementary and high school levels to provide a more comprehensive view of which instructional strategies are more effective for different grade levels in the public school system.

2. A study of various content teachers would make it possible for investigators to examine whether the content area taught has any influence on teacher perceptions or practices. It would be beneficial to see how various teachers at different schools use the different DI strategies.

Reflections

Student achievement and accountability affect the way the public views schools and teachers. Consequently, educational modifications influence the teaching and learning process. With student diversity increasing each year, teachers must know how to teach effectively so that students can be successful. Revealing teachers' perceptions about DI was the focal point of this study. The study did not determine what methods were effective; it revealed the teachers' experiences and awareness of DI.

My research took on a different approach from the initial time of this study. I thought I would have surveys and do a mixed-method study; however, after more research and consideration, I found that a qualitative phenomenological study would be the best approach. This approach would allow me to study the phenomenon from firsthand experiences of the participants. The literature review offered present-day research on differentiated instructional strategies, qualitative research methods that allowed for an intense evaluation, and clarification of the data.

Being a new gifted certified teacher and having several trainings on standards-based strategies such as DI, I had personal preferences for the use of DI. Interviews and observations aided in the validity and reliability of the study. Qualitative studies provide for a rich description of opinions (Creswell, 2007). The participants were able to respond

to the interview questions frankly. I feel that this phenomenological study aided in the teachers being open to discuss their perspectives and thoughts about DI. The extensive literature review, data collection process, and analysis process allowed me to gain a better insight into the research process.

Summary

The purpose of this qualitative study was to explore the perceptions of seven science teachers in a rural middle school in Georgia who had training and book study workshops in DI. The phenomenological approach allowed for a comprehensive examination of the lived experiences of teachers. The research design offered teachers a chance to share their feelings, attitudes, and knowledge about DI strategies. The results of the study indicated that teachers must understand and succeed in using DI for effective implementation. Teachers would benefit from receiving more real-world professional development to improve classroom management, writing lesson plans with useful activities, and practice of DI. Furthermore, the results from the study showed that teachers perceive the approach encouragingly in theory and negatively in classroom practice and application. This study offered evidence about DI strategies and practices used by a sample of science teachers that might help other teachers to be successful by inspiring them to consider implementing instructional strategies that meet the needs of all students.

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Appendix A: Letter of Informed Cooperation From School Principal

July 12, 2012

_____ School System
(School Address)

To Whom It May Concern,

As a doctoral student at Walden University, I am conducting a research study for my doctoral study entitled *Differentiated Instruction in a Middle School Science Classroom.* This phenomenological qualitative study will include five science teachers and three special service teachers from one school within your school district. The study will (a) include one in-depth interview from each participant which last 45–60 minutes with follow-up questions after the observations to verify transcription and (b) two to three 20-minute classroom observation of each participant. The interviews will take place after school. The observations will take place during the teachers' science class. A tremendous effort will be taken not to disturb the teaching activity. Thank you for your cooperation within this study.

I understand the data collected will remain entirely confidential and may not be provided to anyone outside the research team without permission from the Walden University IRB.

Sincerely,

Marsha Hogan
Ed. D Student
Walden University

Principal Signature_____

Appendix B: Letter of Informed Cooperation From District

_____ School System
(District Address)

To Whom It May Concern,

As a doctoral student at Walden University, I am conducting a research study for my doctoral study entitled *Differentiated Instruction in a Middle School Science Classroom.* This phenomenological qualitative study will include five science teachers and three special service teachers from one school within your school district. The study will (a) include one in-depth interview from each participant, which last 45–60 minutes with follow-up questions after the observations to verify transcription and (b) four 20-minute classroom observation of each participant. The interviews will take place after school. The observations will take place during the teachers' science class. A tremendous effort not to disturb the teaching activity will occur. Thank you for your cooperation within this study.

I understand the data collected will remain entirely confidential. No one outside the research team will have access to documentations in this study without permission from the Walden University IRB.

Sincerely,

Marsha Hogan
EdD Student
Walden University

Superintendent Signature_____

Appendix C: Participant E-Mail for Participation

Dear _____,

This e-mail comes to you because I would like to invite you to participate in a study entitled **Differentiated instruction in a middle school science classroom**. This study involves science teacher perceptions on the use and experiences of Differentiated Instruction in middle school science classrooms as part of a doctoral dissertation at Walden University. Participation will involve a 45- to 60-minute interview and four 20-minute prescheduled classroom observations. During the interview, I will ask you about various aspects of your instruction regarding science and differentiated instruction.

You are free to agree or disagree to participate. Your participation in this study is voluntary and will remain confidential. There will be no inducement or tangible rewards granted for participating in the study. In addition, please note that your participation in this study will have no effect on your job. If you agree to participate in this study, I will arrange a time to schedule an interview at your convenience. Once the interview occurs, we will schedule the observation, and I will provide an opportunity for a follow-up session in which you may revise or clarify experiences with using differentiated instruction.

If you agree to participate in this study, please take a consent form from my box, sign it and place it back in my box a week (7 days) after receiving this e-mail.

Thanks,

Marsha Hogan
EdD Student
Walden University

Appendix D: Consent Form

You are invited to take part in a research study title: **Differentiated instruction in a middle school science classroom**. You were chosen for the study because of your experienced, knowledge and availability at the facility that the study will be conducted. Please read this form and ask any questions you have before agreeing to be part of the study. This study is being conducted by a researcher named Marsha Hogan who is a doctoral student at Walden University.

Background Information:

The purpose of this study is to investigate teachers' experiences of using differentiated instruction in a middle school science classroom in order to provide a better understanding of the perceived benefits and weaknesses of this instructional method from a teacher perspective as well as any particular difficulties that are experienced in its use. As well as exploring general experiences of using differentiated instruction, it will also examine teachers' awareness and experiences of a number of specific DI techniques, in order to help illuminate differences in their effectiveness or ease of use.

Procedures:

If you agree to be in this study, you will be asked to:

- Show documentation of the use of a DI strategy (lesson plans).
- Allow observations of lessons.
- Share in a face-to-face interview with the researcher.

Voluntary Nature of the Study:

Your participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want to be in the study. No one at Fort Valley Middle School will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind later. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study:

There are minimal or no seen risk associated with this project. Also the benefits that you will gain will be a result in helping the students retain and mastery science skills that will last a lifetime.

Compensation:

There is no monetary award for participating in this study; however, a verbal thank you for participating in the study will be given once the study is complete.

Confidentiality:

Any information you provide will be kept confidential. The researcher will not use your information for any purposes outside of this research project. Also, the researcher will not include your name or anything else that could identify you in any reports of the study. The interview question and the follow up question after the viewing of the lesson plans and the observations will be coded and recorded with the code assigned to each participant.

Contacts and Questions:

The researcher's name is Marsha Hogan. The researcher's faculty advisor is Dr. Li-Ching Hung. You may ask any questions you have now. Or if you have questions later, you may contact the researcher via e-mail or the advisor at Li-Ching Hung via e-mail at li-ching.hung@waldenu.edu If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Director of the Research Center at Walden University. Her phone number is 1-800-925-3368, extension 1210.

The researcher will give you a copy of this form to keep.

Statement of Consent:

☐ I have read the above information. I have received answers to any questions I have at this time. I am 18 years of age or older, and I consent to participate in the study.

Printed Name of Participant

Participant's Written or Electronic* Signature _____

Researcher's Written or Electronic* Signature Marsha R. Hogan _____

Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an electronic signature can be the person's typed name, their e-mail address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

Appendix E: Teacher Interview Questions

1. Describe your philosophy and viewpoint of teaching as it connects to your work in the classroom, especially with working with students and understanding DI strategies.
2. What changes have you made in your classroom setting since implementing DI?
    a. Describe the physical setting (seating arrangement, wall decor, etc.).
    b. Describe the classroom climate (teacher–student interactions, student–student interactions, classroom management, etc.).
3. What do you know about differentiated instruction? What do you see as the possible benefits of differentiated instruction? How do you differentiate instruction? When you differentiate, do you do it always, or only under certain circumstances?
4. What do you perceive were the challenges while implementing DI (during lessons, planning lessons, etc.)?
5. What specific DI strategies did you use to work with the students in your classroom? Which ones did you consider effective for student learning? Which ones would you exclude?
6. How are teachers held accountable, if at all, to differentiate instruction? What could administrators provide teachers to help them differentiate instruction?
7. What is your general feeling of DI as an everyday methodical strategy for your classrooms?

Postobservation Question: How effective was the DI strategy used for student learning in the lesson taught (challenges/or success)?

Curriculum Vitae

Marsha Hogan

Leader, coach, and certified educator with a specialist's degree and 20 years' experience instructing middle school students. I am currently pursuing my EdD in Teacher Leadership with the goal of improving student performance and inspiring changes by helping students learn today and lead tomorrow.

Summary of Qualifications

- An innovative and passionate educator, mentor and leader who deems that all children can learn in a learning environment that is motivating, nurturing, and suitable to their learning preferences and abilities.
- Specializations include: Middle Grades Education with concentrations in English, Social Science, and Science, Gifted Endorsement.
- Instructional Leadership—Use motivational and data-driven instruction practices to enhance curricula by using rigor.
- Parental Involvement – Work diligently with parents by securing a high level of parental involvement
- Leverage Resources/Strategic Collaborations – Work closely with teachers at my school, teachers at the neighboring school, principals, curriculum facilitators, and community partners to encourage parental involvement and strong community alliances.

Education

2006–Present	Candidate for Educational doctorate – Teacher Leadership
	Walden University, Minneapolis, Minnesota
1996–1997	Educational Specialist—Middle Grades Education
	Columbus State University, Columbus Georgia
1994–1995	Masters of Education—Middle Grades Education
	Fort Valley State University, Fort Valley, Georgia
1991–1994	Bachelor of Science— Middle Grades Education
	Fort Valley State University, Fort Valley, Georgia

Work Experience

2012–2014	Grades 6–8 gifted science teacher
1995–2012	Grade 8 science teacher
1995–2014	Mentors for new science teachers
1999–2011	Science Facilitator
2001–2013	Middle School girls track coach
1999–2008	Middle School Basketball coach
1999–2011	Middle School Softball Coach
2010–2014	Assistant High School Girls Basketball Coach
1994–1995	Grade 6 English, reading and social studies teacher

Licensure and Certifications

L-4 Teaching Certificate: Middle Grades Education with concentrations in Social Science, and English

L-5 Teaching Certificate: Middle Grades Education with concentrations in science, Social Science, and English

L-6 Teaching Certificate: Middle Grades Education with concentrations in science, Social Science, and English

Gifted Endorsement Certification

Professional and Social Organizational Affiliations

Peach County Association of Educators

National Science Teachers Association

Georgia Association of Educators

National Educators Association

Alpha Kappa Alpha Sorority

Achievements

• Contributed to a significant increase in student performances on social studies standardized testing, with a 100% success rate in 2012–2014 school year.

•Contributed to a significant increase in student performances on standardized testing, with a 96% success rate in 2012–2013 school year.

• Contributed to a significant increase in student performances on science standardized testing, with a 93% success rate in 2013–2014 school year.

• Mentored and coached students and teachers to help increase their confidence and competencies in science.