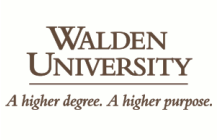

2015

A Case Study Investigating Secondary Science Teachers' Perceptions of Science Literacy Instruction

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COLLEGE OF EDUCATION

This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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2015

Abstract

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by

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EdS, Walden University, 2012

MAEd, East Carolina University, 1994

BS, East Carolina University, 1985

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

November 2015

Abstract

This project study addressed the lack of inclusion of discipline literacy pedagogy in secondary classrooms in a rural school district in eastern North Carolina. Discipline literacy practices are recommended in the Common Core Standards for History/Social Studies, Science, and Technical Subjects. The district had implemented content area reading strategies across content areas, yet no significant progress in secondary students' reading abilities had been demonstrated in statewide or national assessments. The conceptual framework that drove this study was disciplinary literacy, founded by the literacy research of Shanahan, Shanahan, and Zygouris-Coe. Within a qualitative case study method, this investigation of 8 secondary science teachers' experiences teaching literacy during content instruction focused on practices of embedding science-specific reading strategies into lessons and factors that influence teachers' decisions to participate in professional development to advance their learning of discipline-specific literacy methods. Data were collected and triangulated using a focus group and 8 individual interviews. Data from both methods were analyzed into codes and categories that developed into emergent themes. Findings from the focus group and individual interviews revealed that the science teachers possessed limited knowledge of science-specific reading strategies; used random, general literacy practices; and had completed inadequate professional development on science-related topics. Positive change may occur if district leaders support teachers in expanding their knowledge and application of discipline literacy strategies through participation in discipline literacy-focused professional development. The study may provide educators and researchers a deeper understanding of disciplinary literacy and increase research on the topic.

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Dedication

I would like to dedicate this degree to my Lord and Savior Jesus Christ, for His wisdom and understanding led me through this doctoral degree journey. It is to Him that I offer this degree; I would have never made such an achievement. I can do all things through Christ which strengtheneth me (Philippians 4:13). Thank you, Lord, I am eternally grateful.

A very special dedication to my parents, the late Douglas Blackmon and my blessed mother, Peggy Blackmon; if it were not for your constant prayers, support, and encouragement to persevere, none of this would be possible. Daddy, I will never forget your faith in God and your presence in my life. Mother, your love and dedication to our family are never-ending; what an impact you had on me to go into the field of education. Additionally, a very special dedication goes to my beloved sister, Athena Brown. Your love is infinite as the stars in the sky.

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Heartfelt appreciation is declared to the greatest chairperson in the education field, Dr. Ellen Scales. I am indebted to your wisdom; for the past 3 years, your constant insight has changed my life forever. Association with someone of your caliber is an honor. I can only aspire to develop into a professor and scholar like you. You are truly an asset to Walden University. Additional appreciation goes to Dr. R. Fowler and Dr. J. Sorrell; without your knowledge and support, the degree would not have been possible. Finally, deep appreciation goes to Dr. Amanda Cook. Your suggestions from a new perspective and critical insight brought me your editing craft. I am truly indebted to you and hope to pay it forward to future students.

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Section 1: The Problem

Introduction

Adolescents in the 21st-century face greater literacy challenges than their predecessors (Biancarosa & Snow, 2006; Carnegie Council on Advancing Literacy, 2010; Goldman, 2012; Jacobs, 2008; Meyer, 2013). Despite national attention to research-based literacy approaches, little change has occurred in secondary instruction; secondary teachers still view themselves as content specialists and not literacy teachers (Fang & Schleppegrell, 2010; Goldman, 2012; Meyer, 2013). Teachers and students today require knowledge and use of reading and writing strategies that support the ability to solve problems and make decisions in academic, personal, and professional contexts (Goldman, 2012; Graham & Hebert, 2012).

Secondary educators who are not literacy specialists—science, math, and social studies teachers—fail to understand basic, discipline-specific literacy practices (Buehl, 2011). The majority of explicit reading instruction concludes in the late elementary grades (Bean & O'Brien, 2012; Carnegie Council on Advancing Adolescent Literacy, 2010; Shanahan & Shanahan, 2008). The result is that secondary teachers lack knowledge of approaches for teaching reading yet are required to teach reading to the students who need it most (Ulusoy & Dedeoglu, 2011). Zygouris-Coe (2015) found that

> If teachers and schools are to meet the knowledge and literacy demands of the 21st century, they can no longer contain literacy learning in intensive, or corrective, reading classrooms, or make the English language arts teachers

> solely responsible for students' literacy knowledge and skills. Literacy has to be developed in each content area for the purpose of knowing and learning within each discipline. Content and literacy learning cannot be separated; they must develop together (p. xiv).

For years, researchers and educators have maintained that academic content teachers should teach reading strategies during content instruction (Cobern et al., 2010; Darling-Hammond & Richardson, 2009; Fang & Schleppegrell, 2011; Fisher, Grant, & Frey, 2009; Shanahan & Shanahan, 2008). Perspectives relating to content learning have shifted from approaches that support extracting information from text to those that emphasize comprehending texts by applying specific techniques to construct meaning from the text (Goldman, 2012; O'Brien, Stewart, & Moje, 1995; West, Hopper, & Hamil, 2010). Today, the field of disciplinary literacy emphasizes discipline-specific literacy strategies taught by knowledgeable teachers who understand how learning problem solving and decision making depends on analyzing and embedding specific content constructs (Shanahan & Shanahan, 2008; Snow, 2010).

The purpose of this inquiry was to investigate Douglas County's (pseudonym) secondary science teachers' literacy pedagogies with explicit science-specific literacy approaches embedded during content instruction. Concurrently, the exploration involved discovering factors that influence teachers' decisions to participate in professional development to learn discipline-specific reading methods.

The remainder of this section includes (a) the definition of the problem, (b) the rationale for the problem, (c) special terms with definitions, (d) the significance of the

problem, (e) the research questions, (f) a literature review, (g) possible implications of the project, and (h) a section summary.

Definition of the Problem

The problem facing Douglas County, a rural school district in eastern North Carolina, was the lack of inclusion of literacy pedagogy in secondary science classrooms, as recommended in the Common Core Standards for Literacy in History/Social Studies, Science, and Technical Subjects. The Council of Chief State School Officers and the National Governors Association approved the Standards in 2010. The design of these literacy standards mirrored the standards for literature and informational texts, reinforcing the focus on literacy as a shared responsibility across content areas. The common core standards require teachers in Grades 6 through 12 to embed close and active reading of texts, grounding all tasks and assignments in comprehension and analysis of the text itself. The reconceptualization of literacy in the different disciplines manifested in the formation of the Standards (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010).

The reading-in-science standards for the grade spans of 6-8, 9-10, and 11-12, specifically Standards 1 and 4, include the integration of knowledge regarding scientific key ideas and details, as well as craft and structure of grade-level texts and topics. Standard 1 for Grades 6-12 requires students to be able to cite specific textual evidence to support analysis of science and technical texts. However, beginning in Grades 9-10, the descriptor includes students attending to the precise details of explanations or descriptions, and the requirement for Grades 11-12 includes students attending to

important distinctions an author makes and to any gaps or inconsistencies in the account. Students in the upper secondary grades are required to use advanced literacy strategies. It is essential that students in Grade 9 use descriptions directly from the texts, and in Grade 10, students focus on precise details involved in explanation or descriptions used in the texts. Finally, in Grades 11 and 12, students analyze texts by addressing important contrasts the authors attempt to use and any contradictory information in the texts. For Standard 4, the descriptors reflect identical requirements for students in Grades 6 through 12, except for advancing grade-level texts and topics. The standard states that students are to determine the meaning of symbols, key terms, and other domain-specific words and phrases used in a specific scientific or technical context relevant to the specific grade level's texts and topics (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010).

Standards alone cannot change literacy practices within subject areas of teachers' instruction. According to Goldman (2012), secondary grades teachers' "primary responsibility has been to teach content, de-emphasizing the literacy practices central to comprehending the content and thereby increasing the struggles of students who may not have learned how to read adequately in the lower grades" (p. 93). Teachers need opportunities to make learning as vigorous as possible so that learning becomes more transferable in different contexts (West, Hopper, & Hamil, 2010).

Over the past 20 years, there has been a shift in literacy education. In the past, literacy, or simply reading, was thought to be a process of decoding or having the skills to interpret print (Krajcik & Sutherland, 2010). However, changes have occurred in how

those in the education field view literacy and its requisite skills. Shanahan and Shanahan's (2008) benchmark study opened serious conversation on embedding literacy in separate fields of study. Today, the concept of disciplinary literacy remains at the forefront of literacy research. Shanahan and Shanahan's study signifies the understanding of advanced content requiring the ability to apply discipline-specific reading strategies supporting comprehension (Fang & Coatoam, 2013).

Unfortunately, the number of studies conducted on disciplinary literacy and teaching instruction remains relatively small (Goldman, 2012). The limited research has resulted in much-needed attention to specific teachers' instructional practices related to disciplinary literacy and in-depth clarification between content area reading strategies and discipline-specific reading practices. The groundwork for establishing the meaning of disciplinary literacy used in this study was presented by Shanahan and Shanahan (2008) and Zygouris-Coe (2012), as defined on the terminology pages in this section.

As recently as 2013, the Director of North Carolina Curriculum and Instruction and I held a conversation concerning possible instructional needs with North Carolina's secondary teachers. The curriculum director stated, "our state's secondary content-area teachers need to acquire and execute content-specific reading and writing skills within daily lessons guiding all students to success" (personal communication, March 13, 2013). This knowledge supported my interest in investigating a school system in North Carolina in order to gain knowledge of advanced literacy practices among the secondary teachers.

The purpose of this investigation was to examine secondary science teachers' literacy instructional practices in Douglas County schools, specifically the embedding of

science-specific literacy strategies. Additionally, the aim was to explore what factors influence the teachers' decisions to participate in professional development to learn discipline-specific reading methods. The local school district's secondary students have repeatedly demonstrated below-proficient reading performances on the North Carolina statewide assessments and the National Assessment of Educational Progress.

Improving reading strategies among secondary faculty is a challenge (Buehl, 2011). Explicit reading instruction commonly ends in the elementary grades in many schools; in secondary settings, no one person or department is specifically responsible for literacy achievement (Fisher, Frey, & Alfaro, 2013). Content teachers—teachers who are instructing in academic areas other than English—may look to English teachers to carry the literacy torch (National Council of Teachers of English, 2011). However, even secondary English teachers are typically prepared to teach only literature, not literacy (Shanahan & Shanahan, 2008). Researchers have suggested that secondary English teachers possess limited literacy proficiency and that they struggle to support students' application of literacy strategies in their texts (Biancarosa & Snow, 2006; Bleicher, 2014).

While North Carolina (NC) school districts create guidelines to change classroom literacy practices, student achievement data do not reflect that students can apply literacy strategies. The data suggest one possible explanation for the absence of growth in reading: secondary subject teachers' limited knowledge and use of discipline-specific literacy strategies during classroom instruction. Professional development can provide secondary science teachers with content-specific reading strategies to teach to their

students, including hands-on experience with classroom texts (Lee & Sprately, 2010; Schneider & Plasman, 2011).

As Zygouris-Coe (2007, 2012) found, secondary educators cannot afford to use only general literacy instruction in the 21st century; educators must learn and embed content-specific literacy strategies to support students in their content areas. Over the past several years, within Douglas County secondary schools, teachers have been encouraged to teach content standards through the use of broad and simple literacy practices. The current North Carolina science standards related to literacy seem to encourage broad literacy abilities such as finding and determining answers to questions derived from everyday experiences; describing, explaining, and predicting natural phenomena; understanding articles about science; and posing explanations based on evidence derived from one's own work (North Carolina Public Instruction, 2015). Students in Douglas County are instructed to create a "tool-box" of general literacy strategies. These methods, used across content areas, are intended to strengthen understanding of various texts. One general literacy practice used in secondary classrooms is *concept mapping*; this practice involves teaching students the meaning of key concepts through graphic organizers. Graphic organizers can provide a means to compare and contrast, sequence, or organize information around central concepts and subtopics.

Another broad literacy tool commonly used during secondary literacy instruction is called an *anticipation guide*. An anticipation guide is a comprehension strategy used before reading to activate students' prior knowledge and build curiosity about a new

topic. Before reading, students listen to or read several statements about key concepts presented in the text. The guide's structure is a series of statements with which the students can choose to agree or disagree. Anticipation guides stimulate students' interest in a topic and set a purpose for reading (Biancarosa & Snow, 2004).

Douglas County School District is a rural school system in eastern North Carolina encompassing 18 schools. It serves approximately 9,000 students and employs over 350 teachers in Grades PK–12. Douglas County is classified as a regular public school system. The U.S. Department of Education identifies a *regular school* as a public elementary/secondary school providing instruction and education services that do not focus primarily on special education, vocational/technical education, or alternative education, or on any of the particular themes associated with magnet/special program emphasis schools (U.S. Department of Education, National Center for Education Statistics, 2015).

The school system is located in an agriculturally centered county; the schools' communities are of low/middle to middle-income socioeconomic status. The school district is one of many North Carolina school systems that face the challenge of addressing secondary students' below-proficient reading performances. A common approach to addressing the issue is to provide secondary teachers with opportunities to learn and to use general literacy strategies within content instruction. The challenge remains at the forefront of Douglas County and numerous other school systems in the state.

School reform is often lost in budget discussions, and professional development is one area where budgets may be thinned. Public schools in North Carolina operate with funding from local, state, and federal sources. During the 2011-2013 school years, county secondary schools qualified for Title I status under federal guidelines. As a result, during the school year 2012–2013, the district's financial support was $1,370.00 per student from state funds and $2,095.00 per student from federal funds (NC Department of Public Instruction, 2011-2013). This financial support included all expenses concerned with operating schools, including teacher and administrator salaries, textbooks, and other educational supplies and materials, such as professional development (NC Department of Public Instruction, 2011-2013).

During the 2011–2013 school years, each of the secondary schools' enrollment averaged 510 students. On average, 95% of students in Grades 6–8 attended school daily. Students in Grades 7 and 8 in the district were given the opportunity to take credited high school courses in the content areas of science and math (NC Department of Public Instruction, 2011-2013).

Table 1 shows the percentage of students in Grades 6–8 who performed at the achievement level of proficient or above in reading. Within this 2 year period, only one grade level from the district achieved proficiency status as measured by the ABC tests. The ABC is a North Carolina accountability program used to measure relative student performances on statewide assessments during a 2 year period (NC Department of Public Instruction, 2011-2013).

Table 1

District's Performance on the NC ABCs End-of-Grade Reading Tests

	Percentage of students at proficient or above	
Grade level	2011–2012	2012–2013
6	70.3	37.3
7	64.5	39.1
8	65.9	34.2
Overall	68.8	37.5

Note. Retrieved from "Education First: NC School Report Cards," n.d., by North Carolina Department of Public Instruction, retrieved from http://www.ncreportcards.org/src

Consequently, the school district's literacy investments are not resulting in expected literacy gains. Over the past 3 years, the district has disbursed allotted professional development funds to provide secondary teachers with professional development focused on learning and implementing content area reading strategies. The implementation of content area reading strategies appears to be insufficient for students to perform at the proficient level on the NC statewide standardized test for Grades 3-8, the end-of-year assessment. End-of-year assessments are administered during the last 2 weeks of each school year.

Moreover, Table 2 shows the percentage of students scoring at or above grade level achievement in reading for Grades 6, 7, and 8. The data come from the district's North Carolina Grade 8 end-of-grade reading assessments.

Table 2

District's Grade-Level Reading Performance by Student Subgroup

	Percentage of students with passing scores	
Subgroup	2011–2012	2012–2013
Female	67.5	27.2
Male	64.1	25.8
White	77.9	36.6
Black	50.6	14.7
Hispanic	58.9	19.4
American Indian	61.1	29.6
Asian	75.0	NA
Two or more races	66.4	31.1
Low SES	60.5	19.5
Limited English	43.1	8.6
Students w/disabilities	37.4	6.0

Note. Retrieved from "Education First: NC School Report Cards," n.d., by North Carolina Department of Public Instruction, retrieved from http://www.ncreportcards.org /src

The data in Tables 1 and 2 represent assessment results for the school years 2011–2013. Results are published in an annual document titled "North Carolina School Report Card." The school district's proficient scores consistently declined or remained the same over the same period. The percentage of proficient scores enables comparison of subsequent years' students with the "norming" students' performances. The "norming" year was the first year of the assessment. Additionally, the percentages show specific demographic groups' performance at or above the proficient level; percentages range from 1% to 99%.

As stated by the North Carolina state superintendent, the NC School Report Card is one of the state's most comprehensive resources for information about students, districts, and levels of achievement. The report card results for 2012-2013 were the first results after the implementation of North Carolina's new READY standards and accountability model (NC Department of Public Instruction, 2013).

This research study adds to the literature by investigating, through a qualitative analysis, teachers' literacy instructional practices, with a focus on teachers' discipline-specific science literacy strategies. It also explores the factors teachers describe as influencing whether they participate in professional development sessions to improve their disciplinary literacy skills. Taken together, the research provides an analysis of teachers' instruction and teachers' continuing educational goals for student literacy.

Rationale

Evidence of the Problem at the Local Level

District literacy data indicate that secondary students need literacy-rich instructional practices in science class to support their comprehension of complex science texts. District leaders are now focused on providing professional development to help secondary science teachers to learn or advance the learning of discipline-specific strategies. According to Pearson, Moje, and Greenleaf (2010), providing teachers with professional learning opportunities is a valuable way to support teachers' understanding of learning science through texts. Furthermore, Greenleaf and Schoenbach (2004) found that one of the essential elements of professional development was the opportunity to embed learned strategies into authentic lessons.

Research indicates that the majority of secondary content teachers apply content-area reading strategies, such as general study skills, summarizing, or note-taking, not discipline-specific ones involving practices used by a discipline's experts engaging with a text to analyze and synthesize information within and across multiple sources of evidence (Goldman, 2012; Schneider & Plasman, 2011; Shanahan, Shanahan, & Misischia, 2011). The common approach to content area reading in today's secondary classrooms consistently limits the advancement of students' literacy abilities (Marri et al., 2011; Snow & Moje, 2010). In support of this notion, the National Governors Association (2010) remarked that general literacy instructional practices are no longer acceptable for students' literacy achievement.

Moreover, the dire need for reading improvement in content areas is evidenced by stagnant national and international assessment results. The National Assessment for Educational Progress (NAEP) is the largest nationally representative assessment of what America's students know and what they can do in various subject areas. These assessments are conducted biennially in mathematics, reading, science, writing, the arts, civics, economics, geography, U.S. history, and, beginning in 2014, technology and engineering literacy (TEL). The development of a successful NAEP program involves researchers, state education officials, contractors, policymakers, students, and teachers.

Many secondary (Grades 6–12) students in the United States exhibit limited reading skills on the NAEP Science Assessment (Concannon-Gabney & McCarthy, 2012). The results of this assessment are provided through the Nation's Report Card. The Nation's Report Card informs the public of the academic achievement of elementary

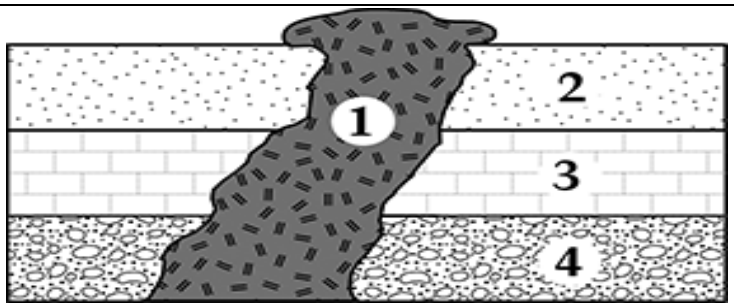
and secondary students in the United States. The Report Cards communicate the findings of the NAEP in content-specific areas over time (U.S. Department of Education, National Center for Education Statistics, 2010). The Grade 8 NAEP average scores have increased minimally over the past 10 years (U.S. Department of Education, National Center for Education Statistics, 2010). In the NAEP Science Assessment, which assesses both science knowledge and the ability to read and comprehend scientific material, the scale scores range from 0 to 300 for all grade levels tested: Grades 4, 8, and 12. Students' scores are grouped into four achievement levels: below basic, basic, proficient, and advanced.

The NAEP has been assessing students in three grade levels—4, 8, and 12—since 1996. The average scale score for students performing at or above the basic and proficient levels on the NAEP Science Assessment was slightly higher in 2011 (152) than 2009 (150). In 2011, only Grade 8 students were tested in science, and there was no significant change from 2009 in the achievement category of advanced (U.S. Department of Education, National Center for Education Statistics, 2010).

The NAEP defines reading as a dynamic cognitive process allowing students to understand written texts, develop and interpret meaning, and use meaning appropriately in relation to all types of texts, purposes, and situations (U.S. Department of Education, National Center for Education Statistics, 2010). Equally important, Kosanovich, Reed, and Miller (2010) stated that reading involves the process of making meaning in written text and manipulating meanings toward the text's purpose and context.

In a world that is quickly changing, science literacy is an essential to success for the nation's adolescents. The NAEP's Science Frameworks of 2009 and 2011 established four key features that combined science content and practices. The first two practices, identifying science and using science principles, are measured as "knowing science" and the other two, using scientific inquiry and using technological design, are reflected by applying the knowledge of science—"doing science" (U.S. Department of Education, National Center for Education Statistics, 2010). The cognitive demands associated with the assessments are (a) "knowing that," (b) "knowing how," (c) "knowing why," and (d) "knowing when and where to apply knowledge" (U.S. Department of Education, National Center for Education Statistics, 2010, p. 61). The assessment's science content combining and crossing the four practices generates students' performance expectations. The expectations lead to the development of inferences concerning what students know and can do (U.S. Department of Education, National Center for Education Statistics, 2010).

Figure 1 depicts a multiple-choice problem that students received during the 2011 NAEP. Although this problem required very little reading, understanding it depended on solid science literacy. The second part of the question required the vocabulary of science as well as the ability to recall and use the vocabulary of rock formations.



I. **Which rock formation was formed most recently?**

A. 1

B. 2

C. 3

D. 4

II. **Explain why you chose your answer and not the others.**

Figure 1. 2011 NAEP science assessment, Grade 8 released item. The diagram above shows a cross-section of rock formations. Adapted from "Science 2011 State Snapshot Report" from National Center for Educational Statistics, 2013, retrieved from http://nces.ed.gov/nationsreportcard/itmrlsx/search.aspx?subject=science

Evidence of the Problem From the Professional Literature

Embedding discipline-specific reading strategies into content instruction engages teachers to change their current mindset and to use pedagogical practices that are necessary for success in content areas (Fisher, Frey, & Alfaro, 2013). Literacy research from Fang and Coatoam (2013) showed that disciplinary literacy instruction is lacking, contributing to the national literacy crisis. Fang and Coatoam argued that content-specific literacy strategies should be taught in all classrooms. Unfortunately, many classroom teachers apply traditional, generic cognitive processing skills, such as but not

limited to predicting, connecting, summarizing, and asking literal questions. These skills are mostly taught through worksheet activities aimed at factual understanding (Shanahan & Shanahan, 2008). Evidence suggests that students retain limited amounts of information when they use limited thinking for worksheet activities (National Council of Teachers of English, 2011; Pearson et al., 2010).

Secondary content teachers commonly apply generalizable literacy practices, such as note-taking and using thinking maps, which are transferable from one subject to another (Bean & O'Brien, 2012). In contrast, disciplinary literacy builds on content knowledge to make meaning of text through the use of content-specific tools, print and other printed matter, such as but not limited to identifying Greek and Latin affixes in defining vocabulary and the use of nonverbal representations (Shanahan & Shanahan, 2008; Zygouris-Coe, 2012).

Researchers have found that teachers should use explicit content-based reading strategies during instruction beyond the elementary grades (Snow & Moje, 2010; Warren, 2013). An example of an essential early reading strategy is having students develop a graphic form that translates what they remember and understand from the information read (Beck, McKeown, & Kucan, 2002). In the area of advanced science, researchers found that scientists defined comprehension as having the ability to represent a concept in multiple formats, such as prose, picture, and formula (Shanahan, Shanahan, & Misichia, 2011). In the process of developing into proficient readers, students need to learn discipline-based reading strategies to learn from complex texts (Greenleaf et al., 2010). Comprehension instruction centered only on generic reading strategies falls short because

comprehension itself becomes more complex as the progression is made from grade to grade (Goldman, 2012).

Literacy and education researchers have defined discipline-specific reading strategies as analyzing various forms of texts, generating explanations by providing textual evidence, and combining information from multiple sources (Pearson et al., 2010; Shanahan et al., 2011). These strategies are measured on state and national assessments, where students' reading abilities are reported. Moreover, Goldman (2012) and Stofflett (1994) found that successful reading in science requires teachers to guide students' engagement in a text with the knowledge and reading habits of those who create and communicate science information. Shanahan and Shanahan (2012) found that the use of scientific vocabulary and the specialized tools to construct and analyze this language is noticeably different from general study techniques. The distinct process of building science vocabulary should consist of focusing on how and why scientific terminology is created and how to use Greek and Latin affixes to understand technical terms. This approach is quite different from assigning students to perform rote memorization of the dense vocabulary contained within the field of science (Shanahan & Shanahan, 2012). Hochberg and Desimone (2010) confirmed that the teacher's role is more powerful than that of any other school factor in predicting secondary students' reading achievement. Paik et al. (2011) specified that secondary teachers' ability to embed discipline-specific reading strategies into content instruction is a vital component of literacy reform at the school, district, and state levels.

This research study adds to the limited scholarly research on the topic of disciplinary literacy. The study's purpose was to investigate, through a qualitative case study, how secondary science teachers provide literacy instruction, specifically how they teach disciplinary literacy during science instruction, and to explore factors that influence teachers' decisions to participate in professional development to learn discipline-specific reading methods. The study's results contribute knowledge regarding secondary science teachers' literacy instructional practices and instruction, particularly in the area of disciplinary literacy. Additionally, the study may provide information to local and state education leaders regarding the benefits of embedding science-specific reading strategies into secondary classroom practices.

Definitions

*ABCs of North Carolina Public Education***:** The State Board of Education developed the ABCs of Public Education in response to the School-Based Management and Accountability Program enacted by the NC General Assembly. The program focuses on strong Accountability, teaching the Basics with an emphasis on high educational standards and maximum local Control. The program sets growth and performance standards for each elementary, middle, and high school in the state. End-of-grade (EOG) and end-of-course (EOC) test results and other components are used to measure a school's growth and performance (NC Department of Public Instruction, 2013).

Achievement levels: Performance standards set by the National Assessment Governing Board that provide a context for interpreting student performance on NAEP, based on recommendations from panels of educators and members of the public. The

levels—*basic*, *proficient*, and *advanced*—indicate what students know compared with what they should know at Grades 4, 8, and 12 (U.S. Department of Education, 2010).

Adequate yearly progress (AYP): Continuous and substantial yearly improvement of student achievement that is rigorous enough to achieve the established goal within the timeframe (U.S. Department of Education, Elementary and Secondary Education, 2013).

Advanced achievement level: One of the three NAEP achievement levels, denoting superior performance (U.S. Department of Education, National Center for Education Statistics, 2010).

Background questionnaire: The instrument used to collect information about teacher demographics and educational experiences (U.S. Department of Education Elementary and Secondary Education, 2013).

Basic achievement level: One of the three NAEP achievement levels, denoting partial mastery of prerequisite knowledge and skills that are fundamental for proficient work. NAEP also reports the "proportion of students whose scores place them below the Basic achievement level" (U.S. Department of Education, National Center for Education Statistics, 2010).

Disciplinary literacy: Involves pedagogical frameworks for disciplinary inquiry supporting content learning; it highlights the complex reading and writing demands and differentiated thinking strategies that characterize each discipline. Each discipline has its own community of language, texts, and ways of knowing, doing, and communicating (Zygouris-Coe, 2012).

Discipline-specific literacy strategies: Discipline-specific tools used to develop and analyze texts; use of the language (grammar, patterns, and uses) applied in a discipline. For example, in science, one strategy to build science vocabulary is to master specific Greek and Latin prefixes and suffixes (Shanahan & Shanahan, 2008).

Explicit instruction: Precise and clearly expressed information about reading comprehension strategies that teachers explain to students (Snow, 2010).

Lesson plan: A lesson plan is an instructor's road map of what students need to learn and how learning will occur effectively during class time. Before planning, the instructor identifies the learning objectives for the class meeting. Then, the instructor designs appropriate learning activities and develops strategies to obtain feedback on student learning. A successful lesson plan addresses and integrates these three key components: (a) objectives for student learning, (b) teaching/learning activities, and (c) strategies to check student understanding (Center for Research on Learning and Teaching, 2014).

National Assessment of Educational Progress (NAEP): The largest nationally representative and continuing assessment of American students' knowledge and ability in various subject areas (U.S. Department of Education, National Center for Education Statistics, 2010).

No Child Left Behind Act, 2001 (NCLB): Congressional educational reform designed to improve student achievement and change the culture of American schools (U.S. Department of Education, National Center for Education Statistics, 2010).

Pedagogy: The art and science of teaching children (Knowles, Holton, & Swanson, 2011).

Performance level: Percentage of students attaining specific levels of performance corresponding to five points on the NAEP long-term reading scales. The descriptions for each level reflect the types of questions that students performing at that level answer correctly more often than students at lower levels (U.S. Department of Education, National Center for Education Statistics, 2010).

Professional development: Learning opportunities made available to teachers and other education personnel with the goal of strengthening their understanding and skills associated with their teaching practice (Darling-Hammond & Richardson, 2009).

Proficient achievement level: One of three achievement levels that demonstrates competency in challenging subject matter, including subject-matter knowledge, application of knowledge to real-world situations, and analytical skills appropriate to the subject matter (U.S. Department of Education, National Center for Education Statistics, 2010).

Reading: Understanding the meaning of text—words, numbers, and images—in print or digital form (International Reading Association, 2013).

Reliability: Consistency of a set of measurements or of the measuring instrument (U.S. Department of Education, National Center for Education Statistics, 2010).

Scale score: A scale used to describe what students know and can do. NAEP subject area scales (including the scale for the science NAEP) typically range from zero to 300 (U.S. Department of Education, National Center for Education Statistics, 2010).

Science classroom: The research project uses the term "science" to encompass the science courses taught in Grades 6–8: biology, chemistry, earth science, general science, physical science, and any other science course offered in the Douglas School District (pseudonym).

Science literacy instructional practices (chemistry): Separating essential from inessential information, visualizing processes of an experiment, thinking of examples of an equation, analyzing graphic data with prose (Shanahan, Shanahan, & Misischia, 2011).

Secondary reading: Reading at the secondary level is the ability to understand and learn from grade-level text. Reading involves complex skills, but the most essential elements are the ability to read text accurately and fluently, background knowledge and vocabulary to make sense of the content, knowledge of and skill in using reading strategies when comprehension becomes difficult, the ability to think and reason about the information and concepts in the text, and motivation to understand and learn from text (Torgesen, Houston, & Rissman, 2007).

Secondary schools: Grades following elementary school. For the majority of North Carolina schools, *secondary* encompasses Grades 6–12 (NC Department of Public Instruction, 2013). Some researchers include Grades 4–12 in their research on content-area literacy (Alliance for Excellent Education, 2012).

Systematic professional development: Professional development that is not a one-time workshop, but rather is of significant duration, collaborative, and "intensive, ongoing, and connected to practice" (Darling-Hammond & Richardson, 2009, p. 5).

Teaching strategies: The purposeful learning activities teachers design to teach concepts or processes required to learn subject matter (Bean & O'Brien, 2012).

Significance

In 2001, political leaders endorsed the No Child Left Behind Act of 2001. This act holds schools and school districts accountable for following federal and state education policies (Draper, Broomhead, Jensen, & Nokes, 2012; Lunenburg, 2011). The law notes that states must identify adequate yearly progress as a component of each school's improvement plan. The political leaders who endorsed the NCLB did not fully understand the severe effect this act would have in terms of secondary teachers' need for resources and professional training to increase students' achievement (Lee & Spratley, 2010; Snow & Moje, 2010). Consequently, political leaders focused only on improving instruction for elementary teachers in Grades 1 through 3.

In 2007, NAEP found that 60% of 12th grade students scored below the proficient level, and of those students, 27% scored below the basic level in reading (Alliance for Excellent Education, 2012). Thus, 27% of secondary students graduated without mastery of the literacy skills needed for successful futures. Secondary teachers need to learn to embed discipline-specific literacy skills into daily lessons to achieve the levels of literacy required of graduating students (Cassidy & Ortlieb, 2012).

Furthermore, research from the National Council of Teachers of English (2011) indicated the need for professional development to guide secondary teachers in learning the importance of embedding discipline-specific literacy skills within content instruction. In 2010, NAEP conducted a reading comprehension analysis and found that American

students' scores were among the world's highest in Grade 4 but plummeted to the lowest by Grade 12. The U.S. Department of Education, National Center for Education Statistics (2010) observed a discrepancy between the scores, reflecting that limited secondary literacy capacities among teachers and students beyond elementary grades could be a cause of the poor Grade 12 scores. Leaders at the U.S. Department of Education consider this situation a crisis needing immediate attention.

The No Child Left Behind Act requires every state to participate in the NAEP assessment; each state must administer the reading and mathematics tests to randomly selected students every 2 years. The NAEP results allow each state to compare their assessments' outcomes to the NAEP expectations as well as to other states' assessments. The wide variation in students' outcomes between the NAEP and state assessments is a critical point of conversation. Questions arise for education leaders at the national, state, and local levels, who have various perspectives on and explanations for the assessment results (Goldman, 2012). The identified discrepancies between NAEP expectations and individual states' outcomes lead states to develop new standards. These state standards establish expectations for what students need to know and be able to do to succeed in college and career (Porter, McMaken, Hwang, & Yang, 2011).

As shown in Table 3, in 2013, eighth-grade students in North Carolina scored an average of 265 on the NAEP exam. This score was not significantly different from the national public school average of 266. The North Carolina average student score was also on par with the national average in 2011 (263) and 1998 (262).

Table 3

The Nation's 2013 Report Card: NC Public Schools Grade 8 Reading Report

	Scores by achievement level (%) and average score (of x)				
NC	Below basic	Basic	Proficient	Advanced	Average score
2007	29	43	26	2	259
2009	30	41	26	3	260
2011	26	43	28	3	263
2013	24	43	29	4	265
U.S. (public)					
2013	23	42	31	4	266

Note. From "National Assessment of Educational Progress (NAEP), Reading Assessments," 2013, by U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, retrieved from http://nationsreportcard.gov/reading_math2013#/executive summary

When secondary students' assessment performances demonstrated limited literacy abilities and education researchers suggested that inadequate literacy instruction was to blame, literacy-based reform shifted to the forefront of national education improvement efforts. It has been on the agenda for more than 20 years (Jacobs, 2008). Jacobs argued that the perception of the quality of national literacy as a crisis most likely stemmed from an NAEP report in 1984. The report *A Nation at Risk* presented "dismal statistics about older adolescents' reading abilities, noting, for example, that about 13 percent of all 17-year-olds in the United States could be considered functionally illiterate" (Jacobs, 2008, p. 278). Again, in 1985, the NAEP's Nation's Report Card indirectly supported the

National Commission's arguments that the reading abilities of students ages 13 and 17 had "either flat-lined or insufficiently increased since 1971" (Jacobs, 2008, p. 279).

After examining this literature, I became interested in observing teachers' instructional practices and noting how secondary teachers explicitly teach literacy in their content areas. That is, I identified a need for a study that would focus on the classroom implementation of disciplinary literacy approaches. Professional conversations I had with colleagues in my role as a state secondary education consultant and as a county secondary literacy coach revealed that teachers were offered limited opportunities for professional growth in the area of disciplinary literacy.

In conclusion, research suggests that the majority of secondary content teachers, even those who apply reading strategies during daily lessons, apply generic reading strategies that are not targeted for understanding and mastering complex science knowledge. After more than 20 years of research to support the topic of disciplinary literacy, it is time to provide secondary science teachers in Douglas School District and in North Carolina the opportunity to move away from applying general reading strategies in science classrooms and toward embedding science-specific reading strategies. Political leaders, researchers, university professors, superintendents, principals, teachers, parents, and students must learn about the concept and implementation of disciplinary literacy; doing so is likely to increase students' reading abilities and raise students' reading performance on local, state, and national assessments.

Guiding/Research Question

Research is beginning to indicate a need to embed discipline-specific literacy strategies within daily classroom instruction in order to improve student achievement. Secondary teachers' ability to apply discipline-specific literacy strategies during instruction relies on the availability of professional growth opportunities that focus on this topic. The research questions of this project, therefore, concerned teachers' literacy instructional practices, focusing on embedding of discipline-specific reading strategies and determining which factors influence decisions to participate in professional development to learn discipline-specific reading strategies through a purposeful sampling of participant teachers.

Researchers have suggested that preparing students with the advanced literacy skills needed for success in the 21st century requires teachers to gain knowledge and learn instructional practices to develop learners in the academic disciplines using explicit subject area literacy strategies (Alvermann & Wilson, 2011; Bean & O'Brien, 2012; Biancarosa & Snow, 2006; Billman & Pearson, 2013; Bleicher, 2014; Brozo, Moorman, Meyer, & Steward, 2013; Buehl, 2011). Students need to understand how each discipline's discourse is developed and how to engage in a subject area inquiry, including how to read texts (Pearson, Moje, & Greenleaf, 2010).

The following questions directed the project study: (a) How are secondary science teachers currently instructing literacy? (b) How are secondary science teachers instructing disciplinary literacy during content instruction? (c) What factors do secondary science teachers describe as influencing their decisions to participate in

professional development opportunities to learn how to apply literacy instruction during science lessons?

Conceptual Framework

For this study, I drew on my own learning experiences of developing new knowledge of key concepts and theoretical frameworks. The learning was grounded in the professional contexts of disciplinary literacy instruction in secondary education. The study's development progressed from identifying a local problem, "to developing research themes and questions, to selecting the methodology, to the implementation of the study, to the results and analysis, and finally to the conceptual and practical outcomes of the study" (Berman, 2013, p. 1).

Initially, the conceptual framework required establishing a research problem. The investigation's identified local problem developed after examining a North Carolina local school district's aggregated collection of local, state, and national assessment data. The defined problem was the reoccurrence of below-skillful reading achievements of secondary students on = narrated assessments. Exploring the literature for ideas addressing the issue led to selection of the research topic, disciplinary literacy.

The primary theory that I used to frame this research was developed by Shanahan and Shanahan (2008, 2012). The researchers' theory supported the use of disciplinary literacy as a means to increase a learner's reading abilities. The research proposition guided the research process. A comprehensive review of the literature indicated numerous studies based on similar theory.

The literature supports the idea that the most frequent use of literacy strategies in secondary education involves content area reading. The literature clearly separates content area reading strategies and discipline-specific instructional approaches. Unlike disciplinary literacy, content area reading strategies have been used in schools for over a century (Shanahan, 2013). Content area reading is a product of reading education, whereas disciplinary literacy arises from unrelated fields of study (Fang & Schleppegrell, 2010). Within the two different types of instructional theories, it was essential to consider the approaches appropriate for the professional context of the study. The determined instructional approach, disciplinary literacy, was drawn from academic literature and professional practices using the theoretical framework.

The study's logic was drawn from multiple perspectives that reinforced the specialized area of disciplinary literacy. Additional disciplinary literacy studies (Fang & Coatoam, 2013; Shanahan & Shanahan, 2008, 2012; Zygouris-Coe, 2015) contributed to the study. As Shanahan (2013) found, disciplinary literacy forms from the "discipline itself and the ways of thinking in that discipline determine the kinds of strategies to use in order to understand texts" (p. 94).

The explicit qualitative research questions guided the entire investigation and shaped the final narrative report (Gollafshani, 2003). The three research questions guided the development of the specific focus group and interview questions presented to the eight participants. The descriptions of the case study design and methods contributed to the dedication to formal and explicit procedures for conducting case study research.

The described data confirmed the assumption that the teachers held insufficient understanding of specific discipline literacy strategies and did not perform science-specific reading techniques within their science instruction. The merged data revealed that the teachers randomly used general literacy practices. Additionally, the teachers shared that they had received inadequate professional development in the field of science and no training on the topic of disciplinary literacy.

A goal of the study was to use the analyzed data to determine what type of support could be provided to address the problem of secondary students' repeatedly low reading performance. The determined genre was professional development. The training presented in the resulting project provides secondary science teachers with the opportunity to learn science-specific reading techniques and support the development of routines that embed the learned strategies into classroom lessons.

The study contributes to the field of disciplinary literacy research. The study provides school districts with information to guide future professional development for secondary science teachers to incorporate science-specific reading strategies within classroom lessons supporting students' academic achievement. Additionally, the project encourages literacy researchers to advance studies seeking other discipline instructional practices dedicated to improving students' reading capacities.

Review of the Literature

In this section, I provide an overview of existing literature that addresses the need for secondary science teachers to learn the importance of embedding discipline literacy skills during content instruction. The literature review confirms the importance of the

study, which adds to the existing discussion in this area by focusing on secondary teachers learning discipline-specific literacy approaches by actively participating in professional development opportunities.

The literature review began with an examination of the literature on the role and purpose of disciplinary literacy. I reviewed books, scholarly journals, and professional articles using Walden University's research databases. The databases used for the retrieval of literature were ERIC, Education Research Complete, Google Scholar, and Sage. Key search terms included, but were not limited to, *reading in science, secondary science education, literacy in the sciences*, *scientist behaviors*, *how scientists read, qualitative methodology, case studies, analyzing interview data, focus group, analyzing focus group data,* and *case study research*. The literature review focused on research published within the last 5 years. In my research, I also included older studies that provided key insights on the topic. To conduct the most exhaustive review possible, I consulted references included in all retrieved articles.

In designing a study to probe disciplinary literacy in science classrooms, I faced two key challenges: (a) the complexity of the chosen topic and (b) the lack of research on disciplinary literacy, especially recent research. The complexity arose in the data analysis and application of how science discourse is developed (Shanahan & Shanahan, 2008). Because previous studies used a limited range of frameworks for approaching the topic of disciplinary literacy, these studies were based on a restricted range of variables defined by each research task. Variables analyzed in previous work included teachers'

preparation, the effects of teachers' beliefs and attitudes, and teachers' experiences and backgrounds related to different educational contexts (Wilson, 2011).

The most marked finding of the literature review was confirmation of the lack of research on disciplinary literacy in the field of education. Recently, literacy researchers and educators, including Fisher et al. (2013); Grant and Fisher, (2010); Shanahan and Shanahan, (2008); West, Hopper, and Hamil, (2010); and Zygouris-Coe, (2012), have voiced excitement about the possibility of advancing research on the topic of disciplinary literacy, but there have not been many studies on the topic thus far.

The review is built on current, relevant literature concerning disciplinary literacy and related topics in the field of secondary education, specifically in the content area of science. Additionally, it includes the findings of research studies that have changed teachers' pedagogies, resulting in increased student achievement. The overall focus of the literature review was identifying, analyzing, and synthesizing evidence-based research that supports the need for secondary students to receive literacy instruction in all content classrooms. This review presents information on four main topics: (a) overview of literacy instruction; (b) pedagogies, moving from general toward more content specific; (c) disciplinary literacy instruction; and (d) teachers' reasons for pursuing professional development.

Overview of Literacy Instruction

Academic literacy goals need to be met for students to be successful in the 21st century. If content teachers can learn to provide explicit literacy instruction and supportive practices, students' literacy and content-area performance will improve. As

identified by Darling-Hammond and Richardson (2009), the act of understanding through reading initially involves recognizing critical vocabulary and forming connections to prior knowledge and experiences (Darling-Hammond & Richardson, 2009). Reading is one ability toward which educators are aiming; indeed, literacy alone does not increase student achievement (Fisher et al., 2009; Kosanovich, Reed, & Miller, 2010).

One point that authors in the literature agree on is that teachers should use reading strategies that engage students as active participants in their learning rather than those that give them the role of passive learners (Lee & Spratley, 2010). In addition, a teacher should never be the sole active thinker and learner in a classroom; students need to develop into independent learners who take ownership of their learning (Schneider & Plasman, 2011). Effective guided instruction combining content knowledge and literacy strategies provides students with the responsibility of thinking and understanding texts themselves (Lee & Spratley, 2010). Stewart-Dore (2013) found that effective instruction guiding students' learning is based on the learners' needs, backgrounds, and interests.

Discipline-specific literacy instruction needs to include the specific language devices used within the subject area to communicate information. Students need to understand that languages differ. The language used in everyday discourse varies from the language of discipline texts, especially as students advance in grade level (Fang, 2012). Language requires in-depth levels of interpretation because it includes discipline-specific features (Alvermann & Wilson, 2011). As stated by Fang and Schleppegrell (2011), a student's success may depend upon how well instructors "manipulate the patterns of discourse characteristics of the knowledge, information, and ideas that schools

value" (p. 259). Teachers need to take responsibility for helping students to understand what they are reading and how language specific to the discipline is used to communicate content.

Content Area Reading Instruction

Most recently, literacy educators and researchers have defined disciplinary literacy characteristics and differentiated *disciplinary literacy* from the established instruction known as *reading in the content areas* (International Reading Association, 2013). Content-area and disciplinary literacy teaching methods share a common instructional goal, which is to support academic growth in all discipline areas through literacy (Faggella-Luby, Graner, Deshler, & Drew, 2012; Johnson & Watson, 2012). The two instructional approaches, however, have several differences. One difference is that content-area reading practices apply generalizable literacy practices such as "study skills" (Bean & O'Brien, 2012; Shanahan & Shanahan, 2008). Other general literacy practices advocated by content-area reading are "graphic organizers, double-entry journals, and summarizing" (Snow, 2010, p. 451). In contrast, disciplinary literacy builds on the knowledge and skills used by content expert readers, such as precisely following a multistep procedure when carrying out experiments; determining the meaning of symbols, key terms, and other discipline-specific words and phrases used in context; and viewing technical vocabulary for the purpose of supporting an authoritative account of a phenomenon (Shanahan & Shanahan, 2008; Zygouris-Coe, 2012).

The differences rely on individual aspects of content-area and disciplinary literacy practices stemming from the way a discipline approaches text structure, language, and

knowledge processing (Zygouris-Coe, 2012). Furthermore, Zygouris-Coe (2015), in her research on disciplinary literacy, acknowledged the ways in which students recognize differences between disciplines and how they learn in those different contexts. The ability to recognize and respond to these differences is a critical component of reading comprehension in content areas (Fang & Coatoam, 2013; Zygouris-Coe, 2012, 2015).

Disciplinary Literacy

Shanahan and Shanahan (2008) pushed the education field away from a generalist notion of literacy toward teaching high-level literacy in all disciplines. They defined disciplinary literacy as reading strategies that are embedded within the specific context of a discipline. They maintained that students must possess knowledge specific to the discipline to read successfully within its context. This knowledge, key to literacy, includes understanding of the ways the information is created, communicated, and evaluated, as well as familiarity with various genres used within the discipline and their audiences and purposes.

Contrary to Shanahan and Shanahan (2008), Faggella-Luby et al. (2012) argued that disciplinary literacy has no place "replacing" general literacy instruction. The researchers based their conclusion on the claims that today's secondary classrooms are filled with students with a multiplicity of learning styles and that teachers cannot possibly meet the needs of all students in the way expected by disciplinary literacy advocates. However, Faggella-Luby et al. supported the notion that a blended approach, a balance of content area reading and discipline-specific reading strategies, would work best to meet the needs of all students.

Undoubtedly, teachers and students need to discuss the differences between reading strategies and how to determine which literacy strategies to use for each specific content text (Fisher & Frey, 2011; Johnson & Massey, 2012). Given the demands of the 21st-century economy, educational systems cannot afford to place responsibility for improving literacy solely on the shoulders of English teachers (Zygouris-Coe, 2007). Teachers generally admit that it is important for students to leave high school with a variety of literacy skills, and educators recognize that too many content-area teachers refuse to take ownership of the teaching of these skills (Johnson & Massey, 2012). Subject-area teachers who do understand the demands of content-specific literacy skills have the capacity to become effective instructors meeting the literacy needs of their students (Johnson & Massey, 2012).

Unfortunately, secondary educators are often uneducated in the area of discipline-specific literacy instruction. But content-area teachers, through the approval and implementation of disciplinary literacy standards, are coming to understand why their participation in literacy instruction is critical to the success of students (Johnson & Massey, 2012).

Disciplinary Literacy: Science Instruction

For 20 years, literacy has been a focus of science education (Snow, 2010). There is still no definitive definition of science literacy (Pearson, Moje, & Greenleaf, 2010). As declared by the National Council of Teachers of English (2011), successful instruction exists when literacy approaches and content are mutually supportive and inseparably linked. Literacy instruction is most successful when teachers engage students in

discipline-specific practices when approaching content and reading (Krajcik & Sutherland, 2010). Furthermore, research affirms that teachers should never teach content and reading in isolation, but should rather teach them interchangeably because they are equally supportive of each other (National Council of Teachers of English, 2011; Pearson et al., 2010; Shanahan & Shanahan, 2008). Moreover, as clearly indicated by West et al. (2010), science literacy instruction can promote successful academic reading achievement. Shanahan and Shanahan (2008, 2012) suggested that educational leaders who want to bolster reading scores need to encourage secondary discipline teachers, especially in the area of science, to implement disciplinary literacy practices into daily instruction.

Teachers of science do not commonly establish routines for using discipline-specific reading strategies to improve understanding of scientific texts; they simply ignore reading altogether (Pearson et al., 2010). Avoidance of reading in content classrooms conflicts with the education theory that teachers are to teach reading strategies needed for all students (Pearson et al., 2010; Shanahan et al., 2011). Pearson, Moje, and Greenleaf (2010) found that text and reading supersede science investigations. Texts are pieces of past investigations and are used for inductive reasoning about scientific phenomena (p. 460). Scientists depend on the text to guide new discoveries and to provide background knowledge necessary for successful future investigations (Pearson, Moje, & Greenleaf, 2010).

The majority of science teachers believe that students must "do" science to learn science (Fisher, Grant, & Frey, 2009). For students to understand and learn scientific

concepts, they believe, students must participate in "hands-on" activities. But when scientists read, they are "doing" inquiry science (Cervetti & Pearson, 2012; Shanahan & Shanahan, 2008). It is a misconception that reading is separate from doing, that scientific text is not part of the scientific enterprise. There is evidence that supports the idea that award-winning, high-achieving scientists read more than other content specialists do (Lee & Spratley, 2010). Scientists, when asked to describe their use of reading against other content specialists, shared that reading is their most commonly applied literacy skill beyond writing, speaking, and listening (Phillips & Norris, 2009).

Shanahan and Shanahan (2008) confirmed that scientists continuously rely on advanced reading skills to accomplish tasks such as investigating and researching a phenomenon, testing evidence, and consuming materials and tools. Hence, secondary science teachers, as scientists, need to embrace appropriate literacy strategies that will engage them, as well as students, in making meaning from scientific texts (Fang, 2006). The language of school science, as identified through Fang's research in 2006, suggests that students should be active participants in the making of meaning. The teacher should not think for the student; the student must become the investigator to gain understanding (Pearson et al., 2010).

Today's science texts are multimodal, using written text that includes graphs, symbols, charts, and diagrams, all of which demand correct communication (Alvermann & Wilson, 2011; Bean & O'Brien, 2012). Reading scientific texts, which are frequently composed of processes and technical information, requires students to analyze the texts' structures and languages. Pearson et al. (2010) provided examples of types of authentic

texts that scientists spend much of their time reading, such as lab reports, research papers, briefs, proposals, explanations of theories and procedures, research studies, and communications from other scientists. Scientific texts include abstracts, section headings, figures, tables, diagrams, maps, drawings, photographs, reference lists, and endnotes. These text features require students to invite multiple points of view or to open up questions that are not provided directly in the text (Lee & Spratley, 2010).

Lee and Spratley (2010) added that the technical vocabulary of science can be especially challenging because the terms often have Latin or Greek roots. They further maintained that scientific texts, like those in mathematics, require the ability to understand tables and figures, as well as visual literacy, which involves comprehension of diagrams, drawings, photographs, and maps used to convey meanings. Scientific text is particularly notable for its use of a variety of visuals; this is because the spatial arrangement and characteristics of the physical universe—central to the scientific inquiry—are often vital to the understanding of the text (Wilson, 2011).

In addition, Goldman (2012) expressed that in order to develop successful readers in sciences, teachers must train students in the reading habits of scientists. This training enables students to develop essential reading skills such as analyzing various forms of texts, synthesizing, generating predictions and explanations through providing textual evidence, and evaluating information from multiple sources (Pearson et al., 2010; Shanahan et al., 2011).

Teachers and students must realize that "what we recognize as scientific is typically construed in language patterns that enable the development of chains of

reasoning that are technical and dense" (Fang & Schleppegrell, 2010, p. 591). Reading science is not a static activity focused on retaining details and terminology. It is challenging to secondary students because the dense, technical language of science "contrasts sharply with the more commonsensical, dynamic language that is typical of elementary storybook texts" (Fang & Schleppegrell, 2010, p. 589). As Fang (2006) clarified, the discourse of science evolved for "functional purposes," developing texts with unique semantics and syntax unlike other disciplines (p. 493).

Since "reading is inextricably linked to the very nature and fabric of science, to learning science, then take it away and there goes science and proper science learning also" (Phillips & Norris, 2009, p. 313). If teachers ignore evidence-based reading strategies, secondary students will continue to struggle (National Council of Teachers of English, 2011). Secondary students need discipline-specific, advanced literacy strategies that will allow them to analyze concepts, synthesize information using multiple text, and evaluate claims in a specific discipline (Lee & Sprately, 2010; National Council of Teachers of English, 2011; Shanahan & Shanahan, 2008). Hence, as middle and high school students obtain discipline-specific reading strategies, they gain the ability to read academic texts as content-specific experts (Warren, 2013).

As we have seen, the empirical evidence supports the proposed need for the research study, recognizing the need to improve secondary science teachers' literacy pedagogies. When this process occurs, teachers can lead students toward in-depth understanding of complex science.

Purposeful Professional Development

Professional development (PD) should build the capacity of individuals to become leaders and learners; improve teachers' knowledge of pedagogy, and student learning; and promote collaboration among educators (Konanovich et al., 2010). Equally important, professional development should build, within a school or school district, the capacity for individual teachers and groups of teachers to be viewed as learners and leaders (Konanovich et al.).

As affirmed by Schneider and Plasman (2011), the development of quality science teachers is central to students' success. Quality teaching is a focus for education researchers. Today, there is a perceived need for on-going PD to develop quality teachers, rather than the one-day, disjointed sessions of the past (Schneider & Plasman, 2011).

Secondary content teachers need to develop self-awareness as contributors in the field of literacy, and this can be accomplished through PD (Draper et al., 2012). Researchers have acknowledged that without the proper PD, content-area teachers would not understand why they are held accountable for teaching subject-area reading strategies supporting students understanding advanced content standards (Conley, 2012; Donnelly & Sadler, 2009; Draper et al., 2012). According to Postholm (2011), teachers' experiences gained through professional development must be processed and lead to development of new and deeper knowledge which enhance one's own performance in the classroom (p. 411).

Paik et al. (2011) affirmed that during PD, teachers need to perceive themselves as learners, and the PD facilitator needs to lead the instruction just as a teacher would conduct a classroom. The session should start with modeling the prototype practice, allow time for the learner to implement the new learning, and then encourage feedback for discussion. Therefore, one major purpose of PD is to provide a chance for teachers to focus on student learning, cooperate with peer teachers, and show increased autonomy and advocacy (Greenleaf et al., 2011). Since secondary teachers are content experts, they need guidance in embracing discipline literacy approaches advancing from applying general reading strategies (Faggella-Luby et al., 2012). As PD assists teachers in understanding how to assist students in coping with specific content challenges, PD must also include guidance in how to assist students with literacy challenges in content areas. For these reasons, quality PD is pivotal to teachers' professional growth (Stewart-Dore, 2013).

Implications

This project's findings could influence secondary science teachers' instructional practices. The advancement of secondary science teachers' pedagogies could lead to increase student achievement in the areas of science and in all reading tasks in the Douglas County School District.

The shift in local and state's educational systems attention to increase secondary students' literacy achievement is transforming North Carolina and Douglas County's secondary teachers' instructional practices. The proposed professional development plan will provide eight 60-minute learning sessions focused on: (a) what constitutes

disciplinary literacy and specifically in the area of science, (b) transition from current literacy practices to establish routines that embed science-specific literacy approaches in authentic lessons and classroom instruction, and (c) change the secondary science teachers' instructional routines to embed science-specific reading strategies.

Throughout the PD plan, teachers will have multiple opportunities to learn, practice, and implement specific reading strategies identified through studying science literacy research. The teachers are encouraged to use the literacy approaches as tools to support student construction of content understanding by using classroom authentic texts and engagement in science literacy conversations. At the close of each PD, the teachers will be asked to participate in a formative assessment type of evaluation. The information gathered from each session will seek to discover what each teacher learned and identify any remaining needs related to the discussed topics and studied strategies. Draper et al. (2012) and Hochberg and Desimond (2010) stated teachers are more likely to sustain learning when provided opportunities to share insights from positive and negative experiences. The teachers involved in the PD will join, after an allotted time implementing each presented and practiced strategy, to share teaching experiences.

The results from each collected and analyzed formative evaluation will guide the direction of each additional session and could guide future staff development opportunities (Clark, 2012). The suggested evaluation template follows the "Professional Development Exit Questionnaire" posted on the public website of the SERVE Center located on the campus of the University of North Carolina at Greensboro. The non-profit SERVE Center is grounded on educational improvement through partnerships with policy

makers and practitioners. The evaluations will gather data through open-ended questions and statements requesting level of agreement using a 1-5 Likert scale (5-strongly agreement – 1 strongly disagree).

The specific strategies introduced during the professional learning opportunities were selected based on their appropriateness for use in science pedagogies, ability to support student understanding of disciplinary concepts, and engagement of science discourses and practices. The strategies focus on science text structure analysis, vocabulary analysis strategies, writing strategies researched to improve comprehension, and the analysis of literacy standards to support students' understanding.

Summary

Presently in North Carolina, and especially in the Douglas County, secondary science teachers, like teachers throughout the United States, could benefit from learning or expanding their current knowledge of scientific literacy strategies. This study will guide secondary science teachers' development of disciplinary literacy instructional practices and teach them to embed literacy strategies into realistic classroom practices. Teaching discipline-specific reading strategies, skills that educators often neglect, is becoming a focus on local and state educational systems.

The following sections include descriptions of the study's methodology, including the participants; the data collection; the analysis processes; and the study's limitations. In addition, presented is the rationale, review of literature, evaluation plan, and implications that support the evidence for the proposed project. The fourth section includes reflections and conclusions which entail the strengths and limitation discovered during the research.

Future implications are also discussed. Finally, the materials used throughout the study are housed in the Appendices.

Section 2: The Methodology

Introduction

For decades, researchers and educators have maintained that academic content teachers, teachers of academic subjects in the social and hard sciences, should be teaching reading strategies in their particular subjects (Cobern et al., 2010; Darling-Hammond & Richardson, 2009; Fang & Schleppegrell, 2011; Fisher, Grant, & Frey, 2009; Shanahan & Shanahan, 2008). Secondary students in a local school district in eastern North Carolina have repeatedly scored below proficient in reading. Leaders within the school district are seeking change in secondary teachers' literacy instructional practices to improve students' reading capabilities and overall academic achievement.

One purpose of this inquiry was to explore secondary science teachers' literacy instruction, with a focus on explicit instruction of discipline-specific reading strategies during content instruction. Another purpose was to discover what factors influence teachers' decisions to participate in professional development seminars in which they could learn discipline-specific reading methods. Despite attempts within the national school system to improve secondary teachers' understanding and implementation of reading strategies focused on strengthening students' comprehension, researchers hold that secondary teachers struggle with limited knowledge of advanced reading strategies needed to support students (Johnson & Watson, 2012; Lee & Spratley, 2010; Shanahan, Shanahan, & Misischia, 2011; Snow & Moje, 2010).

Research Design & Approach

During this qualitative research, I investigated "how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (Merriam, 2009, p. 14). As modeled by Patton (2001), qualitative data collection and fieldwork strategies consist of personal experience, engagement, empathic neutrality, and mindfulness. Further, Patton showed that qualitative data analysis includes the practices of inductive and creative synthesis and context sensitivity. These identified traits were pursued throughout this case study process. Other research designs were not appropriate for the constructs of the study I planned. Quantitative research is used to quantify a problem by way of generating numerical data or data that can be transformed into useable statistics (Creswell, 2012). It is used to quantify attitudes, opinions, behaviors, and other defined variables (Maxwell, 2010).

Researchers use mixed methods design to develop a broad understanding of collected quantitative and qualitative data. The sequence design incorporates explanatory or exploratory designs. According to Creswell (2012), a mixed method researcher's most challenging task is determining how to analyze data collected from qualitative and quantitative research. I did not seek to collect and analyze data in two different phases to deepen my understanding of the local problem but decided to concentrate on one method. When using mixed methods, the researcher can analyze quantitative data separately from qualitative data or integrate the data analysis (Leech & Onwuegbuzie, 2007). I decided to implement qualitative methods in the study, and therefore, I used the data collection methods of focus group and individual interviewing.

Other qualitative methods were not fitting for the study. One approach I considered was phenomenological research; however, this approach requires extensive and prolonged engagement with a small number of subjects (Creswell, 2009). The school principals encouraged limited access to the teachers so that the teachers would not lose their planning time or be taken away from school responsibilities.

Additionally, I did not seek to create a new theory, as researchers do when using grounded theory. Unlike a grounded theorist, who repeatedly collects and analyzes data to determine if the data link the categories into a tentative theory and continually modifies the theory, I collected and analyzed my data in addressing the study's research questions (Glesne, 2011). -The features of a case study, which involves discovering meaning and gaining in-depth understanding of a phenomenon, contributed to the decision to implement this method.

This purpose of the qualitative case study was to investigate a problem facing North Carolina school districts including Douglas County (pseudonym): Students' achievement data do not reflect evidence of actual application of literacy strategies. The school districts seek guidelines to change classroom literacy practices to effectively strengthen students' reading abilities. This problem broadly affects secondary students' academic achievement, leaving teachers with the necessity to learn and apply discipline-specific reading techniques during content instruction (Fang & Coatoam, 2013; Shanahan & Shanahan, 2008; Snow, 2010; Zygouris-Coe, 2012).

The study was conducted using a qualitative research design to investigate the study's three guiding questions: (a) How are secondary science teachers instructing

literacy? (b) How are the science teachers embedding discipline-specific reading strategies during content instruction? (c)What factors do the science teachers describe as influencing their decisions to participate in professional development to learn discipline-specific reading strategies?

A qualitative case study design was selected for the project because it provided an opportunity to study secondary teachers' instructional practices in the natural setting of the classroom (Nixon, Saunders, & Fishback, 2012). Yin (2009) defined a case study as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context especially when the boundaries between phenomenon and context are not clearly evident" (p. 18). The main purpose of following a case study design for this research study was to create a vivid description of the current state of literary instruction in science classrooms (Darke, Shanks, & Broadent, 1998). Analysis of this rich data can contribute to an in-depth understanding of discipline-specific reading strategies that need to be embedded into teachers' pedagogies. The case study design relies on multiple sources of evidence, which provides a richer analysis (Merriam, 2002). The most common sources of qualitative data include interviews, observations, and documents (Patton, 2001). Yin (2014) argued that case studies are appropriate when a researcher wants to provide a baseline analysis against which future researchers can compare the details of their distinct cases. One of the goals of this research study is to support future qualitative researchers in the area of disciplinary literacy. Yin suggested that sound case studies include the following essential elements: (a) research questions, (b) descriptions of the research design, (c) descriptions of the procedures for collecting and analyzing

data, (d) discussion of the data findings, and (e) a conclusion presenting the analyzed data in a useful format for the audience (p. 10).

Participants

The process of finding participants at the district level started with an open electronic invitation sent to several school systems in the eastern region of North Carolina. The district leaders from Douglas County responded positively and showed excitement concerning the opportunity to participate in the discipline literacy study. During the January 2015 middle-grades principals meeting, the Douglas County middle grades director presented introductory information concerning the study and the opportunity to volunteer participation. The director described the study's purpose and goals by using the study's introductory information (Appendices C, E, & G). Two of the four middle-grades principals agreed to participate. After the principals' meeting, the director shared contact information for the two principals who volunteered to participate in the study. Once I received this information, I phoned the principals to discuss any questions they had concerning the study and to schedule an initial in-person introductory meeting. During the meeting at each school, the principal shared a list of the school's science teachers, including their school contact information. Each of the schools employed four science teachers, creating a total of eight possible contacts from whom to request participation.

I immediately sent each of the eight middle-grades science teachers an electronic invitation to participate in the study (Appendix B). I included in the emails brief descriptions of the study's procedures, roles and responsibilities of the researcher and

participants, and the importance of confidentiality throughout the study. Additionally, I attached the consent form (Appendix C) and confidentiality form (Appendix D). I requested that the two documents be signed and returned to determine who would accept participation in the disciplinary literacy study. I shared with the teachers that the decision to not participate would cause them no harm, and I advised them to delete from their computers any materials related to the study. All eight teachers returned signed documents agreeing to participate in the study.

In determining the ideal sample size for a qualitative study, a researcher needs to consider that a large group could challenge the ability to extract thick, rich data (Onwuegbuzie & Leech, 2007). As pointed out by Patton (2001), common qualitative sampling strategies are built on three characteristics of a study: (a) research questions, (b) time frame, and (c) available resources. For this study, the research questions, time frame, and resources supported the selection of a sample size of eight. The process of choosing a limited number of participants within the study's period allowed in-depth inquiry into the problem, resulting in the collection of data (Miles & Huberman, 1994). As the size of the sample within a case study directly relates to the study's purpose (Hancock & Algozzine, 2011), the small sample size allowed me to obtain realistic and comprehensive evidence and to explore teachers' experiences with and perspectives on disciplinary literacy.

Throughout the duration of the research, all contact with the principals and science teachers took place through the school system's phones and email. Emails to the stakeholders, the middle grades director, the two school principals, and the eight science

teachers contained explicit descriptions of each phase of the data collection process, required documents, and answers to all questions regarding the study. Two days before each scheduled interview, I sent an email reminder of the pre-established interview date, time, and location individually. I asked participants to provide rescheduling information if changes were needed. Phone conversations were limited to those used to conduct requested individual interviews.

The first step in protecting the study's participants from unethical practices was to email them two documents. I support Seidman's (2013) idea that the way an interviewer initially contacts the participants can "affect the beginning of that relationship and every subsequent step in the interviewing process" (p. 44). The introductory email contained two documents designed to protect the participants from harm. The first text was the "Participant's Consent" (Appendix C). This form provided in writing a detailed description of the study's purpose and procedures, the roles of the participants and researcher, and possible benefits for participants. In addition, I gave the participants my contact information and a statement of openness to communicate, should they have any questions concerning the study.

The second document used to protect the participants was the "Participant's Confidentiality" statement (Appendix D). This form contained an explanation of the agreement that confidential information within the research study should not be discussed and disclosed, thereby upholding the integrity of the research study. All members signed and returned the requested documents before the first meeting.

Throughout the duration of the study, I communicated the policies of Walden University's IRB regarding the ethics of the study, including my role and responsibilities in protecting the participants, school, and district. All of the described details started the process of developing openness and trust. As found by Tschannen-Moran (2007), education leaders need to build trust with teachers in order to ensure that collaborative discussions occur in decision making and solving complex problems of schooling.

Data Collection

Yin (2014) stated that qualitative case study research is an approach that contributes to the understanding of a phenomenon using a variety of sources (p. 4). When a theoretical lens is used in qualitative research, the perspective "forms the types of questions asked, how data are collected and analyzed, and provides a call to action or change" (Creswell, 2009, p. 62). The primary way a researcher can investigate an educational organization is through the experiences of the individual or group who are a part of the organization. Interviewing the teachers, socially and privately, allowed multiple opportunities for the teachers to share professional perceptions and applications of explicit science reading methods during content instruction. Interviewing is a basic mode of inquiry humans use to make sense of their experiences (Seidman, 2013). The decision to conduct the focus group interview first was based on the limited knowledge I had of the teachers' understandings of disciplinary literacy. I anticipated that the data collected during the focus group could inhibit responses and cloud the meaning of the results between beginning teachers and veteran teachers. However, the results showed that the beginning teachers voiced their knowledge as readily as veteran teachers did. A

goal of these interviews was to create an environment of comfort and to allow the subjects to speak freely about personal and professional perspectives and experiences focused on the research questions (Lodico et al., 2010; Seidon, 2013).

Interviews, the "guided conversations" described by Yin (2014), are a forum in which inquiry leads to in-depth understanding of a phenomenon (p. 110). The interviews in this study concentrated on the three research questions. The questions asked during the interviews were open ended (Creswell, 2012). The format provided opportunities for probing questions, expanding the potential to collect richer data (Bogdan & Biklen, 2007).

As stated by Seidman (2013), listening is a critical element of interviewing. Seidman identified three levels of active listening, each of which requires concentration and focus on the part of the interviewer. The first level is listening to the words that a participant states to make sure that understanding is clear and complete. The second stage is listening to the language used and analyzing the actual message being given through the words. The third and last phase involves the listener being alert to how words are spoken but also focusing on what is said. To excel at the third level of listening, the interviewer must be aware of time, adjusting the conversation to adapt to the material already covered and to what remains to be discussed. I applied the three levels of listening during each data collection effort. Along with the audio recording of each interview, I took notes and kept a handwritten reflection journal to capture extensive details of the discussions.

Focus groups are important because they allow the participants to engage with each other and provide an opportunity to collect data from several individuals (Creswell, 2009; Stake, 1995). Yin (2014) noted that one strength of a focus group interview is that it allows the researcher to understand the participants' "own sense of reality" (p. 112). In this focus group, the goal was to explore the participants' knowledge of and experiences with specific disciplinary literacy strategies and to begin gathering various views on participating in science and literacy-focused professional development. At the beginning of the session, in order ensure respect for all participants, I requested that each participant engage in respectful dialogue throughout the focus group session.

The session took place in a school classroom where distractions and noise were limited. The principal scheduled the focus group on a school day designed for mandatory staff development. The teachers spent the morning participating in an in-service training that focused on pedagogies for English learners, and during the afternoon session, the selected science teachers were allowed to participate in the research study's focus group.

The session was designed to foster dialogue among the participants on the study's topic, targeted at the three leading questions provided on the agenda. The three pre-established questions addressed the research study's guiding questions (Appendix F). The teachers were arranged in a circle formation, allowing everyone to face each other and providing a sense of openness to the discussions (Fishman, Marx, Best, & Tal, 2003).

I provided the teachers with a brief explanation of why the particular topic was being studied and stated that my intention was to use the research procedures to fulfill Walden University's doctoral degree requirements. It was shared with the participants

that I would offer the middle grades director and the two school principals the opportunity to view the final study (Seidman, 2013). I explained the informative documents that participants received along with the invitation email, and I offered the chance for participants to ask any questions they had. The documents explained and described the essential components of the study. The documents were the focus group interview guide (Appendix E), the open-ended individual interview questions guide (Appendix G), and the interview schedule form (Appendix I).

The group of eight science teachers contributed in a focus group interview that took place in a teacher's classroom, a site chosen by the principals. The face-to-face focus group interview method aided in building relationships which served as the foundation for the individual interviews (Hancock & Algozzine, 2011; Onwuegbuzie, Leech, & Zoran, 2007; Seidman, 2013). The focus group discussion started with the reassurance that ethical procedures would be followed throughout the data collection process. Furthermore, since exact words from the teachers could be used in the study's final report, I stressed that personal identities would be removed for protection.

Before the focus group and each individual interviews began, I verbally requested participants' permission to audio record each session. At no time during the data collection process did any participant object to the recordings. Realizing, however, that a participant could feel uncomfortable voicing an objection to the recordings, I advised the participants of the opportunities to review the transcribed data from the focus group and individual interviews. Bogdan and Biklen (2007) verified that recording interviews are the best means to gather descriptions of participants' views and comments when the goal

is to create full transcripts. This process allowed the participants to hold the researcher accountable for protecting their identity; to amass data accurately; and to transcribe the recorded data meticulously. (Yin, 2014). After each interview, I sent the participants an appreciation email for their contributions and for sharing their valuable time for the research study (Seidman, 2013).

During the focus group, I asked key open-ended questions, attempting to retain as much information as possible about the group's perceptions regarding the factors that influenced decisions to participate in professional learning opportunities, I manually took notes of teachers' conversations (Creswell, 2009). The group was encouraged to discuss personal classroom experiences embedding learned practices from attending professional developments, and to share opinions regarding past professional learning opportunities provided by the district (Creswell, 2009; Yin, 2014). On the occasions when the discussion lacked connections with the purpose of the provided questions, I asked a more explicit question or repeated the provided question to regain the focus of the group (Hancock & Algozzine, 2011). During this process, I had to avoid asking too many follow-up questions, because this could put the participants on the "defensive and shift the meaning making from the participant to the interviewer" (Seidman, p. 86).

The second source of data was the eight individual interviews. Darling-Hammond, Wei, Andree, Richardson, and Orphanos (2009) stated it was important to allow participants to have choices in the process of interviews. The teachers were given the option of conducting the individual interviews in person or by telephone. Six of the eight science teachers elected to conduct their individual interviews in person. The

flexibility in offering this option provided the participants some control and agency in deciding when and where to conduct the individual interviews (Seidman, 2013). Each teacher determined the date and time to conduct the individual interview with the researcher. Individual interviews spanned three weeks and were carried out during or immediately after school hours. Respecting teachers' schedules, I sent a reminder email to each teacher 2 days before the scheduled interview. The locations of the interviews were chosen by the individual teacher with the exception that the interviews were to be conducted on school campus. The locations the teachers chose were either in the classrooms, the school offices, or the school media center conference rooms. I was given permission by the principals to enter the schools and go directly to each interview location.

To manage the organization of the eight interviews, I created a matrix, "Participant's Tracker Database" (Appendix J). Creating the document allowed opportunities to concentrate on developing effective interview questions and methods to facilitate communication instead of centering attention on keeping track of administrative work. The early development of formative documents refined ongoing processes of gathering and analyzing data (Seidman, 2013). The extra time provided allowances to anticipate results based on previous readings and preparation for the study. Once the focus group interview was conducted, the data analysis began and continued until all eight in-depth interviews were collected and analyzed.

Additionally, I continued the practice of audio-recording each of the eight in-depth interviews and took notes in case the recorder malfunctioned (Creswell, 2009;

Lodico et al., 2010). At the beginning of each interview, I requested permission to start the audio-recorder. All individual interviews lasted between 30 and 45 minutes. Each participant was asked ten questions that addressed the research questions (Appendix H). Creswell (2009) believed that qualitative researchers need to construct interview questions in such a manner that keeps participants in focus with their responses. Turner (2010) advised that qualitative researchers should develop follow-up questions or prompts to ensure optimal responses. Each interview session began with a restatement of the study's purpose and the process for the discussion and ended with thanking the member for their time and contribution to the research study.

As the researcher, my belief in the importance of this topic is based on my professional experiences as an educator. Creswell (2012) noted that qualitative researchers collect and analyze data from the perspective of personal experiences, bias, values, and culture. As a secondary classroom teacher, a secondary state education consultant, and a secondary school system literacy coach, I have over twenty-five years of first-hand experience in the North Carolina public school system working with secondary teachers. I am currently a retired school teacher. I have no current or past relationships with any of the research participants.

Data Analysis and Findings

In this study, I used a single embedded case study model, which focused on the noted phenomenon (Miles & Huberman, 1994). A single embedded case study enables the researcher to explore differences within and between cases (Shen, 2009). The participating teachers were all females with teaching experiences in North Carolina's

public middle- grades science classrooms ranging from two to 12 years. The science teachers were assigned various science courses: biology, chemistry, earth science, environmental science, and physical science. The teachers gained their professional education from both in state and out of state educational institutes. All of the teachers were North Carolina certified as licensed teachers. This information was gathered during individual interview conversations.

I determined that the time-consuming processes involved in manually creating transcripts of the focus group interview which took an average of six hours were more manageable than the transcribing of the eight individual interviews. The extensive process of listening to the recorded interview data in tandem with transferring verbatim into Microsoft Word files was intense (Hancock & Algozzine, 2011). However, working with the collective set of evidence eliminated the possibility of premature judgments about what information was necessary to keep and what to discard (Seidman, 2013). Each transcript was labeled according to the methods used and the participant's pseudonym name. I created a personal file listing the participants' names and the corresponding alias names to avoid confusion. All files are securely stored on an individual flash drive.

Adhering to the participants' rights to view the transcripts, I sent each participant an electronic copy of the focus group interview transcript and their individual interview transcript and requested feedback concerning the accuracy of the information. The process of member checking was to determine if any information in the transcripts needed to be excluded and interpretations needed to be modified (Hancock & Algozzine,

2001; Saldana, 2013; Seidman, 2013). As stated by Seidman (2013), member checking is the "most essential ingredient the researcher brings to the study" (p. 120). The feedback provided by the participants allowed necessary changes to the transcripts before coding began.

Coding and categorizing strategies were used to analyze the data from the focus group and the individual interviews. Saldana (2013) stated, "In qualitative data analysis, a code is a researcher-generated construct that symbolizes and thus attributes interpreted meaning to each individual datum for later purposes of pattern detection, categorization, theory building, and other analytic processes" (p. 4). I used open coding, breaking the interview data into distinct segments, examining each part thoroughly and comparing them for similarities and differences (Strauss & Corbin, 1998). Another coding strategy applied to the data was the method emphasizing *-ing* words, words that noted action within the data (Saldana, 2013).

I enhanced the coding methods by marking words or short phrases in different colors and circling each corresponding participant's data in the transcribed texts in both the focus group transcript and the individual transcripts. I matched descriptive codes, counted the incidence of the codes, and marked when and where codes needed to be combined (Yin, 2014). According to Miles and Huberman (1994), the preliminary coding cycle is a data reduction process, a continuous process of "selecting, focusing, simplifying, abstracting, and transforming the data that appear in written-up field notes or transcriptions" (Miles & Huberman, 1994, p. 10). I incorporated Patton's (2001) suggestions by remaining "open to multiple possibilities or ways to think about a

problem, engaging in ‘mental excursions’ using multiple stimuli, ‘side-tracking’ or ‘zigzagging,’ changing patterns of thinking, making linkages between the ‘seemingly unconnected,’ and ‘playing at it,’ all with the intention of ‘opening the world to us in some way’” (p. 544).

After I analyzed that the manageable, narrative data from the focus group, and agreed with Saldana (2013) statement that, “There is something about manipulating qualitative data on paper; the researcher retains more control over the ownership of the work” (p. 26). I soon determined that the collected data from the eight individual interviews would need to be handled differently.

The massive amount of data transcribed in the eight individual interviews precluded manual data analysis; to gain reliable results, it was best to use computer-assisted qualitative data analysis software (Yin, 2014). The vast codes I entered into the data were transposed from a Microsoft Excel file, helped keep the evidence and codes connected in individual cells. I entered the textual data and initial descriptive codes into the software NVivo 10, formerly known as NUD-IST. The software efficiently stored, organized, managed, and reconfigured the data into a database (Saldana, 2013). After the analysis was conducted, I verified the coding assignments with the transcript data for my understanding.

Qualitative researchers are skilled at forming categories; connecting and using meaningful systems; creating themes; and interpreting derived frameworks with reference to a proposed theory (Creswell, 2012; Hancock & Algozzine, 2013). The analysis of qualitative data from the focus group and the individual interviews followed an inductive

approach, which allowed multiple types of themes to emerge (Creswell, 2012). Analysis of the data revealed responses which align with disciplinary literacy current literature; novel responses which will add to the disciplinary literacy literature, and responses which are beyond simple classification can contribute within the field of disciplinary literacy (Creswell, 2012).

I created a file labeled, "Unrelated to Questions." The purpose of the file was to collect narrative data which appeared unrelated to one or more questions during the interviews. I formed a table representing unrelated data (Table 4). I reviewed the evidence as possible outliers and including outliers could strengthen the reliability of the study (Miles & Huberman, 1994). In Table 4, participants are listed with corresponding data. I discovered the broad responses related to various teaching approaches conducted by teachers in any content area. After studying the data more closely, I determined the responses failed to address the research questions that focused on explicit science reading strategies used in classroom instruction.

Table 4

Data Unrelated to Research Questions

Participant	Data
Teacher H	I find my classroom resources through the internet, and I use hands-on activities and real world relevance as my teaching style.
Teacher D	Telling students where the information is, is easier than trying to teach them to locate the information because all they do is ask me anyway for the answers.
Teacher C	I stay after school and help students understand their homework.
Teacher B	I spend much of my time preparing for the state's assessments. We [teachers] are always giving some type of required assessment. I am evaluated on how my students score on the tests; that is what I focus on.

Analyzing data involves "making sense out of text and data and preparing the data for analysis, conducting different analyses, moving deeper and deeper into understanding the data, representing the data, and making an interpretation of the larger meaning of the data" (Creswell, 2009, p. 183). A researcher's explanation of the data is flexible to new constructs and theories, given that existing variables are often unknown (Ryan & Bernard, 2003). The study's data focused on the participants' subjective experiences with literacy and discipline-specific reading strategies used in classroom instruction. The analyzed data discussed nonconforming data as well as any rival or alternative explanations to the theoretical proposition (Ryan & Bernard, 2003).

The data transformation from the focus group and the in-depth interviews involved creating codes and themes qualitatively, then counting the number of occurrences in the text data (Creswell, 2009). I sorted the themes into three groups related to the three research questions. The first category of themes related to research question on: How do the secondary science teachers teach literacy during content instruction? The second group of ideas related to research question two: How do the secondary science teachers embed discipline-specific reading strategies during science lessons? The third and final type of issues related to research question three: What factors influence the secondary science teachers' decisions to participate in professional development to learn or advance their learning discipline-specific reading strategies?

Research Question 1

How do the secondary science teachers teach literacy during content instruction? The primary themes related to this research question were the teaching methods of applying general literacy strategies during science instruction; applying basic practices to build science related vocabulary; and applying trial and error as a teaching method. The degrees to which these pedagogical practices were emphasized or utilized in the science classrooms were undetermined. The data validated the participants used similar reading strategies, but at different frequencies. In Table 5, the primary themes for research question one are summarized and defined. The frequencies with which the three themes for research question one appeared across the interviews are located in Appendix K. The findings suggested a relationship between the students' consistently low literacy

achievements and a lack of consistent use of research-based reading practices in the classroom.

Table 5

Themes and Definitions for Research Question 1

Theme	Definition
Apply general literacy strategies	This theme referred to teachers' experiences using general literacy strategies during science instruction
Apply basic strategies building science vocabulary	This theme referred to teachers' experiences using basic strategies to build students' science vocabulary
Apply trial and error as an instructional method	This theme referred to teachers' experiences using trial and error as a method of teaching students both reading and science

Applying general literacy strategies. The most common theme related to research question one was applying general literacy strategies during content instruction. Each of the eight participants reported using at least two general reading strategies during class instruction. The theme was mentioned 23 times in eight interviews. During the past two school years, the teachers participated in district professional learning opportunities focused on the use of general literacy strategies, including how to annotate a text; how to summarize a reading; how to find the main idea; and how to conduct a whole class or small group read aloud. The teachers' responses reflected the belief and

practices of the general literacy strategies presented during the district staff development sessions.

General literacy strategies are approaches that are used across multiple content areas (Snow, 2010). But according to Zygouris-Coe (2012), secondary educators cannot afford to use general literacy instruction in the 21st century; educators must learn and embed content-specific literacy strategies, which support students as they learn discipline-specific material (Shanahan & Shanahan, 2008). Disciplinary literacy, unlike general literacy, builds on the knowledge and skills used by content experts who develop, communicate, and use knowledge to make meaning of text (Shanahan & Shanahan, 2012; Zygouris-Coe, 2012). The instructional practices provided support the use of general literacy strategies. Teacher A, one of the participants, stated,

> A lot of the teachers like to "chunk the text"; they will pull paragraphs out and make sure that students are focusing on smaller amounts of materials at a time to understand. They are making sure they are repetitive in presenting the text to them, so the kids have the experiences of seeing and hearing it more than once. Another thing that is new to teachers is reading orally with students as the first read and then letting students read silently, and then do some type of structured activity, like a worksheet. This gives access to the material. We do things like highlighting important information within a text and annotating a text. These are new strategies we have learned within the past two years.

In addition, Teacher D, another participant, stated,

> I had the students write a paper on the effect of deforestation and then I brought in a narrative text. Students had to decide whether the character should keep the land or destroy it as we read the story orally from an environmental and economic perspective. This helps them get the main idea. Another strategy I use a lot is assigning students to underline the main idea in a paragraph or paragraphs in a selection. Also, the students are good at identifying words they do not know since they do this in all of their classes. This is an initiative in the district to build students' vocabulary. We use a lot of different types of worksheets to help.

Applying basic strategies building science vocabulary. The second most common theme that emerged for research question one was applying simple literacy practices to build students' science vocabulary. This referred to the science teachers' practices of supporting their students' abilities to identify, define, and use science vocabulary in oral and written presentations. This issue was mentioned 16 times in eight interviews. Again, the degree to which the teachers used the approaches was undetermined. Teacher D shared,

> Focusing on my previous discussed strategies [annotating text], I give my students vocabulary activity sheets before every unit, so they can become familiar with the scientific terms beforehand. Being ready to use that scientific vocabulary is important for understanding science from grade level to grade level. I mean use it and say it. Students must use a term to really learn it.

In addition, Teacher G shared an approach she uses:

> Because now that I teach a class that is tested, I now focus on the importance of content-specific vocabulary. Now we do intense work with vocabulary. Students hate it because we are making them think, not just recall for a test. We have them make connections through visuals like note-taking and summarizing for main ideas and use science terms they have learned in writing science reports. Vocabulary, I think, will bring all the other ideas together. It might not be only science words; it could be other words that hinder students from understanding.

In a final example supporting this theme, Teacher B explained, "Vocabulary is a big thing and in science it is important. If you can understand the vocabulary, you can get the gist of the content. I focus on vocabulary by doing four squares." Disciplinary literacy concentrate on the morphology of technical terms that develop a field of study. These type of understandings advance students literacy abilities beyond identifying unknown words and defining them.

Applying trial and error. The third common theme for research question one was participants' application of instructional practices classified as trial and error. This practice was mentioned 12 times in four interviews. This approach involves teachers using a literacy strategy such as the whole group read aloud, followed by evaluating its effect on students' scores on a classroom assessment. Next, the teachers would judge the efficacy of the approach, either retaining it or moving to another strategy. The process of trial and error is not directly linked with teaching practices. Teacher A stated,

> I feel like it [reading] is sometimes a hit and miss kind of thing. If the students catch on, then good, I can continue to use the strategy, but if they don't I just

> move on. It is difficult to keep learning new ways to teach some students how to read the materials we have to give to students. I learn my strategies from talking with other science teachers. If it works for them, it should work for me.

Teacher B reflected,

> It is basically the language arts teacher's responsibility. I use the reading strategies that I used during student teaching and others I get from science and language arts teachers, but it is hard to find science strategies and reading strategies that match. The responsibilities are too much for one teacher. I try to help the students read with basic reading strategies, but that is all I know to use. I use what it given to us.

Research Question 2

This section contains a summary of the one issue that emerged related to the second research question: How do the secondary science teachers embed discipline-specific reading strategies during content instruction?

The outcome developed from the teachers' sharing the uncertainty of the concept of disciplinary literacy and the instructional practices involved. Table 6 summarized this theme related to question. The frequency of the topic and the number of interviews which mentioned it is located in Appendix K. The primary conclusion of the data revealed concerning research question two was the participants' uncertainty of understanding and embedding discipline-specific reading strategies during content instruction.

Table 6

Theme and Definition for Research Question 2

Theme	Definition
Uncertainty of the disciplinary literacy concept	This theme emphasized the science teachers' uncertainty of the concept of disciplinary literacy and the instructional practices involved

Uncertainty of disciplinary literacy. The primary theme for research question two was the instructional uncertainty, which referred to the science teachers expressed the limited knowledge of the concept of disciplinary literacy and instructional practices involved in teaching the concept. This theme was mentioned 17 times in all eight interviews. According to Zygouris-Coe (2012), disciplinary literacies practices rely on individual aspects of a discipline, such as text structure, language, and the way knowledge is processed. These differences are critical components of students' ability to comprehend content texts (Fang & Coatoam, 2013; Zygouris-Coe, 2012). As I reflected over the transcripts, it emerged that the novice teachers (four teachers with a range of two to three years' experience teaching science) shared similar feelings of uncertainty as the veteran teachers (four teachers with experience teaching science from six to 12 years).

For example, Teacher H, a beginning teacher, expressed uncertainty when asked to share specific teaching methods used in classroom instruction that supported students understanding an assigned science text. Teacher A responded, "I have no particular teaching method that I use. I teach the standards. I have never heard of disciplinary literacy before." Another participant, Teacher F, shared,

> Sometimes, I feel that I should to be able to help students understand the text I give them. I don't give students complex text because they [students] can't comprehend it, and I am not sure I know how to help them learn it. I know that I need to teach that, I am not sure how to teach that. I have been teaching 11 years and still don't know, I am more than willing to learn if someone would show me how in my science classroom.

Teacher A shared,

> I have heard the term disciplinary literacy, but I am not sure what all it means. I don't understand how reading strategies can be different in different subjects. Isn't reading, reading? I was never taught about different reading strategies in college and other teachers don't talk about it. But, if it will help my students read better, I will try to learn it and teach my students. .

Research Question 3

This section contains a summary of the three issues that emerged from the question: What factors influence the secondary science teachers' decisions to participate in professional development to learn or advance their learning discipline-specific reading strategies? Table 7 contains the summary of the primary themes that emerged for research question three. Appendix K contains a list of the items, the number of frequencies each topic was discussed, and the total number of exemplary quotes on each topic related to research question three.

Professional development (PD) should build the capacity of individuals to become leaders and learners, improve teachers' knowledge of pedagogy and student learning, and

promote collaboration among educators to develop shared responsibility (Konanovich et al., 2010). My findings suggest that disciplinary literacy professional development could provide teachers with the opportunity to learn, practice, and implement science-specific literacy strategies.

Table 7

Themes and Definitions for Research Question 3

Theme	Definition
Continue learning	This theme referred to science teachers' perceptions that they participate in PD because of a need to continue learning
District Science PD is unavailable	This theme referred to science teachers' perceptions and experiences that district science PD is unavailable
Lack of district funding for PD	This theme referred to the science teachers' perception of the lack of district funding for PD

Continue learning. The primary theme related to research question three was the participants' perception that PD allows them to continue their professional learning. This theme was mentioned 10 times in eight interviews. Teacher C discussed the role of PD for continued learning as:

> Some PD is being required and some grasp the teaching of science. I prefer ones on science content or on how to teach science. PD allows us time to discuss how

> we [district science teachers] teach certain topics within the classroom, and it allows us time to share ideas and thoughts between teachers.

In regards to PD, Teacher A stated, "As I started to teach, I started seeing I was not fully prepared, so I searched for different workshops and different resources to help me better prepare myself to teach the kids the subject." Teacher G felt similarly,

> I look for what I don't know. I have been to a lot of trainings that have been great in theory, but I need what I can use in my classroom. I need strategies that I can use in my classroom; then I am happy.

In a final example supporting the theme, Teacher D explained the need for PD:

> I want something [a PD] that will benefit me. I want something [PD] that I can use in my classroom. I want something [PD] that is good for utilization of my time. Some [PD] that's going to speak to me; something that will make my students better. I enjoy learning and I like to share that excitement with my students.

District science PD is unavailable. The second theme that emerged related to research question three was that science PD is unavailable; the science teachers reported that PD specific to the content area of science was unavailable. The theme was mentioned eight times in eight interviews. Teacher C expressed her perspective on the district's PD as, "I have no choices in PD. Most of the PD do not revolve around science, and I find them to be a waste of my time. I would like to have some options. There was one science PD, but it was very dry, and I felt like I wasted my gas to get there." Teacher F had a similar experience,

> We have the county-wide social studies and science Professional Learning Community (PLC) meeting together in our district twice a year. This allows us little time together to find out what we are teaching and how each other is doing. This is the only thing that comes to mind that is organized by the district that centers on science.

Similarly, Teacher G responded concerning the district's PD opportunities by stating,

> The county does offer us some choice of in-house PD. Most recent has been Paideia. Last year, we were offered some different workshops we could attend given by our academic coaches. To me, however, it seemed as though they were geared towards our less experienced teachers and not us with experience.

In a final example of this theme, Teacher B stated,

> There has been support by way of PD in the past, but not so much recently. We do have PPD (Personalized Professional Development Plan). This is tied to the teacher evaluation model; online tools like activities and articles that help you in our specific teaching areas, like classroom management. It is not content specific, so we don't have any content specific PD.

Lack of district funding. The last theme that emerged related to research question three was lack of district funding to support teachers' opportunities to learn through PD, which referred to the science teachers' perception of a decrease in district funds for conducting PD. This theme was mentioned six times in seven interviews. Teacher E described the lack of funding:

> Money is a big factor. The certification I am working on now will add to my K-12 licensure. I have to pay out of my pocket now, but if I score high enough in the course and make good grades, the county will reimburse me later. There is very little staff development money for schools.

Similarly, Teacher C indicated,

> We are not supported financially any more from the district. We are not provided with funding to learn or expand our learning. I have to do my own research for science teaching materials. I have even gone into other school's trash dumpsters trying to find textbooks to use in my classroom.

In a final example, Teacher G stated,

> We don't go to training sessions any more. We [district] don't have the funds. I would love to have options. I don't see any options presented to us. I don't like to take my Saturdays to attend PD, and they [district] don't have money for us to take a school day to attend.

Conclusion

The section described the methodology of this study, qualitative single case study, and the rationale for the application of this method. The study attempted to understand and explain a social phenomenon, how secondary science teachers instruct literacy and embed discipline-specific literacy strategies during content instruction. Also, the study investigated factors which influence teachers' decisions to participate in professional development to learn discipline-specific reading strategies. The study examined and described the perspectives and experiences of one group of eight secondary science

teachers in one school district located in eastern North Carolina. Each participant contributed to open conversations through a focus group and an individual interviews, the methods for collecting data.

In addition, this section detailed how the data were gathered, compiled, and analyzed. I attempted to describe people's lived experiences, events, or situations in a "thick" way (Denzin, 1989). I provided rich details; meaningful social and historical context and experiences; and was attentive to emotional content in an attempt to open up the words of whoever or whatever was being discussed (Patton, 2001).

Furthermore, patterns emerged from the data through the application of the comparative method, individually, and between cases. The comparative method provided insight into the perceptions of patterns, themes, and relationships in the data to determine if the study's findings supported the proposed theoretical proposition or a rival explanation. According to Yin (2014), if empirical research and a case study's pattern of evidence "appear to be similar, the results can help a case study to strengthen its internal validity" (p. 143).

Although the study was small in size, it is worth considering whether these eight teachers are representative of the larger teaching population. If the lack of knowledge about content-specific literacy instruction is represented, and if other teachers in the district also experience a lack of support in learning content-specific literacy pedagogies, district and school leaders need to prioritize the application of disciplinary literacy with secondary teachers. A systematic access to content-specific literacy PD is important for secondary teachers.

Section 3: The Project

Introduction

Researchers support the idea that reading instruction provided to students in Grades 4 through 12 needs to consist of more than basic literacy strategies; they also suggest that secondary teachers focus literacy instruction on discipline-specific reading methods (Draper et al., 2012; Fang, 2014; Shanahan & Shanahan, 2012). Secondary teachers need to view discipline-specific literacy techniques within a subject area as key components of effective instruction that result in students' academic growth (Shanahan & Shanahan, 2012; Wilson, 2011). Traditional secondary-level reading practices, however, focus on general, rather than discipline-specific, literacy strategies, commonly referred to as *content area literacy* (Adams & Pegg, 2012; Fang, 2014; Shanahan & Shanahan, 2012). Examples of strategies used across content areas are making inferences, asking questions, summarizing a text, and finding the main idea of a text. School administrators often encourage these classroom methods because they can be applied to a broad range of content areas (Adams & Pegg, 2012; Fang, 2014; Shanahan & Shanahan, 2012).

In contrast, disciplinary literacy focuses on teaching specialized reading and writing practices required for comprehension and critical analysis of ideas (Bean & O'Brien, 2012). Effective practices of this type are the use of highly specialized vocabulary (roots, prefixes, and suffixes), the use of language to communicate ideas (e.g., verbs used as nouns), and the use of text structures and features (e.g., boldface headings and vocabulary, diagrams, charts, and photographs) (Fang, 2014; Shanahan & Shanahan, 2012).

Findings from the report *Writing to Read* (Graham & Hebert, 2010) support the notion that "comprehending a text involves actively creating meaning by building relationships among ideas in text, and between the text and one's knowledge, beliefs, and experiences" (p. 13). The evidence provided in the *Writing to Read* document supports the idea that when students write about what they read, their ability to make meaning is enhanced. Writing activities influence students' comprehension of text when they compose extended responses involving personal reactions to the text or analysis and interpretation of it (Graham & Herbert, 2010). An example of an extended writing activity is guided journal writing. Students respond to the text by answering open-ended questions. In science, students may be asked to write an essay in which they compare the information written in print to the data presented in a corresponding diagram.

The qualitative case study of this project investigated a problem in a North Carolina school district, Douglas County (pseudonym). Schools struggle with standards and curricular guidelines to change classroom literacy practices to strengthen students' reading abilities. Student achievement data suggest that students are not applying literacy strategies in their work; that is, the currently implemented literacy strategies are not improving literacy outcomes (NC Department of Public Instruction, 2011-2013). This problem affects secondary-level students' academic achievements. This study's professional development project illustrates the need for the secondary science teachers to participate in the proposed learning opportunities centered on science-specific reading and writing strategies (Fang & Coatoam, 2013; Graham & Hebert, 2010; Shanahan & Shanahan, 2008, Snow, 2010; Zygouris-Coe, 2012).

The American Educational Research Association (2005) confirmed that professional learning opportunities based on specific content dedicated to student learning have a significant effect on student achievement.

In discussions of K-12 literacy strategies, frequently the terms *content area literacy* and *disciplinary literacy* arise. They both relate to pedagogies of reading and writing practices beyond the language arts classroom (Lee & Spratley, 2010). It is useful to distinguish content area literacy from disciplinary literacy in order to understand the merits of both. Table 8 compares characteristics of content area literacy to those of disciplinary literacy. Furthermore, it should be noted that teachers often combine the strategies of content area and disciplinary literacies as students read and respond to increasingly complex texts in the disciplines (Lee & Spratley, 2010; Shanahan & Shanahan, 2013)

Table 8

Differences Between Content-Area Literacies and Disciplinary Literacies

Content area literacy	Disciplinary literacy
Focus: Study skills that students use to learn from multiple subject area texts	*Focus*: Knowledge and abilities possessed by those who create, communicate, and use knowledge within the specific discipline
Emphasis: Techniques that a beginning learner might use to make meaning of a text	*Emphasis*: The unique tools that experts in a discipline use to engage in the work of that discipline
Recommends: Study reading and writing techniques that can help the learner to find information within a text or remember the text better	*Recommends:* Unique uses and implications of reading and writing within the various disciplines
General strategies are usually the same regardless of the subject area, with no significant increase in student's reading abilities	Disciplines differ extensively in their fundamental purposes, specialized genres, tradition of communication, and use of language

Note. Adapted from "Teaching Literacy in the Disciplines and Teaching Disciplinary Literacy," by T. Shanahan and C. Shanahan [PowerPoint presentation], retrieved from http://publications.sreb.org/2013/TeachingDisciplinaryLiteracy.pdf

Evidence from eight of Douglas County's secondary science teachers confirmed the idea that secondary teachers in North Carolina lacked knowledge of the concept of disciplinary literacy. The teachers stated that they needed training in the pedagogy before they could embed the strategies into their classroom instruction. The district previously invested time in training secondary teachers in the use of content area reading strategies during classroom instruction, and the teachers shared experiences of applying those practices. Examples of general literacy strategies that the teachers used included assigning students to underline the central ideas in paragraphs, to summarize a section of

a text, to take notes on viewed materials, and to circle unknown science terms. These strategies are often used as procedures to learn and retain content information; they refer to a basic set of strategies for reading and responding to texts with little differentiation among the subject areas (Biancarosa & Snow, 2006).

The proposed professional development plan, "Disciplinary Literacy: The Language of Science" (DLLS), is grounded in this study's findings. The needs identified in the interviews are the foundation for a project lasting a minimum of 8 weeks, with participants meeting for 1 hour each week, focusing on feedback concerning embedding the learned strategies. The aim of the plan is to inform teachers about unique reading and writing strategies supporting students' comprehension. Such strategies are focusing on science text structures (bold headings and explicit instruction for developing structured note-taking templates), technical vocabulary strategies (Latin and Greek roots, prefixes, and suffixes often found in science terms), and analyzing how Standards 1 and 4 of the Common Core Literacy Standards for history/social studies, mathematics, science, and technical subjects support students' comprehension of science texts. Additionally, writing strategies suggested to improve students' comprehension have been incorporated; they are writing responses to text that involve personal reactions, analysis, or interpretation of the text; writing structured summaries (identify main information, delete trivial and repeated information, include support information), and extended writing opportunities (e.g., journal entries).

The proposed professional development is intended to provide multiple opportunities for the teachers to study particular characteristics of the language of science

and learn how these traits contribute to understanding of the content. Teachers' in-depth understanding and embedding of discipline-specific reading strategies into instructional routines support students in improving their reading abilities and therefore increase achievement (Wellington & Osborne, 2001; Yore et al., 2004).

Description and Goals

The proposed project combines published research findings, proposed literacy routines, and science-specific reading and writing strategies to support teachers' literacy learning. The professional development (PD) program is suggested for the eight secondary science teachers who participated in the research study. The first goal of the PD is to guide the teachers to understand the concept of disciplinary literacy. The second goal of the PD is to support the teachers in learning science-specific reading and writing strategies that can improve students' comprehension. The third goal of the PD is to build literacy instructional routines based on the embedding of the science-specific strategies.

I conducted interviews with secondary science teachers in Grades 6–8 to gain an in-depth understanding of their experiences teaching literacy during content instruction. The secondary science teachers' conversations exhibited the challenges that teachers face in trying to meet the literacy needs of the students enrolled in their schools. The intended project will address the problem by helping teachers learn and implement discipline-specific literacy routines that will improve student reading comprehension. The PD will allow science teachers to create a literacy-rich environment, helping students to use explicit strategies to read complex science texts (Wilson, Grisham, & Smetana, 2009; Windschitl, Thompson, Braaten & Stroupe, 2012). Teachers seek to possess well-

developed content knowledge and pedagogical content knowledge (Zygouris-Coe, 2015). Pedagogical content knowledge involves a teacher's in-depth understanding of the content and ability to convey literacy strategies that facilitate student learning (Zygouris-Coe, 2015). This PD will enhance teachers' disciplinary pedagogical knowledge. The PD will provide teachers with multiple opportunities to learn science text structural features, to use word parts to build word knowledge specific to the field of science, to discover ways that two standards located in the Common Core literacy standards can support students' comprehension of science texts, and to use a number or writing strategies, such as writing responses to text through personal reactions and analysis or interpretation of the text, writing structured summaries, and extended writing.

Rationale

The goal of professional development (PD) in schools is to accelerate teacher and student learning. An effective PD session requires time and coordination in the areas of planning, implementation, and follow-up (Southern Regional Education Board, 2000). The secondary science teachers in Douglas County need to modify their current literacy instructional methods to include science-specific literacy techniques supporting an increase in students' comprehension capabilities.

This PD also addresses the impediments that the teachers identified as preventing their application of discipline-appropriate literacy instruction. Participants in the study stated that in-service sessions were limited in number and had little meaning outside education. The teachers also indicated that they were less likely to want to participate in district-led professional development sessions that were unrelated to teaching science;

they saw less value in mandatory PD that had no connection to science. Last, the teachers expressed concern that the district budgeted money for reading and math materials and related PD, showing little support for science advancement.

Providing secondary science teachers with in-person training establishes a uniform knowledge base in disciplinary literacy within the district. The foundation of the proposed professional development was established in Guskey's (2002) theoretical framework. The suggested professional development design illustrates that process–product logic that has dominated the literature on teacher professional learning for 13 years (Opfer & Pedder, 2011). Guskey established that effective professional development leading to change in teachers' pedagogies consists of three elements. The three components are presented in Figure 2.

The first element Guskey (2002) described is identification of a needed change in teachers' current instructional approaches. In this study, I argue that the participants in the PD should modify their current general literacy instructional practices to include discipline-specific literacy practices. Second, Guskey noted that teachers are more likely to change practices after viewing improvements in students' learning outcomes. Once teachers can witness students using the learned strategies and see assessment scores increase, they are more likely to implement the strategies on a routine basis. Research supports that when teachers consistently incorporate discipline-specific literacy strategies into content instruction, students' reading abilities improve, resulting in academic achievement (Opfer & Pedder, 2011). After science-specific reading strategies have been embedded, the students' reading capabilities should improve, resulting in increasing

assessment scores (Fang & Coatoam, 2013; Fisher, Frey, & Alfaro, 2013; Shanahan & Shanahan, 2012). The final element is a focus on changing teachers' attitudes and beliefs about the instructional practice. Guskey noted that when teachers progress through these three steps, they consistently uphold the change in their pedagogies.

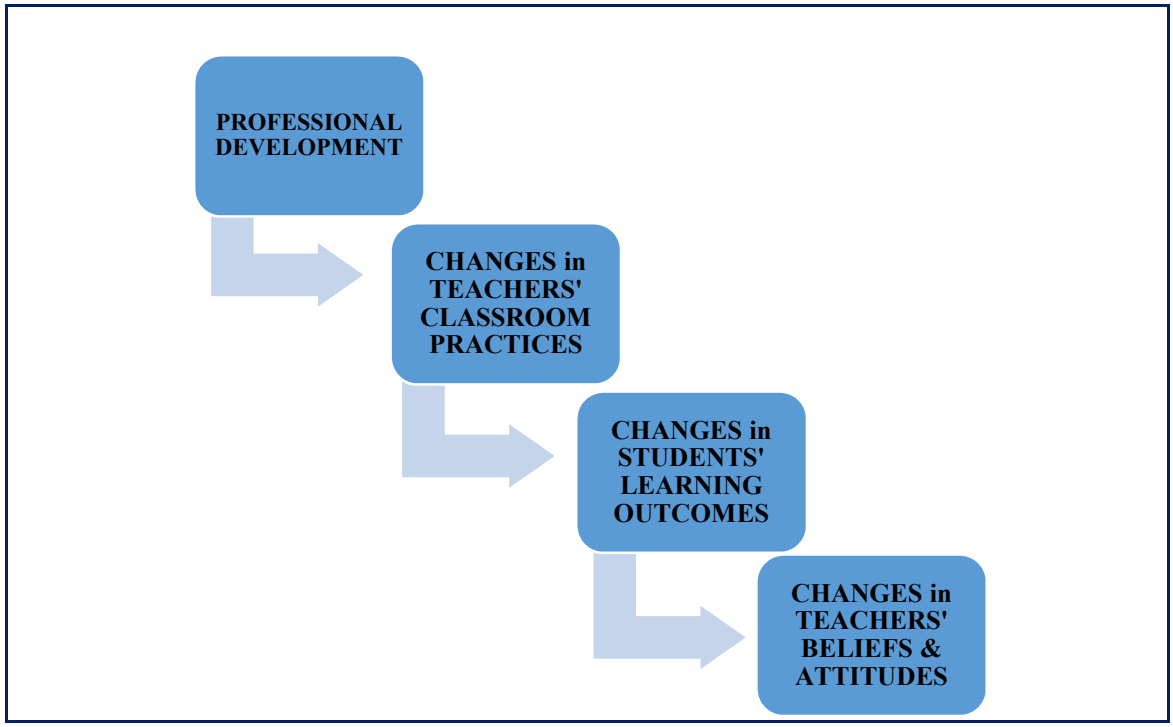


Figure 2. Theory for pedagogical change. Adapted from "Professional Development and Teacher Change," by T. R. Guskey, 2002, *Teachers and Teaching: Theory and Practice*, *8*(3), 383. Copyright 2002 by Taylor & Francis Ltd.

The model of teacher change shown in Figure 2 illustrates an unconventional approach to presenting professional development (Guskey, 2002). The model suggests that teachers' beliefs and attitudes change after they gain experience using new classroom practices, and after they witness students demonstrating improvement. The interview data support that the teachers do not routinely teach reading with their students, mainly because the strategies used fail to improve a majority of pupils' reading capacities.

Guskey (2002) stated that teachers view classroom practices as successful only when they help students reach specified learning goals. The PD supports teachers in learning and establishing discipline-specific reading pedagogies that could improve reading abilities and result in increased academic achievement (Fang & Schleppegrell, 2011).

Review of the Literature

To guide the literature review for this project, I used Walden University's online library databases (ERIC, Education Complete, and SAGE), Google Scholar, public reports, books, and dissertations. Key search terms included *reading in science*, *secondary science education*, *literacy in the sciences*, *disciplinary literacy*, *disciplinary literacy assessment*, *common core standards*, *formative assessment*, *think aloud*, and *science vocabulary instruction*. The review focused on disciplinary literacy and related topics within the specified period of 5 years. Despite the importance and complexity of the topic, there is limited research on the topic of disciplinary literacy.

The goal is to strengthen students' abilities to comprehend content texts. The data from Section 2 reveal the challenges the district encounters in attempting to adjust secondary teachers' literacy instructional practices. Therefore, I propose a professional development that offers secondary science teachers opportunities to learn and to modify lessons to include science-specific reading strategies. Science teachers need to instruct students in the procedures used by scientists when gaining an understanding of scientific texts. The literature indicates that when teachers create routines using such strategies, students' reading abilities could increase, supporting students' academic achievement. I

have organized the literature review around the main topics of professional development, disciplinary literacy, content area reading, and vocabulary instruction.

Professional Development

Professional development for teachers has been a focus of research for decades (Avalos, 2011). Teachers' professional learning is a complex process encompassing cognitive and emotional elements of teachers as individuals and as a group (Pedder & MacBeath, 2005). During the past 20 years, empirical research has shown that effective professional learning takes place within a supportive community (Webster-Wright, 2009).

Learners construct meaning from both content and context. Postholm (2011) found that a majority of teachers' learning involves conversations with other teachers about classroom experiences. The proposed professional development, Disciplinary Literacy: The Language of Science, provides multiple occasions for teachers to discuss and practice information learned during the PD. The proposed PD provides multiple opportunities for the teachers to converse with each other by sharing experiences in and out of classroom.

Avalos (2011) and Postholm (2011) supported that teachers must reflect on information if they are to learn. Postholm, in fact, defined reflection as an instrument for teachers' learning and development for classroom implementation. Reflection brings theory and practice closer together. Metacognition is a high level of reflection; it suggests thoughts about thoughts. "Metacognition is the common denominator for metacognition strategies and metacognitive knowledge" (Postholm, 2011, p. 407). When

teachers are aware of metacognition, they become knowledgeable about their methods of teaching. One of the strategies useful for both teacher and student learning is the metacognitive technique known is *think aloud*. This method provides teachers' opportunities to listen to classroom students read a text orally, and listen for any misconceptions that might form and cause understanding to collapses (Fisher, Frey, & Lapp, 2011).

Disciplinary Literacy's Instructional Practices

According to Dew and Teague (2015), disciplinary literacy engages secondary students with techniques specific to experts in the designated field of study. Disciplinary literacy incorporates knowledge of a particular content's intricacies to achieve purposeful reading and productive conversations (Shanahan & Shanahan, 2012). Dew and Teague notes two components that create a discipline-rich environment. The first calls for teachers to select intentionally disciplinary techniques which support students' comprehension, and second, teachers must decisively place the practices within their lessons. These methods are incorporated into the DLLS framework. During the 8 week PD plan, teachers have the opportunities to learn the three science-specific reading strategies and to embed the strategies into modified lessons.

According to Fang (2014), there are two critical elements to disciplinary literacy, the language, and the text. Analyzing a discipline's language requires looking for patterns of language that communicate meaning. Townsend (2015) emphasizes that each discipline has a unique formation of language. Fang & Schleppegrell (2008) clarified language as a resource for making meaning, and within a discipline, language is

purposefully used to communicate the discipline's meanings. In addition, research suggested that to gain in-depth understand of a discipline, a learner needs to practice using the language (Laufer & Rozovski-Roitblat, 2011; Nagy & Townsend, 2012). Since the data support the teachers' uncertainty of understanding the concept disciplinary literacy, the PD provides teachers with detailed information to support their learning and application of such critical researched components.

Content Area Reading Instruction

Today, secondary content teachers are asked to multi-task; they must provide practical instruction, consider state standards, and prepare students for numerous assessments. Teachers are held responsible for students mastering skills of analysis, reasoning, and communication (Kiili, 2013). However, the National Center for Educational Statistics (2013) showed that 64% of eighth grade students the United States tested at or below proficient in reading.

According to Ulusoy and Dedeoglu (2011), in the literature content area reading is a set of strategies that support improved understanding of texts. The approaches include not only reading, but also writing, speaking, listening, viewing, problem-solving, and critical thinking (Adams & Pegg, 2012; Ulusoy & Dedeoglu, 2011). Many school districts invest large sums of money into secondary teacher professional development encouraging the implementation of content area reading methods. Still, only a limited number of teachers implement these literacy strategies within content instruction (Adams & Pegg, 2012). Research suggests, moreover, that when secondary teachers incorporate

content area reading strategies into content instruction, the broadness of strategies results in inconsistent outcomes (Adams & Pegg, 2012).

While the early grades of learning to read include a majority of narrative text, students also encounter expository text learning content area curriculum. As students' progress through grades, they learn to use general procedural strategies, such as predicting, inferencing, and summarizing a discipline text, to support their comprehension (Meyer, 2013). Secondary content teachers hesitate to incorporate literacy approaches during content instruction because they lack the knowledge of how to use disciplinary literacy (Concannon-Gibney & McCarthy, 2012). This realization could be in part due to the limited research conducted on the topic of disciplinary literacy.

Vocabulary Instruction

According to Gillis (2015), elements of vocabulary knowledge include the depth of knowledge of the word, the elements found in the word, and the relationships the word has with other related words. Research supports teachers presenting students with numerous opportunities and in different contexts guiding understanding through making connections which build vocabulary (Gillis, 2015).

Gillis (2015) suggests that vocabulary instruction requires refining students' knowledge of the word and supporting students' ability to make connections among words. He noted that the "recursive process of learning vocabulary entails pre-active exploring and constructing concepts and interactive detailing the enhancement of information learned of the vocabulary" (p. 282). The process of taking ownership of

vocabulary involves developing knowledge of appropriate use, multiple meanings, and connecting vocabulary within similar fields.

Each discipline has a unique system of roots and affixes, just as it has its exclusive vocabulary (Mountain, 2015). For example, in science, the prefix geo- (meaning earth) recurs in words like geography and geology. Content teachers can learn instructional approaches such as the morphemic method in learning science specific terms. Teaching students to group words by family or by prefix or suffix help students to gain clarity of a text's meaning (Mountain, 2015).

In the same fashion, Townsend (2015) said that students gain a broad understanding of a discipline's language and meanings by identifying repeated roots and affixes of discipline-specific words. According to Nagy and Townsend (2012) and Mountain (2015), knowing the origin of a word helps to identify its roots and affixes, and can make it easier to understand its use in context. This knowledge enables teachers to appreciate the benefits of teaching roots and affixes helping students comprehend words in each discipline.

Implementation

This section describes the resources needed to implement the DLLS, existing supporters, and potential barriers. I outlined a proposed schedule for the implementation of the project, and the roles and responsibilities of all participants involved in the project.

Potential Resources and Existing Supports

The resources needed to administer the project are email addresses to invite the teachers to participate in the PD; materials such as chart paper, markers, hard copies of

the science reading passages and research articles; and copies of the formative evaluation. Additionally, conducting the project at a school district site limits the teachers' time spent traveling long distances and paying extensive travel expenses from the district's budget. Future PD expenses can remain limited by using local school sites and resources. When the district uses school employees as PD facilitators, the literacy coaches, the expenses for an out of district presenter would be eliminated.

The role of the literacy coaches is to establish and maintain district fidelity concerning the knowledge of disciplinary literacy among the science teachers, district leaders, and school principals. The reliability centers on consistent classroom instruction of the science-specific reading and writing strategies presented in the PD. Also, the literacy coaches are expected to conduct future PD for new hired secondary science teachers and to continue researching and sharing research studies with the PD participants.

One of the foundational resources of the PD is the PowerPoint. The created slides provide the long-term goals, the background information from the research study, and the sequential information for each sessions with detailed notes. The developed PowerPoint guides the learner with research driven information. The created slides and explicit notes create consistency in presenting the PD.

An additional resource is the evaluation form. The request will be made that all participants complete and return evaluation forms to the designated locations before leaving each session. The PD facilitators will analyze the feedback to determine if any modifications are needed for the next day's materials. The evaluation forms contain

several open-ended questions giving participants an opportunity to express professional views on what they liked and did not like about each session format and provided information (e.g., Which of session's expectations were unmet? and How could this PD be improved to better meet your needs?), and the form contains a Likert scale allowing participants to rate various aspects of the session (e.g., small-group activities, participants materials, leaders' presentation style, and usefulness of content). (Appendix A).

Additional resources for the PD are the required handouts that support the development and clarity of presented information. One document is the PD progression diagram; this document illustrates the development processes and the school district's stakeholders who are required to impact successful teacher change in literacy instructional practices. This handout is shared with the district and school leaders, the literacy coaches, the science literacy team, and the PD participants. Another resource will be the quarterly newsletter designed for the district science teachers. The development of the newsletter is the responsibility of the district science literacy team. It will be recommended that the newsletter be published at least twice a semester to continue building teachers knowledge of science-specific reading and writing approaches.

Another important source is the information detailing the role and responsibilities of the district literacy coaches and the science literacy team (Appendix A). The purpose of the document is to provide clarity of the roles and responsibilities to the stakeholders; the descriptors can be changed by the district and school leaders. The literacy coaches with the assistance of the PD developer will establish a date to conduct follow-up

meetings with the participating teachers to continue gaining feedback on teachers' literacy practices and monitoring students' performances using the strategies.

Potential Barriers

One possible barrier is the secondary science teachers' limited use of rich text-based instruction which is needed to educate students in disciplinary literacy structures (Schoenback, Greenleaf, & Hale, 2010). Schoenback, Greenleaf, and Hale's research reported secondary teachers' reluctances to use text during class instruction because of the students' lack of reading ability and the teachers' lack of experience instructing reading. The participants in the study exemplified similar experiences. Insofar as the teachers did implement general literacy instruction, the teachers tended to read the text orally and assign students to take notes during the readings. After the reading, the teachers would share the important information that the student should have written.

Another possible barrier is that after the PD, the teachers may question how to apply the learned science literacy methods into other classroom materials. The science teachers may continue to be uncertain of their abilities to apply discipline-specific reading strategies after the eight sessions. The sessions in the PD deliver intense information and provide multiple opportunities for the teachers to modify lessons and practice embedding the strategies into classroom instruction; however, when teachers need to implement the discipline-specific strategies into other lessons, uncertainty of embedding the practices could become an issue. The science teachers will learn to focus content instruction to include rich science texts, and guide students to use science-specific reading and writing strategies when approaching science information.

Proposal for Implementation and Timetable

The multi-level professional development follows a stepwise theory of action, with its ultimate goal being improved student academic achievement (Corrin et al., 2012). The first step is a meeting involving intense discussions between the district and school leaders and the PD developer about the proposed professional development plan (Figure 3). The meeting's focus is to establish (a) the purpose of the Disciplinary Literacy: The Language of Science (DLLS) professional development plan, (b) the components of structural and instruction fidelities within the DLLS framework, and (c) the technical assistance to be provided by the developer and the district literacy coaches. Also, the group determines which secondary science teachers participate in the PD.

Once the district's commitment is confirmed, I plan to schedule a meeting with the district's literacy coaches to discuss the purpose of the proposed DLLS, describe the professional development elements, and define their roles and responsibilities as the PD facilitators. The literacy coaches will support the teachers' learning during and after the proposed PD.

The district and school leaders, with the assistance of the literacy coaches, plan to establish a secondary science literacy team. The district leaders will establish the designated literacy team and define the roles and responsibilities of its members. The PD developer provides a draft document that shares ideas for their roles, but the leaders have the final word. The literacy coaches will notify the teachers of the newly formed team and the obligations of the team. One of the first purposes of the literacy team is to support the final development of the DLLS plan. Another responsibility of the team is to

send the selected teachers invitations to participate in the DLLS PD. The group needs to schedule meetings once a month to guide the implementation of the DLLS practices and to make sure the teachers have the resources necessary for DLLS-aligned instruction. The group can schedule specific meetings within the schools and prioritize specific instructional components of DLLS for implementation based on the student performances data and perceived instructional weaknesses. The members can encourage the teachers to participate in the PD and to use the routines and strategies in their classrooms. The literacy coaches and the termed literacy team are instrumental in creating fidelity within the schools and the science teachers' instruction.

The DLLS plan extends over several months (Appendix A). The procedural elements of the model align with school goals and practices as well as teachers' instructional needs. The DLLS PD processes of embedding the literacy strategies support the teachers' reading and content instructional routines. The beginning of the PD consists of meetings with the district and school leaders to finalize the development components of the PD. Beyond the PD, I am establishing a web page for secondary teachers to have access to disciplinary literacy research-based information and materials. Teachers will also have opportunities to respond to blogs posted related to various aspects of disciplinary literacy. The web site will address areas of disciplinary literacy not only in science but also in fields of physical education, language arts, social studies, mathematics, and additional fields located in scholar research.

I believe, based on previous research that the DLLS framework can ultimately improve the quality of teaching, and the improvements can directly advance students'

literacy capacities and achievement. Therefore, the DLLS professional development progression model (Figure 3) illustrates the advancement of the initial district and school commitment involving communication with the District Site Coordinators, to the secondary science teachers, establishing fidelity of change (Corrin et al., 2012). The results of the DLLS PD framework should improve teaching and learning in science classrooms.

The PD involves guiding the teachers to learn and develop literacy strategies accessible for students at all reading levels. This level involves training science teachers to learn and develop unique literacies of science "inclusive of the knowledge, discourses, and social practices that contribute to the professional identity, consideration of instructional approaches to make visible" the strategies for mastery (McArthur, 2012, 27). As stated by Corrin et al. (2012), this process "helps teachers [of science] select the essential content, learn how to enhance that content for mastery, and then implement the enhancements through the use of explicit and sustained teaching routines" (p. 13).

The first literacy strategy used in the plan is a metacognitive protocol, thinking of one's thinking processes, named think-aloud (McArthur, 2012). The approach requires teachers to learn from modeling and through individual practice while reading classroom texts. Furthermore, the plan includes the procedures of asking follow-up questions gauging the level of understanding of the text.

The next approaches are centered specifically on how science is communicated through vocabulary and text structures. The strategies emphasize how experts create and communicate science knowledge. Furthermore, discussions focus on how literacy

standards found in the Common Core Literacy Standards for History/Social Studies, Mathematics, Science and Technical Subjects support students' comprehension of science texts. Finally, discussions focus on how literacy specific researched writing strategies improve comprehension (explicit instruction for taking notes, respond to a text in writing personal reactions, analyzing and interpreting the text, writing structured summaries of a text, and extended writing opportunities).

The PD for science teachers is viewed as a critical component if schools are to implement successfully the DLLS plan. Level one focuses on the use of science literacy instruction; level two focuses on teachers' demonstrating understanding by embedding literacy strategies in the school's existing science curricula. Level two of the DLLS plan provides support for the secondary science teachers to modify lesson plans, embedding DLLS literacy methods. Each teacher selects strategies based on their science courses' texts, critical content, and on students' needs. Then, the teachers rewrite lesson plans demonstrating how to introduce the strategy to students and how to use the approach in classroom texts. The strategies learned throughout the PD overlap in lessons. The overlapping is significant because it offers multiple opportunities for teachers and students to practice the strategies to gain mastery.

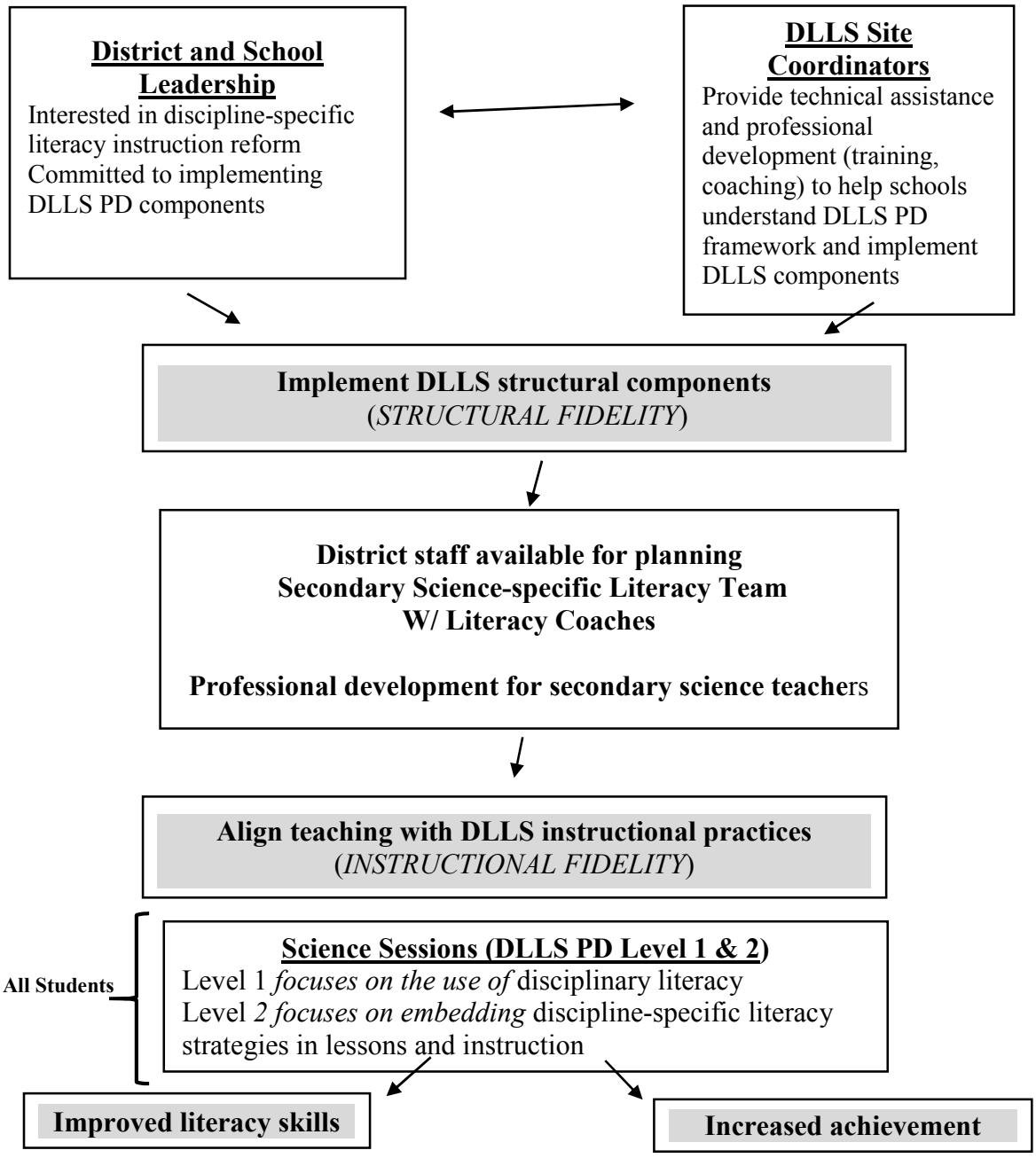


Figure 3. Disciplinary literacy model: Language of science—Professional development action model. A progressive model for implementing the professional development design. Adapted from *Evaluation of the Content Literacy Continuum: Report on Program Impacts, Program Fidelity, and Contrast*, by W. Corrin, J. J. Lindsay, M.A. Somers, N. E. Meyers, C. V. Meyers, C. A. Condon, and J. K. Smith, 2012, Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Science. Copyright 2012 by the U.S. Department of Education.

Roles and Responsibilities of Student and Others

Teachers play vital roles in and out of the lives of students in their classrooms. Teachers are best known for the role of sharing knowledge with the students who are assigned to the teachers (Darling-Hammond et al., 2009). Teachers continuously improve pedagogies through participating in profession development (Fisher, et al., 2003). Draper, Broomhead, Jensen, and Nokes (2012) identified that teachers' direct conversations during and after a professional learning opportunity ensure continuous professional growth in learning and practicing literacy.

Concomitantly, the PD facilitators will encourage the teachers to attend each session to effectively build instructional practices. During the PD, time is allowed to practice embedding best practices within class lesson plans, and to give and receive advice and constructive criticism to gain confidence as disciplinary literacy teachers (Concannon-Gabney & McCarthy, 2012). In addition, the facilitators will encourage the teachers to take a leadership role in the district and possibly in other school districts interested in discipline-specific literacy. In the future, the facilitators can rotate roles and responsibilities in conducting extended district disciplinary literacy professional learning opportunities. The literacy coaches' in-depth understanding of each aspect of the PD is essential in creating fidelity within the PD.

Administrators at the district and school level need to support the PD by attending and actively participating in the sessions. The support of the leaders demonstrates the importance of the reform. The facilitators will assist the administrators throughout the PD by answering inquiries regarding the PD information, materials, and by engaging in

conversations with other community leaders and parents. The administrators should be available for meetings with different community groups to provide clarity about the plan.

Project Evaluation

The evaluation plan for this project study is goal-based. The goal of this project is to increase the science teachers' instructional practices to include science-specific reading and writing strategies in a consistent manner. The teachers and literacy coaches should make this goal a driving force in creating classroom practices. At the end of each PD session, a PD Evaluation Form (Appendix A) will be provided for each participant. The two part form offers participants' opportunities to rate various components of the session; one part using a Likert scale of 5 (*strongly agree*) to 1 (*strongly disagree*) in areas such as the profession development was timely; was relevant to the participants' needs; and enhanced the participants' understanding of how to develop science-specific reading techniques into their science lessons. The second part of the form contains four open-ended questions concerning participants' learning process during each session. After analyzing the results from the evaluations, the PD developer and literacy coaches will determine what modification, if any, need to be implemented in the next session's plans to ensure the PD is meeting the session's goals and the participants' needs. The purpose of using this type of formative evaluation is to create collaborative work with the literacy coaches and the science teachers to reach the proposed long and short term goals of the project (Burns, Pierson, & Reedy, 2014). The team should feel a shared ownership of the PD goals and work collaboratively to set and achieve the goals.

The overall evaluation goal for the PD project is for the teachers to maximize student learning by creating and consistently using science-specific reading strategies to increase students' reading comprehension. Students will provide evidence of improved reading comprehension through increased scores in classroom, local, and statewide assessments. A related goal of the PD is for the teachers to improve their learning of disciplinary literacy approaches, and to embed effectively strategies within classroom lessons. The district literacy coaches can monitor the fidelity of embedding science-specific reading strategies in the science teachers' lessons by conducting twice a week walkthroughs and noting specific discipline literacy activities in teachers' lesson plans.

Implications Including Social Change

Local Community

This professional development project could create a paradigm shift in literacy instructional practices for a school district's administrators, literacy coaches, and teachers. This project, by helping the teachers learn, embed, and reflect using the new strategies, is critical to the faculty of the local school district who is seeking to improve the low literacy aptitudes of secondary students. The project is important to the students because the secondary students of Douglas County have failed to meet learning growth measured on statewide assessments; improved literacy will improve their academic success and achievement in future endeavors. Finally, the project is important to parents who demand implementation of research-based practices supporting the future success of their children.

Far-Reaching

The PD, additionally, may lead the participating local school district and other districts in North Carolina to mandate secondary teachers to learn and embed discipline-specific reading strategies in daily lessons. The reading strategies taught in this PD benefit all students who are required to read a text or primary source during classroom instruction. School leaders could require secondary disciplinary literacy practices as a factor in teacher evaluations.

Conclusion

The first three sections of this doctoral study presented a problem that exists in a local school district and the study that explored the problem. This section proposed a final project that evolved from the findings based on the study. Section 4 outlines the strengths and limitations discovered in the study; recommendations for addressing the local problem; and lessons learned from this study. In addition, reflections on the experiences and the lessons gained as a scholar and practitioner are shared in this section.

Section 4: Reflections and Conclusions

Introduction

The purpose of Section 4 is to discuss the strengths and limitations of the professional development project to improve discipline literacy instruction with secondary science teachers in a North Carolina school district. I present reflections on the scholarship of teaching, project development and evaluation, and leadership and change. In addition, I explore the project's potential impact for social change. I conclude the section with a discussion of implications, applications, and directions for future research.

Project Strengths

An overall strength of the project's professional development (PD) plan is its systematic design. The program provides the local school system's administrators with the instructional expertise of literacy coaches to cooperate with science teachers in learning and embedding science-specific reading practices. The district coaches can apply the philosophy of supporting teachers' learning and enabling teachers to use new pedagogical techniques in multiple settings (Bell & Cordingley, 2010). The PD marks the district's commitment to developing a method of improving instructional practices in secondary science classrooms. The science-specific reading strategies in the PD are centered on a structured summarization template supporting students in learning how to summarize a science text and a vocabulary-building strategy using Greek and Latin affixes specific to assigned terms. Each PD's instructional component guides teachers toward understanding the concept of disciplinary literacy and developing a collection of

discipline-specific literacy methods. The PD equips teachers with knowledge of the topic of disciplinary literacy and with three unambiguous, evidence-based science reading approaches (Shanahan & Shanahan, 2008). Researchers recommend that content-area teachers be required to attend PD that holds them responsible for exercising subject-area literacy tactics that assist students in mastering challenging content standards (Bell & Cordingley, 2010; Conley, 2012).

Limitations and Potential Solutions

The PD exposes teachers to a set of subject area literacy ideas associated with pedagogy methods. The anticipated timeframe of 8 hours to administer the PD could limit the teachers' in-depth understanding of the provided reading methods. Gulamhussein (2013) found that professional development is intended to improve teachers' pedagogies, which requires them to apply acquired information in instructional systems; thus, PD should be maintained over an extensive period. Research suggests that teachers are more likely to use instructional practices gained in PD programs that last a minimum of 80 hours (Bell & Cordingley, 2010; Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009). The extended time allows teachers to improve professional knowledge, skills, and attitudes (Gulamhussein, 2013). This evidence could bolster support among community leaders to provide ongoing PD.

Another recommendation for improvement is to extend the teachers' knowledge of discipline-specific reading practices beyond the three strategies provided in the proposed PD. The data show that teachers have limited knowledge of the concept of disciplinary literacy and of using science-centered reading strategies during content

instruction. The proposed project addresses three of many explicit science literacy approaches for teachers to learn and embed into daily instructional practices. The district literacy coaches should provide additional learning opportunities for the teachers to extend their knowledge and application of science-specific literacy approaches. Also, the proposed website designed to assist secondary teachers with information related to disciplinary literacy could assist teachers with knowledge of the concept. As the teachers increase their learning of science-specific reading strategies and embed the strategies into instructional content routines, students' literacy capabilities will continue to improve.

An additional improvement would be to include more than one discipline in the PD. As researchers have found, specialty disciplines such as science, mathematics, and social studies have concentrated reading requirements within the field of study (Fang & Coatoam, 2013; Shanahan & Shanahan, 2008, 2011). Incorporating multiple areas of inquiry into the PD design could compound students' improvement in comprehension. Adopting this suggestion would result in the participation of more of the district's teachers in learning discipline-specific reading strategies, thereby enabling them to assist more students in increasing their reading abilities. Finally, if this PD consisted of added subject areas, the community administration could include school-wide learning environments and move away from one field of focus (Bell & Cordingley, 2010). As additional teachers were informed of disciplinary literacy, I would remain an information resource for the district. District teachers would be encouraged to visit the website frequently to gain information and become involved the website's disciplinary literacy blog.

Scholarship

Van den Bergh and Beijaard (2014) found that "teaching and learning are contextually situated, professional development activities optimally build on teachers' knowledge, beliefs, perceived problems, and classroom practices" (774). The foundation of the study's professional development was built on these characteristics. Additionally, the literature review confirmed the need for extended research in the area of disciplinary literacy and thus encouraged the development of this project.

One of the principal goals of professional development (PD) is to support teachers' capacity to embed actual science-specific reading methods for students' selected texts. The PD allows teachers to engage actively in discipline literacy practices as they progress through learning each approach. Time is allotted for embedding into lessons and actual classroom implementation of each learned strategy while extended support is provided by the literacy coaches and PD developer through in-person and electronic conversations.

Throughout the process of the PD, active learning is modeled and practiced with all stakeholders (school leaders, literacy coaches, and teachers). Active learning was selected because of the knowledge-driven society of the United States and the necessity of lifelong learning. As Van den Berg and Beijaard (2014) found, the metacognitive knowledge and skills required to sustain lifelong learning need to be learned actively. During the PD, teachers will learn and practice essential science reading strategies before embedding them into their classroom lessons. Furthermore, feedback will be given to the teachers throughout the learning process from the school leaders, literacy coaches, and

PD developer. Support will be provided through in-person and electronic conversations and resources available during and after the timeframe of the PD.

Project Development

Before approaching the development of the doctoral project, I had experiences with developing plans to assist various levels of educators through in-service training focused on general education topics. Project topics included how to create classroom objectives, teaching students to search for information, writing and reading across the curriculum, and using formative assessment to guide instruction. Once I entered into the development of this project, I realized that my past experiences limited my perspective on the skills required to analyze studies as a developing researcher (Roskos, 2012). Studying peer-reviewed literature evolved into determining whether the project's findings were reliable and valid. The initial task of identifying a compelling topic that addressed a local problem with an authentic connection to state standards was a top priority. As a developing scholar, I was inspired to expand my research on the determined subject. The development process involved designing the problem statement, developing guiding research questions, performing a literature review, collecting and analyzing data, illustrating research findings, and designing the proposed project.

My prior experience with interpreting data consisted of holding conversations with an assembly of coworkers concerning a set of data. During these examinations, negotiations led to consensus of the group, not of the data themselves. People's individual interpretations of the data determined a student's score. These interpretations often led educators to view the process as being subjective and difficult to defend.

However, in the doctoral process of conducting data analysis, one must rely solely on the collected data (Yin, 2014). I learned that a scholar cannot rely on personal interpretation but must rely on documented data. As I compiled and analyzed the data, emergent data appeared. Each specific component that produced relevant questions and detailed data was crucial to creating a narrative that could affect education (Creswell, 2012).

Ultimately, I discovered the importance of confidentiality. My professional experiences had indicated the importance of ethical concerns in leading professional development sessions, but it was not until I appreciated the requirements of ethical methods that I fully understood the concept of confidentiality. During my years of involvement in educational projects, I thought that others would guard my integrity. In working with Walden's Institutional Review Board, one of my chief goals as a researcher was to safeguard individual participants from unspecified injury. An effective researcher needs to build trust with the participants because without trust, "communication becomes constrained and distorted, thus making problems more difficult to resolve" (Tschannen-Moran, 2007, p. 99). Therefore, when conducting research, the leader needs to establish a tone of trust to support its reliable and valid outcomes (Shenton, 2004).

Leadership and Change

In a time when education seems to change regularly, educational researchers need to become change agents (Guskey, 2002). Teachers' pedagogy must change based on research findings; moreover, teachers must know why they need to exercise different practices to be successful at incorporating change (Grant & Fisher, 2010). If teachers

lack reasons to support the pedagogical change, knowledge gained through professional development can be wasted (Guskey, 2014).

In order to be effective, research leaders need to possess the ability to work with their colleagues, especially when investigating a situation and proposing a plan to address it (Corrin et al., 2012). I learned that being mindful of the means of communication and the opinions of the individuals contributes to the depth of data. As Danielson (2006) found, "the skills of collaboration are central to a teacher's success as a teacher leader" (p. 133).

I learned that when all levels of educators collaborate for a common goal, the collaboration can create a powerful change. A key to effective school change is having a leader who possesses a strategic vision for the school—a leader who can collaborate with and motivate others, and who recognizes the performances of others (Southern Regional Education Board, 2010).

Analysis of Self as Scholar

Throughout the process of developing into a researcher, I focused on the fact that a scholar significantly adds to a discipline. My particular field of research is disciplinary literacy. One of the primary roles of a scholar is to build a foundation of knowledge and to determine if a study is required (Creswell, 2012). First, I identified a school system that accepted the opportunity to participate in doctoral research. After I had examined the system's data, I discovered that secondary students repeatedly demonstrated poor reading skills on local, state, and national assessments. I then proposed a solution to the problem by suggesting that science teachers learn and embed science-specific reading

strategies into instructional practices through participating in a designed professional development program.

Additionally, as a novice researcher, I discovered that understanding ethical methods throughout the project helped me to create a reliable report. Scholars must illustrate values and responsibility in their work, accept helpful critique, treat others with respect, and not accept personal gains at the expense of others (Boote & Beile, 2009). I incorporated feedback from the participants at various steps in the process of collecting and analyzing data. Using member checking, I provided the teachers with opportunities to correct any errors and challenge perceived interpretations. I discovered that the time allotted for member checking provided the participants with an opportunity to volunteer additional information.

Analysis of Self as Practitioner

The knowledge and experiences I had gained through the various roles and duties I had performed in secondary education sparked my enthusiasm for investigating techniques to enhance instructional methods. The numerous opportunities I have had to support teachers and school administrators in extending their learning, performing, and supporting students' learning in all classrooms have been extremely rewarding. Being a part of children's and adults' learning inspires me to continue my own learning.

Teaching is a profession that demands that an individual stay informed of the most recent studies supporting constructive change in instructional practices (American Association of Colleges for Teacher Education, 2010). I believe that teachers need to model any change that they want to achieve with their students. I support the idea that

teachers need to be knowledgeable of new practices. Research supports the idea that when educators learn and apply proper information, they lead learners toward success (Guskey, 2014).

Analysis of Self as Project Developer

During the development of the project, I felt a sense of confidence because of my past experiences in creating hundreds of professional development events for districts in North Carolina. However, my prior PD programs were simple; they typically focused on an idea requested by community leaders, and the topics were broad in nature. Topics included reading and writing across the curriculum, formative assessments in classrooms, and learning in secondary schools. The experience of developing a doctoral-level project was new and forced a concentration in the area of secondary science literacy. This type of project development led to the discovery of a topic often neglected (Fisher, Frey, & Alfaro, 2013). Teachers' limited knowledge of explicit disciplinary reading strategies affects the quality of the methods they use in lessons and is therefore too powerful to ignore (Shanahan & Shanahan, 2012). School leaders can use this project as a guide to bringing about changes in literacy instruction in secondary classrooms.

The Project's Potential Impact on Social Change

District and school leaders may have a significant influence in advocating a change in secondary science teachers' literacy instructional methods. The school system's leaders need to pledge assistance to the literacy coaches, the science-specific literacy team, and the secondary science teachers during and after the learning process of the proposed professional development and future learning opportunities. Provisions for

teachers to extend their learning and to embed science-specific reading strategies into daily lessons can strengthen all students' reading capacities, resulting in various academic achievements.

School leaders often seek research-based literacy approaches designed to improve students' reading abilities (Concannon-Gibney & McCarthy, 2012). I believe this is felt sharply in secondary schools across North Carolina. In North Carolina, secondary teachers are not required to meet any reading requirement to sustain their teaching certification (North Carolina Department of Public Instruction, 2013). However, elementary, middle, and special education teachers are required to pass a reading foundation exam to obtain a teaching certification. It is imperative that secondary teachers in higher grades continue to uphold literacy as a component of instructional routines (Shanahan & Shanahan, 20012).

The data collected and analyzed in the study indicate that the secondary science teachers in a local school district demonstrated limited knowledge of the concept of disciplinary literacy. The teachers illustrated their use of content-area reading strategies but indicated limited use of precise science reading strategies. The teachers stated that district and school leaders provided only limited learning opportunities that could lead to their understanding and implementing science-specific reading techniques in classroom instruction. This limitation may have resulted in students' weak reading performance in the classroom and on local and state assessments. The study's findings led to the development of a PD specifically for secondary science teachers. The PD addresses the

evidence analyzed from the research focus group and individual interviews. The PD is a reliable solution for the local site's problem.

Implications, Applications, and Directions for Future Research

The greatest implication for social change in literacy achievement is the ability to improve literacy instructional practices (Shanahan & Shanahan, 2008). To further literacy achievement, this study investigated how the secondary science teachers taught literacy during content instruction; how the secondary science teachers embedded discipline-specific reading strategies during content instruction; and what factors influenced the secondary science teachers' decisions to participate in professional development to learn or advance their learning discipline-specific reading strategies. One of the purposes of the study was to close the research gap of the topic disciplinary literacy and to provide information concerning science-specific reading practices.

The district leaders determined the level of resources provided for professional development (Guskey, 2014). According to DuFour (2014), effective professional development features are ongoing, collective, job-embedded, and result-oriented. The district leaders need to invest in PD that significantly focuses on building teachers' knowledge of using discipline-specific reading strategies. The leaders need to encourage teachers to extend learning practices to advance student obtaining science literacy (Grant & Fisher, 2010). As more disciplinary literacy is used effectively in district classrooms, interest from other school systems across the state could form.

Disciplinary literacy is not a newly researched topic, but it has regained the focus of literacy researchers over the past decade (Zygouris-Coe, 2015). Research supports the

power of understanding a discipline's unique communication tools (Shanahan & Shanahan, 2008). Education leaders seek knowledge and understanding of improvement students' reading performances (Burns, Pierson, & Reddy, 2014). Therefore, encouraging teachers to participate in the proposed project could usher in social change to improve literacy achievement. A professional development (PD) grounded on discipline-specific reading practices would ultimately develop secondary students' literacy strategies. The PD has implications for changing secondary science teachers' literacy instructional routines. Therefore, during and after conducting the PD, the district builds fidelity within the school structures and the teachers' instructional practices (Corrin et at., 2012).

Being a vested educator, it is clear that all levels of educators want the best for students, and that includes adopting current, researched, instructional practices. Teachers in the interviews echoed this point. A teacher's goal is to provide all students with the most productive instruction possible (Dew & Teague, 2015). The information contained in the study assisted in the identification of a local problem, provided data to support it, and identified a professional development guiding the teachers addressing the problem.

Future researchers may want to research how secondary science teachers' literacy instructional practices influence students' reading performances after implementing the science-specific strategies compared to students who do on received specified instruction. This type of study would determine the need for additional research centered on exploring how secondary teachers learn and incorporate discipline-specific strategies within the content instruction.

The study demonstrates the process of advancing literacy one step at a time. Publications that flow from this research can illustrate two important aspects of disciplinary literacy. One is the mandate to embed disciplinary reading strategies for all students who are required to read a text or primary source. The second is the teachers attempt to integrate effective literacy strategies in the content curriculum, and to support teachers wanting to learn more methods to improve instruction by participating in specifically designed PD.

Conclusion

Secondary teachers are asked to implement literacy strategies to unlock content curriculum for students with a broad range of reading abilities. Through this study, I intended to analyze how teachers in a local school system taught literacy and specifically science-specific literacy strategies, and what factors influenced their decisions to participate in professional development to learn science-centered literacy practices. Through the results of this study, I confirmed a local group of secondary science teachers acquired a limited understanding of disciplinary literacy. Additionally, the school district provided limited professional development guiding teachers in science and no teacher preparation on learning science-specific reading strategies.

As district leaders review the outcomes of the study and apply the findings to the proposed professional development, students' reading should improve. Community leaders may modify policies related to requiring secondary teachers to embed discipline-specific literacy strategies in daily lessons. As literacy instruction improves as a result of customized professional development, teachers' increased knowledge and use of

discipline literacy strategies can result in better decision-making which improve student learning.

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Appendix A: Professional Development Plan

A1. Professional Development Informational Brochure

Guiding Teachers for Success

At the close of the PD, the teachers can become district leaders in the area of disciplinary literacy, specifically in the field of science. The PD establishes a foundation upon which teachers can enhance their pedagogy of embedding science-specific reading techniques and writing strategies into classroom lessons.

About The Developer

Phyllis Blackmon has over eighteen years of experience as a secondary English teacher and a literacy coach. She served as a secondary English language arts education consultant for the State of North Carolina for eight years. Phyllis' doctoral project was titled, "A Case Study Investigating Secondary Science Teachers' Perceptions of Science Literacy Instruction."

Learning science-specific reading methods with writing strategies can improve students' literacy abilities leading to increased academic achievements (Shanahan & Shanahan, 2008).

DISCIPLINARY LITERACY: THE LANGUAGE OF SCIENCE

Phyllis Blackmon, EdS
Walden University Doctoral

Results

✓ Participants attempted to support students' comprehension through the use of content area reading strategies. The teachers expressed the district has not enforced a systematic approach to teaching literacy strategies in their classrooms.

✓ Participants' insights and experiences instructing disciplinary literacy were limited for both novice and veteran teachers.

✓ Participants consistently demonstrated a lack of district-led professional learning opportunities in the area of science and disciplinary literacy.

Proposed Professional Development Plan

✓ Opportunities to understand the concept of disciplinary literacy

✓ Support for learning science-specific reading approaches and writing strategies that can improve students' reading comprehension.

✓ Guidance in building literacy instructional routines based on the embedding of science-specific reading strategies.

Research Questions

Literacy research is beginning to recommend embedding discipline-specific literacy strategies within secondary daily classroom instruction to improve student achievement. Secondary teachers' knowledge to apply discipline-specific literacy strategies during instruction relies on the availability of professional learning opportunities that focus on such topic. The research questions of the project were to investigate how the secondary science teachers taught literacy during content instruction, how they embedded discipline-specific reading strategies during instruction, and to explore what factors influence the their decisions to participate in professional development to learn or advance their learning discipline-specific reading strategies.

Method

During this qualitative, case study research I investigated "how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (Merriam, 2009, p. 14). Data were collected and triangulated using a focus group and individual interviews with eight secondary science teachers.

Background

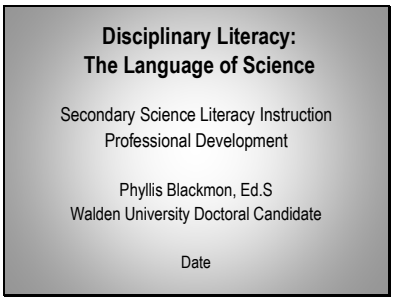
Today, the field of disciplinary literacy emphasizes discipline-specific literacy strategies taught by knowledgeable teachers that understand how learning content through problem-solving and decision-making depend on analyzing and embedding specific discipline constructs (Shanahan & Shanahan, 2008; Snow, 2010).

To gain an understanding of teachers' knowledge and perceptions of disciplinary literacy and its processes in the area of science, a case study of eight secondary science teachers was conducted in 2015.

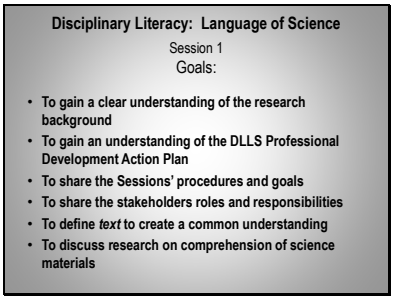
The investigation was conducted at two middle schools in a district located in eastern North Carolina.

A2. Professional Development PowerPoint Slides with Presentation Notes

This professional development is intended to inform educators of the concept of disciplinary literacy, and provide multiple opportunities to learn explicit science reading and writing techniques through active participation and reflection. The professional learning opportunities present empirical evidence that has accumulated over the past decade on what elements of reading and writing instruction work best with adolescents. The disciplinary literacy literature is grounded in the initial study conducted by Shanahan and Shanahan (2008). The research related to the presented strategies are small, but can improve students' abilities to comprehend secondary science texts. The slides provide detailed information allowing the capacity of duplication.

Introduction Slide		Provide the participants a brief introduction to the PD. Ask each presenter to share a brief self-introduction. The adult learners need to know that the presenters are vested in their learning and have knowledge of the topic. Presenters share their education and work background, and knowledge and experience with the research topic.

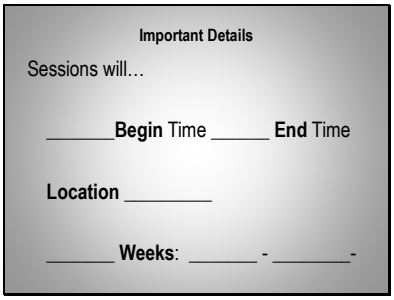
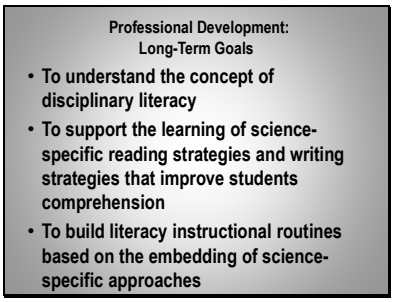
Session 1 Goals



Read orally and discuss each bullet with the group. Distribute the following handouts:
DLLS Action Model and articles (if not previously). As you distribute each item, discuss its purpose. For example, share the following when reading each article, take notes on what was learned and what can be applied to classroom instruction.

Review the Research Study

The researcher needs to reflect on the data collection procedures. Share with the participants the deep appreciation for the wealth of information given during the study's focus group interview and the individual interviews. Continue to express appreciation for the input shared during the member checking process for each method of collection.
Briefly share the data analysis process and the study's findings with the group. Answer all questions related to the collection and analysis processes. Close with how the findings led to the proposed project. (see the narrative for descriptive details)

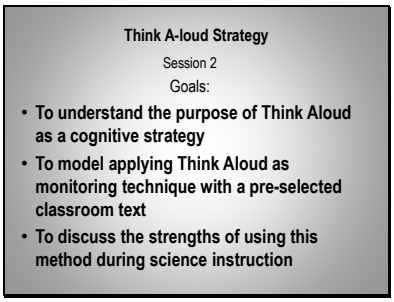
Session Details		This information will be completed before PD begins. The details will need to be determined by the district stakeholders (Middle Grades director, school principals, district literacy coaches, and teachers). This information is presented to the teachers as a reminder of the requirements of the PD program.
PD Long-term Goals		Read orally and discuss each goal with the group. Answer questions that relate to the PD. Distribute all materials needed for Session 1 (articles by Fisher, Frey, & Lapp and Lee & Spratley). Request teachers read and prepare for discussions of articles in up-coming sessions. Remind group members the importance to participate in every session. If anyone has conflicts with the schedule, notify the school's literacy coach immediately to schedule an individual make-up session.

The applied definition of a text	**What is a Text?** As quoted by Wilson (2011) **"a text is any "instance of communication that is used to convey meaning – such as a mineral that students examine to ascertain its properties…and the written and spoken words that serve as instruction to perform discipline-specific tasks on these texts – all of which instantiate what it means to "do earth science"…at a given point of time" (p. 436).**	Discuss characteristics of the science text used in classroom instruction. (e.g., lab reports, science articles, textbooks, magazines articles, medical books, argumentative essays). How do we currently use texts in our classroom? Should we use more texts? What restricts us from using texts? How can we change our instruction to support using various texts in our classrooms and real life? Brainstorm examples of different types of texts in a classroom, in various locations around school campus, in a community (print and non-print – billboards, the internet, etc.)
Identifying practices teachers use to comprehend a science text	**Applying Science Literacies** **Each person view one science text, and focus on the literacy strategies you use to help yourself comprehend the text's information.** 1. While reading the text, identify if the scientist's used mathematical and/or visual techniques within the text. If so, identify specifics. 2. Identify and list **all specific literacy strategies** you used to comprehend the text's information. 3. Did you use any literacy strategies other than mathematical or visual? 4. How did you know to use such methods? 5. Do your students know about these practices? If not, should you include them in your instruction?	Provide teachers with research evidence supporting the importance of using Think Aloud to monitor students' comprehension. Use a text that is commonly used by the teachers. Ask the literacy coaches to supply the text from the district's curriculum. Ask one of the literacy coaches to model this procedure for the teachers, so consistent, district-wide support can continue with using this approach. After the modeling activity – discuss in detail how the approach was implemented and how the teachers can use it in their lessons. Determine if any teachers currently implement this approach in classroom instruction. If so, allow their input into the discussion. Discuss if the strategy makes any teachers uncomfortable and what elements of the approach could cause a teacher to feel uncomfortable. Discuss ways the teachers and literacy coaches can limit these feelings. Discuss what needs to occur at the

district level to increase teachers' abilities to use this strategy with their students.

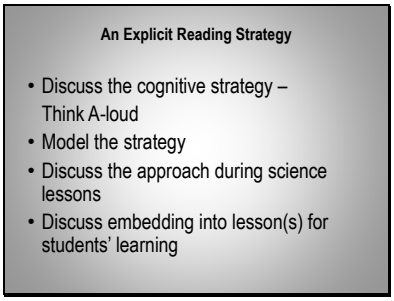
Request the teachers embed this strategy within at least one lesson and then return with reflects on strengths and weaknesses of using this approach during class instruction.

Session 2/Think Aloud



Metacognition is a high level of reflection; it suggests thoughts about thoughts. "Metacognition is the common denominator for metacognition strategies and metacognitive knowledge" (Postholm, 2011, p. 407). One of the strategies that are useful for both teacher and student learning is the metacognitive technique known as "Think Aloud."

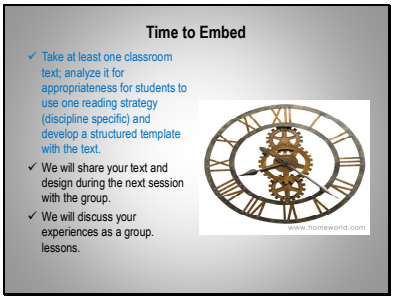
Think Aloud continued



The entire session will take time to model the Think Aloud method with a selected science text. (The literacy coaches will determine the text from the science curriculum and conduct the activity). This process needs to be conducted at a slow pace, especially for teachers who have not conducted this procedure before. After the procedure has been conducted, discuss the steps taken. Request input from any teachers who have experience with implementing this method. Discuss the strengths for applying this method in the science classroom. Request a

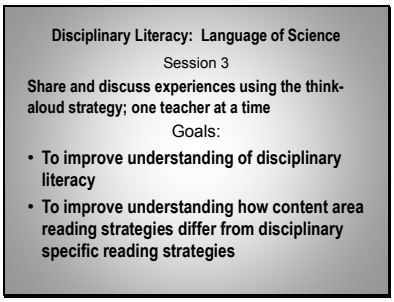
participate to select a text or even a limited section of a text to conduct the Think Aloud strategy and demonstrate it for the group. Some teachers might want to practice and then share out with the group at a later session.
Provide teachers with research evidence supporting the importance of using Think Aloud to monitor students' comprehension.
Use a text that is commonly used by the teachers. Ask the literacy coaches to supply the text from the district's curriculum. Ask one of the literacy coaches to model this procedure for the teachers, so consistent district-wide support can continue with using this approach.
After the modeling activity – discuss in details how the approach was implemented and how the teachers can use the approach in their lessons.
Determine if any teachers currently use this approach. Discuss what aspects of the strategy make the teachers uncomfortable. Discuss ways the teachers and literacy coaches can limit these feelings. What can occur to increase teachers' strength in using this strategy?
Request the teachers embed this strategy within at least one lesson and then return with reflects on strengths and weaknesses of using this approach during class instruction.

Teachers are given time to embed the strategy - Think Aloud

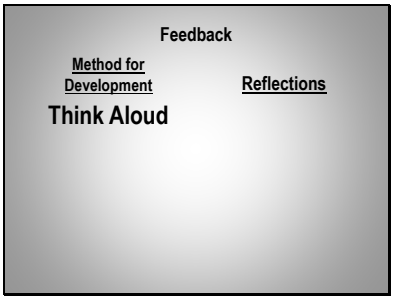
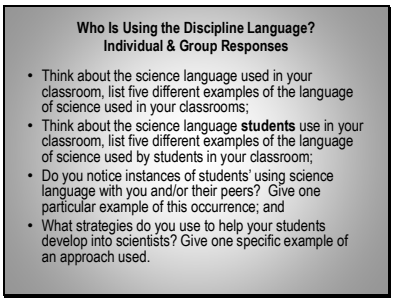
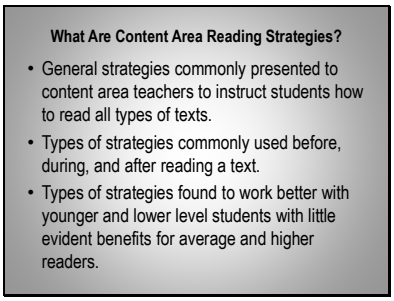


This slide is repeated throughout the PPt. Each time is it used; it signals time for the teachers to embed a new science-specific reading or writing strategy into their practices.
Read orally and follow each step presented on the slide. The teachers should be comfortable with this format by this time in the PD. Answer all questions about the new strategy and embedding the strategy into classroom lessons.

Session 3/ Introductio n to DL

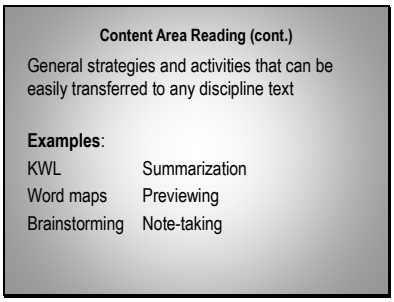


Follow in sequence and detail of each bullet:
Teachers (one at a time) share experiences using Think Aloud during at least one science lesson
Discuss the purpose of today's session: 1. to begin learning about the concept disciplinary literacy, and 2. to compare current literacy practices known as content area reading strategies to those identified as discipline-specific reading strategies.
Read orally and share the goals of the session

Time to share experiences embedding Think Aloud		Teachers share their experiences and perspectives of using the strategy Think Aloud. One person will record evidence on chart paper for posting. The purpose of posting feedback is to remind the teachers of used methods and provide evidence of instructional growth during and after the PD.
Group activity: who uses the language of science in the real world		PD's Essential Questions Have these questions pre-posted on chart paper (one question per group or all questions for each group if the group is small). Allow time for the teachers to discuss responses and then share out as a whole group. Display group (s) responses in PD room. *Note*: Have markers ready for teachers to write responses on chart paper. Literacy coaches need to move around the room answering teachers' questions.
Introduction to content area reading		Begin this slide by charting the literacy practices currently implemented by the teachers. Orally read and discuss each bullet listed. How do we change out instructional practices? When is it necessary to change our instructional practices? *Note*: Visit the Annenberg Learner website: they have a Reading and Writing in the Discipline Course. Discuss this possibility with the district and school leaders – for at least

the PD participants or literacy coaches to use this information in the future.

Content area reading continued



Compare knowledge of listed practices to ones listed on chart paper from actual implementation.
Discuss: How do teachers in math, social studies, English, PE, computer science, etc. probably use the same named strategies in their instruction? Then discuss how teachers in health use the same name strategies in their instruction? Or do they?
Determine if the teachers identify a pattern. What are the positives of this occurrence? Do we "see" any challenges in this? What happens when a text become more complex?

Content area reading and teaching vocabulary

Content Area Reading Strategies with Vocabulary

Instruction that tends to focus on memorization techniques….

- limits making connections among concepts
- uses graphic organizers
- applies brainstorming, semantic (work parts) maps, word maps, rate knowledge of a word, categorize words, develop synonym webs, etc.…

Self-reflection:
How many times were we asked to memorize material in school that we forgot quickly?
How often do you require your students to memorize information for the sake of memorizing? How long do students retain the information? Does evidence determine this?
What strategies do you use to support your students to remember information?
How effective are the strategies?
Would you like to learn "new" strategies to support students learning science material?

Content area reading and vocabulary continued

Content Area Reading Strategies with Vocabulary (cont.)

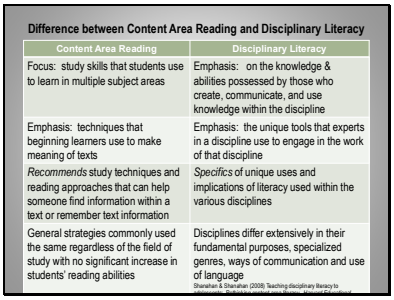
Instruction could sound like this: "Here is a list of science-related affixes commonly found in science vocabulary words. Each week you will take a vocabulary quiz. We will start with list one and work until we finish with list 30." "For the quiz, you will be expected to write down the definition of the prefix/suffix, give one example of the word, and define the word." **Does any of this sound familiar**?

List #1

a-/an- without/not	arthr - joint
ad- to, towards	auto – self
amphi- both	arche- ancient

Read orally and discuss.
What about this instruction makes if effective for students learning science vocabulary?
How many of us use this type of instruction?
How long do we expect students to retain this type of information?
What elements lead us to retain the information?
Why are children different?

Chart – comparing traits of content area reading to disciplinary literacy



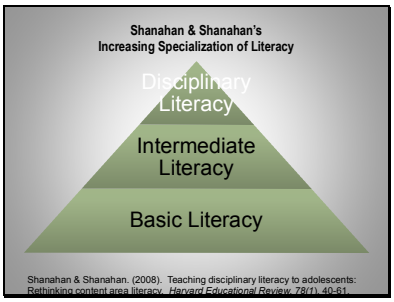
Difference between Content Area Reading and Disciplinary Literacy

Content Area Reading	Disciplinary Literacy
Focus: study skills that students use to learn in multiple subject areas	Emphasis: on the knowledge & abilities possessed by those who create, communicate, and use knowledge within the discipline
Emphasis: techniques that beginning learners use to make meaning of texts	Emphasis: the unique tools that experts in a discipline use to engage in the work of that discipline
Recommends study techniques and reading approaches that can help someone find information within a text or remember text information	*Specifics* of unique uses and implications of literacy used within the various disciplines
General strategies commonly used the same regardless of the field of study with no significant increase in students' reading abilities	Disciplines differ extensively in their fundamental purposes, specialized genres, ways of communication and use of language

Shanahan & Shanahan (2008) Teaching disciplinary literacy to

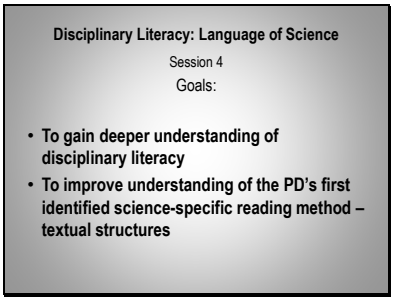
Introduction: the differences between CAR to DL. Information comes from Shanahan and Shanahan's article (2008) information.
Analyze each element in the group setting.
What specific characteristics make the differences?
Do we discover any patterns in differences?
Stress this information came from Shanahan and Shanahan (2008) article.

Shanahan & Shanahan's DL Pyramid



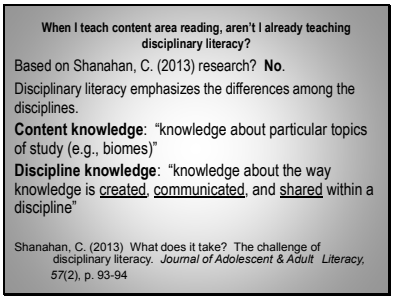
This pyramid illustrates the development of literacy. All information is from Shanahan & Shanahan, 2008 (article noted in previous slides)
How do we support our students who enter our secondary classrooms without mastering the basic and intermediate literacy skills? What are your current literacy instructional practices? How would you score your success rate?

Session 4 Goals



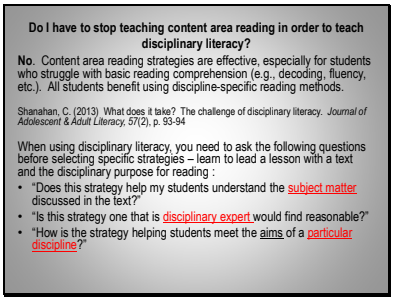
Review – ask a teacher to share their views of DL. Ask another teacher to share their view of the differences between CA and DL reading strategies.
Share that we are going to learn a specific science reading strategy that they could embed into their lessons.
Share the template provided will need to be modified to meet each specific text.

Question about teaching DL



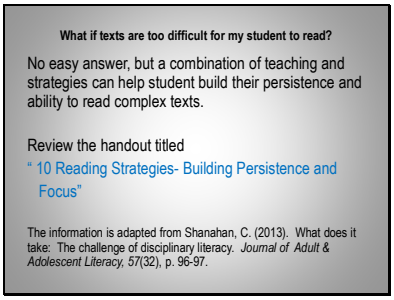
Answer any questions that may still exist between the differences between content area reading strategies and disciplinary literacy practices. This slide shows another perspective of the differences.
Discuss the perspectives between content knowledge and discipline knowledge. Ask the teachers to share the differences between biology and physical science and then share commonalities among the sciences. This type of information can help clarify the information presented on the slide and guide them as they develop their lessons.

Teaching both content area and discipline-specific reading strategies



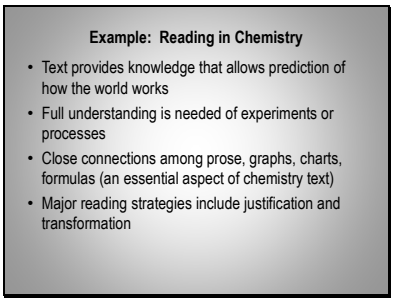
This slide is powerful in helping teachers determine lesson and text purposes. Teachers need to learn to select a text and then determine the discipline purpose for reading the text. The three researcher's questions need to be displayed in the PD room and shared with the teachers so they can use when developing lessons.

Teaching complex text



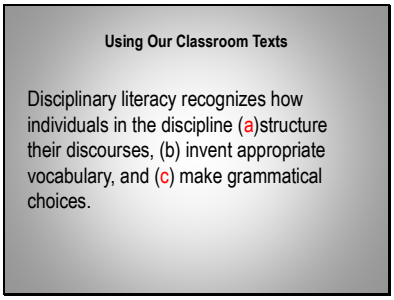
Read orally the question on the slide and the researched response.
Distribute the handout (Appendix A)
Read each strategy and discuss as needed.
Answer the final question on handout.

Chemist reading a text



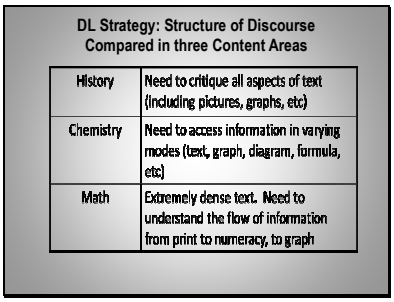
All information comes from Shanahan & Shanahan (2008) study:
How do you approach a science text? What thinking occurs in your mind as you review a science text? Do you view a text for specific features? Do you skim for vocabulary? Do you skim for visuals to help you understand the information in the text? Do you think your students use any strategies before they read a science text? Do you think they have knowledge of any of the strategies you apply before, during, and after your read a science text?

Recognize disciplinary literacy



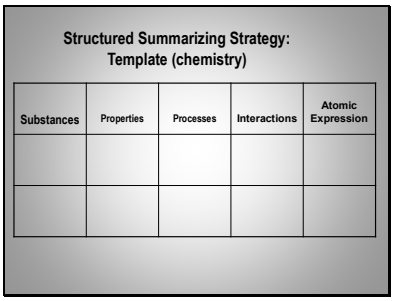
Discuss our next plans for embedding our learnings into our lesson plans. Take time to practice the lessons in the group setting before teachers are asked to present the lessons with students. Teachers can discuss revisions needed in lessons throughout the process. Discuss each section of information on the slide in small groups or as one group.

Discourse in 3 different subject areas

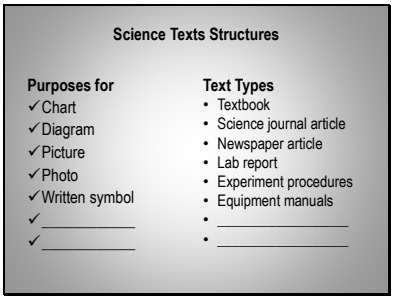


The first element is structured discourse. This information comes from Shanahan and Shanahan's research (2008). The study involved scientist and how they read science texts. They were observed by the researchers and then interviewed to discuss the cognitive strategies implemented.
Discuss why the text is not frequently used in our classrooms. What holds us back? How can we remove these uncertainties?

Example of a structured summary template for a chemistry text

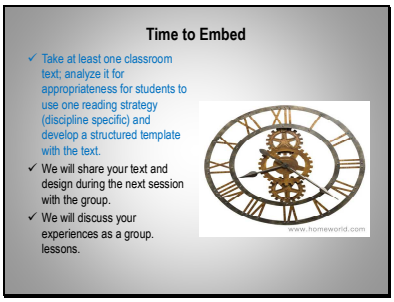


Examples of science texts structures



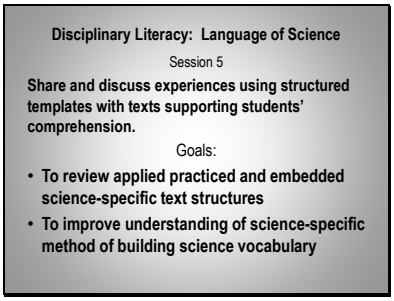
Discuss each section of chart, and add additional examples as provided by the participants. Post results in PD room. Teachers can add purposes and types of texts as they are discovered.

Time for teachers to embed the learned science-specific strategy



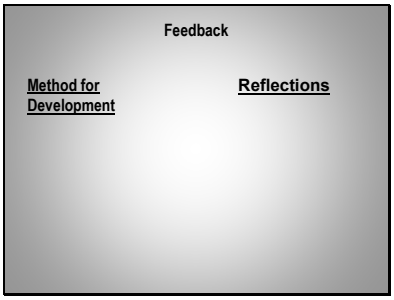
This slide is repeated throughout the PPt. Each time is it used; it signals time for the teachers to embed a new science-specific reading or writing strategy into their practices.
Read orally and follow each step presented on the slide. Answer all questions about the new strategy and embedding the strategy into classroom lessons.

Session 5 Goals



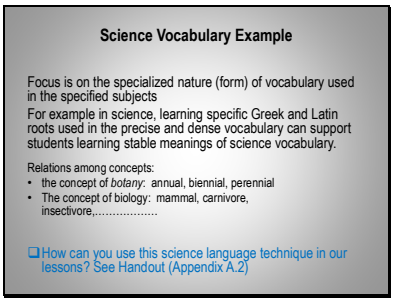
Read orally and discuss the next session's goals.

Experiences embedding the learned science-specific strategy



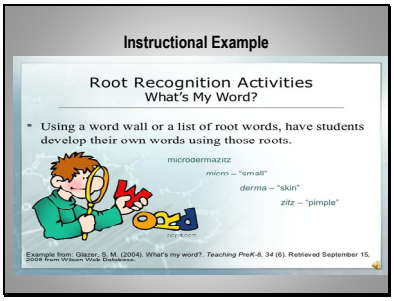
Review and share orally teachers experiences embedding structured templates into daily lessons. Reflect on lessons learned with the group. Discuss the challenges in developing such tools. Discuss the benefits for such tools.
Post complete chart in PD room.

Teaching science vocabulary



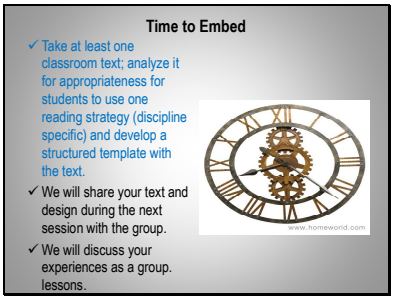
How can we implement this technique into our lessons
Can a teacher show us how? Maybe a teacher already uses this type of strategy.

Word Wall



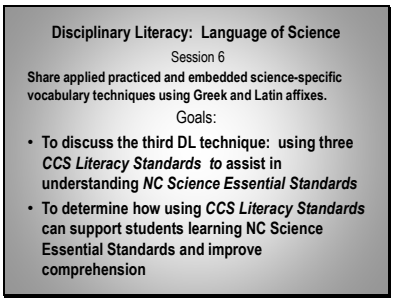
Do any teachers currently incorporate Word Wall into their classroom instruction? If so, allow them to share classroom experiences.
Word Wall is a simple instructional tool that does not take much time to create and keep updated.
Share other websites that are useful for teachers' instruction using Word Wall.

Time for teachers to embed



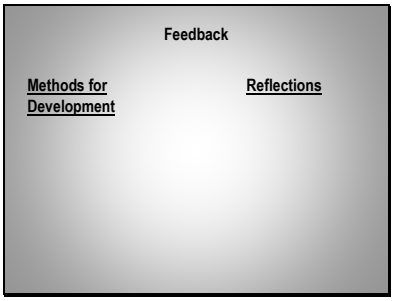
Read and follow each step listed on slide
Discuss any questions regarding embedding strategies into lesson(s).
Provide time for the teachers to practice implementing the lesson in the group.
Establish a date to re-join as a group to share-out experiences (strengthens and weaknesses)

Session 6 Goals



Discuss how the Common Core Literacy Standards can assist in teaching the state's science standards. Determine in groups (specific areas of science) what teaching strategies can be used in combining these standards.

Experiences embedding the science-specific strategy



Complete the chart with teachers' responses to classroom experiences with building students' science vocabulary through using Greek and Latin affixes. Post the completed chart in the PD room.

Common Core Literacy Standards

Literacy Standards for Science & Technical Subjects, Grades 6-8

Key Ideas and Details

- Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (RST.6-8.3)

Craft and Structure

- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (RST 6-8.4)
- Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic. (RST.6-8.6)

Directly stated as ***Common Core Literacy Standards*** *see link at end of slides*
Are these standards reflected in state standards?
How are they different?
Is the goal the same in each standard?
How different are needed instructional practices from the two types of standards (if they are different)?

Time to embed

Time to Embed

- ✓ Take at least one classroom text; analyze it for appropriateness for students to use one reading strategy (discipline specific) and develop a structured template with the text.
- ✓ We will share your text and design during the next session with the group.
- ✓ We will discuss your experiences as a group. lessons.

Read and follow each step listed on slide.

Session 7 Goals

Writing to Improve Comprehension

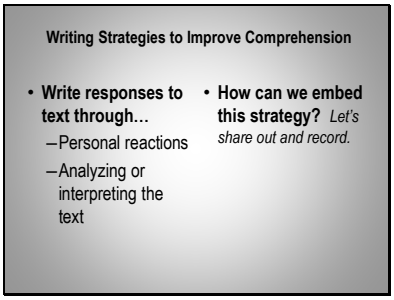
Session 7

Goals:

- **To discuss the next technique: using writing to strengthen comprehension through the resource *Write to Read* by Graham & Herbert (2010)**
- **To understand the specific writing techniques and discuss ways to embed into classroom lessons**

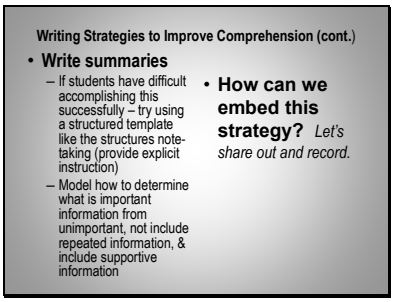
Read orally and discuss this session's goals.
Note: Literacy coaches should have copies available to distribute to the teachers.

Write responses to text



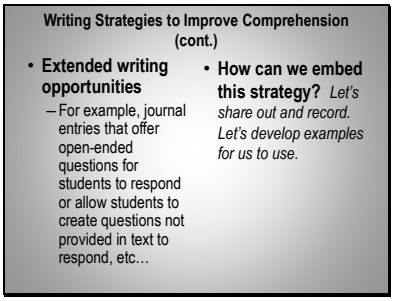
As teachers analyze this information; someone needs to record the responses on chart paper for display. Modify throughout PD.

Write summaries



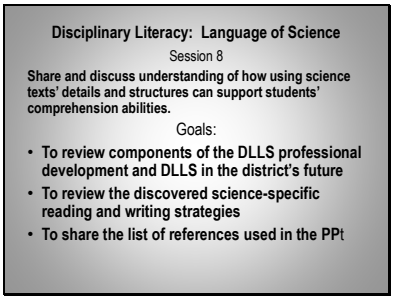
As teachers analyze this information; someone needs to record the responses on chart paper for display. Modify throughout PD.

Extended writing opportunities



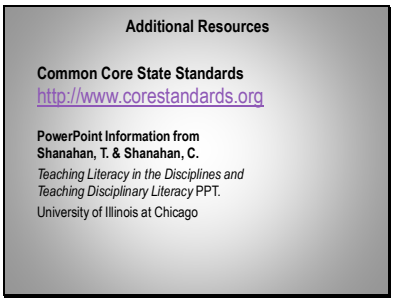
As teachers analyze this information; someone needs to record the responses on chart paper for display. Modify throughout PD.

Session 8 Goals



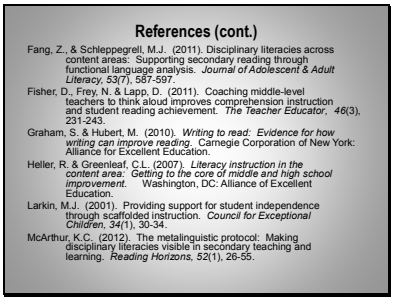
Review the strategies and the processes of embedding science-specific reading and writing strategies to improve students' comprehension.

Additional Resources



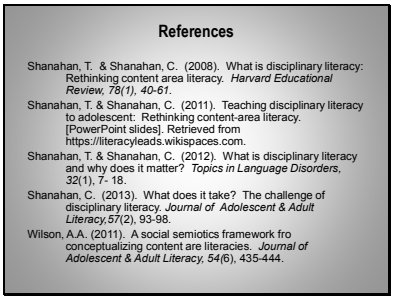
Discuss resources with district Middle Grades director, school principals, district literacy coaches, and teachers

References



This is the second list of references. The first list of references was provided during the focus group interview. Remind the participants of their first list of references. Have copies of the first list.

References



This is the second list of references. The first list of references was provided during the focus group interview. Remind the participants of their first list of references. Have copies of the first list.

A3. Handout 1

Science Literacy: Stakeholders' Roles & Responsibilities for Professional Development

Literacy Coaches' tasks

- ☒ Organize necessary PD materials: PowerPoint, handouts, school site specific area for to take place on your trip; book appointments and meeting rooms.
- ☐ Work with science-literacy team with newsletter.
- ☐ Work with district and school leaders to maintain instructional fidelity.
- ☐ Confirm appointments, schedules, reservations, etc.
- ☐ Tie up any loose ends at the office (finish up projects; set up out-of-office replies; notify or remind coworkers about training dates, times, and specific locations).
- ☐ Print out hard copies of presentations, agendas, and important documents.

Science-specific literacy team tasks

- ☐ Create and publish a quarterly newsletter for teachers (ask teachers for feedback to include in document).
- ☐ Create continuous bi-yearly professional development for the district science teachers on science-specific reading approaches to embed in classroom lessons.
- ☐ Work with literacy coaches supporting teachers embedding reading strategies.
- ☐ Work with district and school leaders maintaining district's mission regarding disciplinary literacy.

Secondary science teachers' tasks

- ☐ Actively participate in all professional development sessions.
- ☐ Provide honest feedback on each sessions' formative assessment supporting changes in each session.
- ☐ Embed learned science-specific reading strategies into daily lessons supporting students increased reading abilities.
- ☐ Conduct dialogue with literacy coaches, literacy team, school administrators and district leaders with concerns regarding new teaching approaches and students' performances.

A4. Handout 2

Greek and Latin "Starter List" Sheet

Root/Affix	Meaning
aud	listen
bi-	two
-cracy	rule
dict	speak
equ	equal
frac	break
gen	family/race
greg	flock
metr/meter	measurement
migr	move
mono	one
poly/poli	many
scop	view
scrib/p	write
struct	build
tech	skill
tele	distant
trac	pull
vert	turn

Note. Adapted from "Recurrent prefixes, roots, and suffixes: A morphemic approach to disciplinary literacy" by L. Mountain, 2015, *Journal of Adolescent & Adult Literacy, 58*(7), p. 563. Copyright 2015 by the International Literacy Association.

Do you think we need to remove or add any roots/affixes to the list for our curriculum?

If so, let's determine the changes.

A5. Handout 3

List of 10 Teaching Approaches Supporting Students to Read Complex Texts

- Begin the school year, or semester with less complex and shorter in length texts and increase text complexity and length as the school year or term progresses.
- Chunk longer textbook chapters, articles, etc. into smaller chunks to build success among struggling readers.
- Provide explicit intentions to build persistence and capacity and through explaining why reading the text is important. Celebrate students' accomplishments, small success matter.
- Create a safe environment where students understand that struggling with a text is a part of learning. You can do this by modeling actual struggling with a text, and recognize (encourage) students to work through the difficult areas.
- Provide instruction that encourages students to pay attention to the important sections of a text or annotate for disciplinary purposes.
- Set purposes for reading that are authentic to a discipline. Why are you assigning the text to the students?
- Work carefully through significant passages by modeling and then having students' practice close reading of a text within a disciplinary lens. For example, in chemistry, look for language that explains the extent of confidence one can have that a reaction will occur, given a particular mix of chemical.
- Do your homework, before you teach a text - pre-determine the key ideas and significant details you want students to know and be able to do at the end of the lesson.
- Refrain from telling students what is in the texts they are about to read in groups or independently. Instead, guide students to determine their own answers, and often their own questions as they read. *Shanahan suggested the rule is talk less and listen more. It is important that students feel ownership for their interpretations of texts.*

Note. Adapted from "What does it take? The challenge of disciplinary literacy" C. Shanahan, 2013, *Journal of Adolescent & Adult Literacy, 57*(2), p. 96.

A6. PD Timeline

January Semester	
District and School Leaders	▪ Collaborate with district and school administrators on finalizing the proposed project - DLLS Theory of PD Action Model. ▪ Preview and edit details in DLLS-PD, and the PowerPoint goals and content. ▪ Discuss short- and long-term roles and responsibilities of district and school leaders with project developer. ▪ Determine the site for conducting the DLLS PD. ▪ Support leaders to provide and ensure teachers with available time to participate in the PD plan and full implementation into instruction and lesson plans. ▪ Schedule training(s) for district Literacy Coaches with the DLLS PD developer.
January	
District Literacy Coaches	▪ Collaborate with Literacy Coaches elements of the DLLS PD. The project development needs to elaborate the development of the DLLS - Theory of PD Action Model. ▪ View and discuss detailed elements of DLLS PowerPoint. Answer all questions to gain fidelity of DL and DLLS among the stakeholders.

	▪ Discuss roles and responsibilities of district and school leaders and project developer. ▪ Schedule next month's meeting(s) to finalize all supports (short- and long-term goals, timelines, procedures, and forms) needed to implement uniform PD. ▪ Discuss schedules and procedures for conducting walkthroughs and viewing teachers' lessons plans for evidence of embedding science-specific reading and writing strategies.
February	
Secondary Science Literacy Team	▪ Create and publish a newsletter at least twice a semester for teachers (ask teachers for feedback to include in document). ▪ Create continuous bi-yearly professional development for the district science teachers on science-specific reading approaches to embed in classroom lessons. ▪ Work with literacy coaches supporting teachers embedding reading strategies as requested. ▪ Work with district and school leaders maintaining district's mission regarding disciplinary literacy among community leaders and parents.
February/March	
Secondary Science Teachers	▪ Collaborate with school campus literacy team leaders to create, distribute, and display the PD

information (short- and long-term goals, timelines and procedures) at the determined site.

Participant and embed the following session information:
Session 1: Introduction to purpose of PD, presenters, and procedures; will recap on research study,
Session 2: Define what a text and embed Think Aloud,
Session 3: Content area reading compared to discipline-specific reading,
Session 4: What is disciplinary literacy?
Session 5: The Language of Science: structured summarization,
Session 6: The Language of Science: Vocabulary,
Session 7: Using writing strategies to comprehend texts, and
Session 8: Review science-specific reading and writing strategies and used references.

- Use the formative assessment forms to give feedback to each session's goals, presentation, and information.

A7. PD Sessions: Formative Evaluation Form

Name _____ (optional) Position/Role _____

District/School _____ Date _____

Session Topic _____

To what degree do you agree with the statements below? (5 Strongly Agree – 1 Strongly Disagree). Write the number in the corresponding column to match your response. **The professional development:**	**5 Strongly Agree**	**4 Agree**	**3 Neutral**	**2 Disagree**	**1 Strongly Disagree**	**0 Not Applicable**
1. was timely.						
2. was relevant to my needs.						
3. format and structure facilitated my learning.						
4. enhanced my understanding of the concept of disciplinary literacy.						
5. enhanced my understanding of how to embed science-specific reading strategies into my classroom lessons.						

6. helped me gain new information and skills.						
7. will assist me in making better-informed decisions concerning reading practices.						
8. provided important resources for me.						
9. will assist my district/school/ me in developing more effective literacy lesson plans.						
10. met my expectations.						

Respond the following questions:

1. What was the most useful part of today's session? Why?

2. What was the least useful part? Why?

3. What additional information/training/support do you need related to the topic covered in today's session?

Appendix B: Request Permission Letter: District

Dear _____:

Discipline-specific literacy places emphasis on the knowledge and abilities possessed by those who create, communicate, and use knowledge within the discipline. This type of explicit literacy strategies, which were identified through previous researchers' (Fang & Coatoam, 2013; Shanahan & Shanahan, 2008, 2012; Zygouris-Coe, 2012 and more) published works, are the foundation of this study. When researchers conducted disciplinary-literacy studies, they used actual scientist, historians, etc. to identify content-specific literacy strategies they used while reading content texts. These strategies developed into discipline-literacy for reading. Through research evidence, researchers have proven when teachers embed ongoing instructional practices, students' demonstrated academic achievement. Today, teachers are encouraged to embed disciplinary literacy strategies throughout their lessons to strengthen students' aptitudes for comprehending complex texts, which could lead to academic success.

I am a doctoral candidate from Walden University, studying the concept of disciplinary literacy. _____School is invited to participate in the study. If you accept, the following steps will take place:

- I will remove all identifiable information that could possible identify all stakeholders involved from _____as the participating school system in my study.
- Participants' names will be separated from all data collected and reported.

I will share the results of the final report by following _____policies and procedures for releasing Research Study Results.

If you have questions regarding participation, I would be happy to answer them via phone (###-##### or email _____@ waldenu.edu or come to your office for a face-to-face meeting.

Please reply to this email with your permission. Additionally, I need you to copy this letter to Walden University's Review Board at the following address: irb@waldenu.edu

Sincerely,

Director's Signature: _____

Date of Signature: _____

Appendix C: Participant Consent Form

Dear Colleague,

I am currently enrolled as an Ed.D. Graduate student at Walden University. As a requirement for my degree, I will be conducting a research project study entitled, "A Case Study Investigating Science Teachers Perceptions of Science Literacy Instruction." First, the purpose of this study is to explore how, when, and if secondary science teacher instruct literacy (reading) during content instructional practices. Another purpose of the study is to explore how, when, and if secondary science teachers learn current evidence-based instructional practices. I am requesting you as a participant for this project study.

The collection of data will begin January 15, 2015 and end February 5, 2015. If you agree to participate, you will be asked to provide a protected email address so the study's materials can be securely emailed to you. The first task is to conduct our initial meeting, "Introduction to Disciplinary Literacy: A Focus Group." This meeting will be scheduled at your school and at a time that is most convenient for all teachers. At the completion of the preliminary meeting, I will then share the second data collection instrument titled, "Secondary Science Individual Interview Questions." The next step of the process is for you to complete a provided document titled, "Interview Set-up Form." The information needed on this form will guide the date and time for our individual interviews. The final tool used during the data collection process will be to conduct individual interviews. Each interview will be schedule for a period of 30-40 minutes. All discussions will be recorded on my personal tape recorded in order to assist my accurate data collection and interpretation. Each of these data collection opportunities will afford you the opportunity to offer your own perspectives on the data transcripts and research interpretations, called member checking. Know that all personal information will be removed during data analysis.

Possible benefits for the participants of this project are to enlighten secondary science teachers regarding literacy instruction and benefits for including discipline-literacy instruction within secondary science instruction, and influence the decisions of educators who develop school policies. Reading the final report and listening to your voices could guide instructional changes in schools, and establish possible voice in future professional development topics offered to science teachers across North Carolina and nationwide.

I chose this school because I wanted to work with a school that employed science teachers, Grades 6-9, who appeared eager to advance their science professional practices and students' achievements with current evidence-based information.

There are no foreseeable risks or discomforts for participants in this project. Your name and all other personally identifiable information will be kept confidential throughout the entire research study. At times, you might see that I use the school name, *Douglas School* System as the name of your school; I created this pseudo name to protect any identification to your school system. I will implement the same process with your identity information: I will probably implement a number as your identification.

Your participation in this project is voluntary and there will be no compensation. If you decide to participant in this project, you have the right to inspect all instruments or

materials related to the proposal before the actual collection of data. During the member checking procedures, I will involve send you our collected data to review and offer you a 24-hour timeframe to provide any comments, additions or corrections back to me regarding the information is an accurate representation of your responses.

As a participant, you will be sent an electronic copy of the Consent and Confidentiality forms; please sign each document and return the forms to me. Please make yourself a copy before deleting the form from your computer. If you decide to join the study, you have the right to stop participating at any given time. If you feel stressed during this study, discuss your concerns with me. You may skip any questions that you feel are too personal. If you choose not to participate in the study, please delete this email and attachments; no harm will come to you for not participating.

If you have any questions or concerns about this research project study, please contact me at #### or _____@ waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. _____. She is the Walden University representative who can discuss this with you. Her phone number is 10-24-14-0240904. Walden University's approval number for this study is ## and it expires on _____.

If you are willing to participate in this research, please complete the information below:

Participant's Name (please type), date, and resend to _____@waldenu.edu

Participant's Signature or Electronic Signature and Date

(Your typed name represents your signature)

_____ (Date)

_____

Return to **by _____**

Sincerely,

Appendix D: Participant Confidentiality Agreement

_____ **(**Name of Signer**),**

During the course of my activity in collecting data for this research: "A Case Study Investigating Science Teachers Perceptions of Science Literacy Instruction," I will have access to information, which is confidential and should not be disclosed. I acknowledge that the information must remain confidential, and that improper disclosure of confidential information can be damaging to the project.

By signing this Confidentiality Agreement, I acknowledge and agree that:

1. I will not disclose or discuss any confidential information with others, including friends or family.
2. I will not in any way divulge, copy, release, sell, loan, alter or destroy any confidential information except as properly authorized.
3. I will not discuss confidential information where others can overhear the conversation. I understand that is not acceptable to discuss confidential information even if the participants' names(s) are not used.
4. I will not make any unauthorized transmissions, inquiries, or modification of confidential information.
5. I agree that my obligations under this agreement will continue until the termination of the job that I will perform.
6. I will only access or use systems or devices I am officially authorized to access, and I will not demonstrate the operation or function of systems or devices to unauthorized individuals.

Signing this document, I acknowledge that I have read the agreement and I agree to comply with all terms and conditions stated above.

Signature: **Date:**

Appendix E: Focus Group Guide

Questions for Participants' Responses

Time	Date	Location	Names	Positions

Participants: At the start of the discussion, please share your name initials as we respond to the following questions. Your initials will assist me in transcribing responses accurately. Please be reassured when writing the final report I will remove all identifiable information protecting your rights as participants.

1. How do you professionally stay current with the most current science instructional resources?

2. Are you supported by your school leaders to continue strengthening your science-specific reading strategies to embed in your classroom instruction?

3. What type and topic of professional developments have your participated that influenced your teaching practices improving students reading abilities?

Appendix F: Focus Group Addressing Research Questions

Focus Group Interview Questions Addressing Research Study Questions

Focus Group Interview Questions	**Research Questions**
1. How do you professionally stay current with the most current science instructional resources?	RQ3
2. Are you supported by your school leaders to continue strengthening your science-specific reading strategies to embed in your classroom instruction?	RQ2 & RQ3
3. What type and topic of professional developments have your participated that influenced your teaching practices improving students reading abilities?	RQ3

Research Questions

R1: How do the secondary science teachers teach literacy during content instruction?

RQ2: How do the secondary science teachers embed discipline-specific reading strategies during content instruction?

RQ3: What factors influence the secondary science teachers' decisions to participate in professional development to learn or advance their learning discipline-specific reading strategies?

Appendix G: Individual Interview Questions Guide

Open-Ended Individual Interview Questions Guide

1. Describe how you learned to teach science. Provide specifics.
2. Who in your school environment has the responsibility teaching students reading?
3. Describe how you currently teach reading in your science instruction.
4. Describe your professional opinion(s) regarding the educational theory, "all teachers are responsible for teaching students reading."
5. Describe in detail how you support your students to *think* like scientists. Give specific examples.
6. Which reading strategies do you believe all students need to master in order to understand grade-level science texts? Support your response with how you developed this belief.
7. Do you support the idea reading science texts requires a reader to apply different reading strategies than when one reads a text from math, social studies, language arts, art, or physical education? Explain your response.
8. How do you support student(s) when they have flawed understanding, interpretations, and/or misconceptions before, during, or after reading a science text? Explain your response providing classroom experience.
9. How are secondary science teachers in your school system supported to learn or expand learning of updated evidence-based teaching practices? Give specifics.
10. What factors influence your decision to participate in professional development opportunities?

Appendix H: Individual Interview Questions Addressing Research Questions

Individual Interview Questions Addressing Research Study Questions

Interview Questions Source	**Research Questions**
1. Describe how you learned to teach science. Provide specifics.	Learning about how and why teachers individually became science teachers; this could bring insight into their ideas for reading and thinking in the discipline of science
2. Who, in your school environment, has the responsibility teaching students how to read?	RQ1 & RQ2
3. Describe how you currently teach reading in your science instruction.	RQ1 & RQ2
4. Describe your professional opinion(s) based on the theory "all teachers should share the responsibility of teaching students reading.	RQ1 & RQ2
5. Describe in detail how you support students to *think* like scientists. Give specific examples if this applies to you.	RQ2
6. Which reading strategies do you believe all students need master to understand grade-level science texts? Support your response with how you developed this belief.	RQ2
7. Do you support the idea reading science texts requires a reader to apply different reading strategies than when reading texts from math, social studies, art, physical education etc.?	RQ2
8. How do you support student(s) when they have flawed understandings, interpretations, and /or misconceptions before, during, or after reading a science text? Explain your response. Give specific examples.	RQ1 & RQ2
9. How are secondary science teachers in your school system supported to learn or expand learning of current teaching practices and science reading strategies?	RQ3

10. What factors influence your decision to participate in professional development opportunities? Provide specifics.	RQ3

Research Questions

R1: How do the secondary science teachers teach literacy during content instruction?

RQ2: How do the secondary science teachers embed discipline-specific reading strategies during content instruction?

RQ3: What factors influence the secondary science teachers' decisions to participate in professional development to learn or advance their learning discipline-specific reading strategies?

Appendix I: Participant Interview Scheduling

Participants' Interview Scheduling Form

Dear Colleague,

First, I would like to thank you again for participating in the project study. This email is for the final portion of the study, the interview. As mentioned before your participation in this study is voluntary and what you say will be kept in complete confidence. I know that you are busy but I hope you can assist me. Attached is a copy of the interview questions for your review. The interview should only take between 30-40 minutes.

Please reply with the following information to set up the interview:

Your Name: _____
Your School's Name: _____
Your Contact Phone Number: (W) _____

Interview date of choice: Provide your first and second choices of dates and times that are best for you. You need to remember the research project available dates.

1st choice date _____ time _____
2nd choice date _____ time _____

Interviews will be held face-to-face during your planning periods or after school on school campus or through phone access. Mark your preference (Check ONE):

(1) Your classroom during your planning period _____

(2) Your classroom immediately after school _____

(3) Over the phone during, agreed time between participant and researcher _____

Sincerely,

Appendix J: Participant Tracker Database

Participants Tracker Database

Participant's identification Names	**Consent Form Returned Signed**	**Participants Involved in Focus Group**	**Confidentiality Form Returned Signed**	**Conducted Secondary Science Interview Date/Time/Location**
Teacher A	✓	✓	✓	2/4/2015 Classroom 10:00-10:35
Teacher B	✓	✓	✓	2/4/15 Media Center Conference Rm. 3:10-3:45
Teacher C	✓	✓	✓	2/3/15 Classroom 11:05-11:45
Teacher D	✓	✓	✓	2/30/15 Classroom 8:15-8:45
Teacher E	✓	✓	✓	1/3-/15 Media Center Conference Rm. 12:30-1:15
Teacher F	✓	✓	✓	2/4/15 Classroom 11:25-12:05
Teacher G	✓	✓	✓	2/4/15 Classroom 12:05 – 12:50
Teacher H	✓	✓	✓	1/30/15 Classroom 8:30 – 9:00

Appendix K: Research Question Data Frequency Tables

Research Questions Data Analysis - Frequency Tables

Research Question 1

Frequency of Themes for Research Question 1

Theme	Number of interviewees mentioning this theme	Total exemplar quotes
Apply general literacy strategies	8	23
Basic Science Vocabulary	8	16
Strategies Trial and Error	4	12

Research Question 2

Frequency of Themes for Research Question 2

Theme	Number of interviewees mentioning this theme	Total exemplar quotes
Uncertainty of Disciplinary Literacy Concept	6	17

Research Question 3

Frequency of Themes for Research Question 3

Theme	Number of interviewees mentioning this theme	Total exemplar quotes
Reasons for Participating	8	10
Science PD Unavailability	8	8
Lack of District Funding	7	6